BACHELOR OF SCIENCE IN CIVIL ENGINEERING

Programme

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 Civil Engineering

Curriculum For:
Bachelor of Science in Civil Engineering

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Submitted To:
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Bachelor of Science – Civil 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) 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 Science, Technology, Engineering and Mathematics 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 delivers degree programmes and serves 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 Civil Engineering responds to the need for Science, Technology, Engineering and Mathematics (STEM) education at the postsecondary 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 drives 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 entrepreneurial skills. The donor agency (The World Bank) desires to have a curriculum that can be bench-marked 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 of 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*), and in Ghana (*Kwame Nkrumah University of Science and Technology*), and 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 Geophrey Anornu, the Dean of Faculty of Civil Engineering (anoprof1@yahoo.com) and Professor Yaw Kankam (ckkankam.coe@knust.edu.gh) , former Head of Civil Engineering for review and feedback. A roundtable discussion was also held with Civil 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 28, 2022. Representatives were invited from Gambia Ports Authority (GPA), Gambia Works Authority (GamWorks), Ministry of Transport, Works and Infrastructure (MoTWI), National Accreditation & Quality Assurance Authority (NAQAA), Ministry of Higher Education, Research and Training (MoHERST), and Construction Department of University of Applied Science, Engineering and Technology (USET). The attendees were provided with the draft document. The recommendations arising out of the discussions were considered in the development of the draft of the final curriculum, which was discussed with the Management Team of USET on November 1, 2022.

2.6 Final Curriculum

The final curriculum, hereby presented, is provided in accordance with the requirements of NAQAA. Sections that were not part of the discussions have been included for completeness.

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

Civil Engineering

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

Bachelor of Science

5.0 Programme Description

Civil engineering is a profession that focuses on the delivery of engineering services to civil society. The developmental drive of Gambia requires physical modifications to the natural environment in a systematic and strategic manner. The Bachelor of Science in Civil Engineering programme has been initiated to provide The Gambia citizens with the knowledge and skills needed for civil infrastructure improvement and development in The Gambia. Civil engineers specialize in diverse aspects of their profession. These include specialties such as project management, design and construction, transportation, geotechnical engineering, water management, structural engineering, and environmental engineering.

A civil engineer commonly works in teams with colleagues from sectors such as Environmental Planning, Architecture, Community Development and Town Planning, Quantity Surveyors, as well as engineers from other disciplines. Some civil engineers work on construction sites, some take up

positions in engineering design, all levels of government agencies, in private consulting companies, in public utilities, and in global enterprises.

6.0 Admission requirements – 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 Civil 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 at least 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 2.5 (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

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 programme'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 constituents. The following objectives must be achieved within five years after graduation from the Civil Engineering Programme:

(1) Demonstrate competence in the application of knowledge, technical and entrepreneurial skills as a trained civil 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 being 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 ability to analyse and solve problems in at least four technical areas appropriate to civil engineering; conduct experiments in at least two technical areas of civil engineering and analyze and interpret the resulting data; design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design; explain basic concepts in project management, business, public policy, and leadership.

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

1. An ability to identify, formulate, and solve complex civil engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design 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 design a system, component, or process in at least two civil engineering contexts, including principles of sustainability in design.
9. An ability to explain basic concepts in project management, business, public policy, and leadership.
10. An ability to apply innovation and entrepreneurial concepts to develop marketable products.

***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 worth 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 ABET and NAQAA Learning Outcomes

N	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	Design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design;		✓	✓	✓		✓
9	Explain basic concepts in project management, business, public policy, and leadership;		✓			✓	
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. (Civil 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 Science 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. Civil Engineering Programme Categories

Item	Category	Accreditation Minimum Credit Hours Requirements	USET Programme Credit Hours
1	General Education	None Specified	14
2	Mathematics and Basic Sciences	30	30
3	Engineering Topics	45	80
4	Entrepreneurship Requirements	None Specified	16
5	Internship	None Specified	Required. No Credit.
Total		124	140*

The extra 16 credit hours is due to the additional entrepreneurship requirement at USET

9.1.2 Numbering System for Courses: Presented below are the courses that shall be offered in the Department of Civil 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. 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 (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. These courses collectively provide communication skills and socio-economic knowledge to the student and to improve the student's soft skills. A total of 14 credit hours is required. The general education courses are provided Table 3.

Table 3. Required 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 below provides the list of Basic Science and Mathematics Courses in the programme.

Table 4. Science and Mathematics Requirement

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 Civil Engineering Topics: Engineering topics consist of engineering science, engineering principles and engineering designs. 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 designs 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 Civil Engineering Programme.

Table 5. Civil Engineering Courses

No	Course Code	Course Title	Credit Hours
1	CIEN 121	Introduction to Civil Engineering	2
2	ENGR 113	Engineering Graphics	2
3	CIEN 112	Design Principles and Civil Engineering in Society	2
4	ENGR 102	Fundamentals of Materials Science	2
5	CIEN 114	Civil Engineering Computer Graphics	2
6	CIEN 204/214	Engineering Surveying and Photogrammetry /LAB	3
7	CIEN 222	Civil Engineering Materials	2
8	MEEN 201	Engineering Mechanics - Statics	3
9	MEEN 202	Engineering Mechanics-Dynamics	3
10	ELEN 301/311	Electric Circuit Analysis/LAB	3
11	CIEN 206/216	Strength of Materials/LAB	4
12	CIEN 301/311	Fluid Mechanics/LAB	4
13	CIEN 317	Computer applications in civil engineering	**1**
14	CIEN 305	Structural Analysis	3
15	CIEN 310	Construction Engineering	2
16	CIEN 302/312	Hydraulics and Hydrology/LAB	3
17	CIEN 304	Steel and Reinforced Concrete Designs	3
18	CIEN 306/316	Transportation Engineering/LAB	3
19	CIEN 308/318	Soil and Rock Mechanics/LAB	3
20	CIEN 401	Quantity Surveying and Estimating	3
21	CIEN 403/413	Water Supply and Environmental Engineering/LAB	3
22	CIEN 427	Elements of Civil Engineering Practice	2
23	CIEN 425	Foundation Engineering	3
24	CIEN 426	Geotechnical Engineering	3
25	CIEN 422	Construction Management and Systems Engineering	3
26	CIEN 424	Water Resources, Irrigation and Drainage Engineering	3
27	CIEN 428	Water and Wastewater Treatment	3
28	CIEN 497	Civil Engineering Capstone Project I	3
29	CIEN 498	Civil Engineering Capstone Project II	4
Total Credits for Engineering Topics			**80**

9.2.4 Innovations and Entrepreneurship Requirements: Innovations and Entrepreneurship Practical Training is a required component of the programme. Students will be equipped with knowledge, practical skills and competences in materials, advanced materials for construction, pavement, advanced materials for water/wastewater treatment, water innovations, resource recovery business models and entrepreneurship, waste processing innovations and recycling (shredding, rotary drying and extrusion of waste materials into value added products), SMART/digital technologies in transport, data management instrumentation innovations (digital flow measurement, digital Level and pressure measurements), Instrumentation telemetry and SCADA, near real-time measuring instruments, Practical and laboratory sessions on Instrumentation, Calibration and Maintenance of measuring instruments.

Table 6 provides a list of Innovations and Entrepreneurship Topics in the BSc Civil Engineering Programme.

Table 6. Required 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	3
7	ENGR 423	Entrepreneurship Project	3
Total			**16**

9.3.5 Industrial Internship: 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 the general 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 Tables below provide the required courses, their lecture-hours, laboratory-hours (if any) 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. Tables 8 to 15 provide semester-by-semester schedule showing the course number, course title, number of lecture hours for each course, number laboratory/practical hours for each course and total number of credits for each course. The overall semester information is also provided. The workload analysis is presented in Table 16.

Table 8. Year I – Semester One

No	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	ENGL 101	English Communication	2	0	2
2	MATH 101	Calculus I	3	0	3
3	CHEM 101	Applied Chemistry	3	0	3
4	CHEM 111	Applied Chemistry Lab	0	2	1
5	CIEN 121	Introduction to Civil Engineering	1	2	2
6	ENGR 113	Engineering Graphics	0	4	2
7	ENGR 111	Introduction to ICT	0	4	2
8	ENGR 103	Introduction to Entrepreneurship	2	0	2
Total Hours			**11**	**12**	**17**

Table 9. Year 1: Semester Two

No	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	CIEN 112	Design Principles and Civil Eng in Society	1	2	2
2	CIEN 114	Computer Graphics for Civil Engineers	0	4	2
3	MATH 102	Calculus II	3	0	3
4	PHYS 102	Applied Physics I	3	0	3
5	PHYS 112	Applied Physics I Lab	0	2	1
6	ENGR 102	Fundamentals of Materials Science	2	0	2
7	ENGL 102	Technical Report Writing	2	0	2
8	ENGR 116	Introduction to Innovation Projects	0	4	2
Total Hours			**10**	**14**	**17**
ENGR 100	First Internship – 6 weeks at 40 hours/week			**240**	**0**

Table 10. Year 2: Semester One

No	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	PHYS 201	Applied Physics II	3	0	3
2	PHYS 211	Applied Physics II Lab	0	2	1
3	MATH 221	Numerical Methods with MATLAB	2	2	3
4	MATH 201	Mathematical Analysis	3	0	3
5	MEEN 201	Engineering Mechanics I - Statics	3	0	3
6	SOCI 201	Principles of Sociology	2	0	2
7	ENGR 201	Enterprise Development	2	0	2
Total Hours			**15**	**4**	**17**

Table 11 Year 2: Semester Two

No.	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	MEEN 202	Engineering Mechanics II-Dynamics	3	0	3
2	CIEN 204	Eng Surveying and Photogrammetry	2	0	2
3	CIEN 214	Engineering Surveying Laboratory	0	2	1
4	CIEN 222	Civil Engineering Materials	1	2	2
5	CIEN 206	Strength of Materials	3	0	3
6	CIEN 216	Strength of Materials Lab	0	2	1
7	MATH 202	Differential Equations	3	0	3
8	PSYC 202	Principles of Psychology	2	0	2
9	ENGR 212	Intermediate Innovation Project I	0	4	2
Total Hours			**14**	**10**	**19**
ENGR 200	Second Internship - 8 Weeks at 40 Hours per Week			**320**	**0**

Table 12. Year 3: Semester One

No.	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	MATH 303	Engineering Statistics	3	0	3
2	CIEN 301	Fluid Mechanics	3	0	3
3	CIEN 311	Fluid Mechanics Lab	0	2	1
4	ELEN 301	Electric and Electronic Circuits	2	0	2
5	ELEN 311	Electric Circuit Lab	0	2	1
6	CIEN 305	Structural Analysis	3	0	3
7	ECON 301	Principles of Microeconomics	2	0	2
8	ENGR 315	Computer Applications in Civil Engineering	0	2	1
9	ENGR 301	STEM Entrepreneurship	2	0	2
Total Hours			**15**	**6**	**18**

Table 13. Year 3: Semester Two

No.	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	CIEN 310	Construction Engineering	1	2	2
2	CIEN 302	Hydrology and Hydraulics Engineering	2	0	2
3	CIEN 312	Hydraulics Laboratory	0	2	1
4	CIEN 304	Steel and Reinforced Concrete Design	3	0	3
5	CIEN 306	Transportation Engineering	2	0	2
6	CIEN 316	Transportation Engineering Laboratory	0	2	1
7	CIEN 308	Soil and Rock Mechanics	2	0	2
8	CIEN 318	Road Materials and Soils Laboratory	0	2	1
9	ECON 302	Engineering Economic Analysis	2	0	2
10	ENGR 316	Intermediate Innovation Project II	1	4	3
Total Hours			**13**	**12**	**19**
ENGR 300 Third Year Internship – 10 Weeks at 40 Hours per Week				**400**	**0**

Table 14. Year 4: Semester One

No.	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	CIEN 401	Quantity Surveying and Estimating	3	0	3
2	CIEN 403	Water Supply and Environmental Eng	2	0	2
3	CIEN 413	Environmental Engineering Laboratory	0	2	1
4	CIEN 425	Foundation Engineering	2	2	3
5	CIEN 427	Elements of Civil Engineering Practice	1	2	2
6	CIEN 497	Civil Engineering Capstone Project I	1	4	3
7	ENGR 423	Entrepreneurship Project	1	4	3
	Total Hours		**10**	**14**	**17**

Table 15. Year 4: Semester Two

No	Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
1	CIEN 422	Construction Management and Systems Eng	2	2	3
2	CIEN 424	Water Resources, Irrigation and Drainage Eng	2	2	3
3	CIEN 426	Geotechnical Engineering	2	2	3
4	CIEN 428	Water and Wastewater Treatment	2	2	3
5	CIEN 498	Civil Engineering Capstone Project II	0	8	4
Total Hours			**8**	**16**	**16**

Table 16. Programme Workload Analysis- Civil Engineering

Programme Workload Analysis- Civil Engineering					
Year	**Semester**	**Lecture Hours**	**Lab Hours**	**Contact Hours**	**Credit Hours**
Year 1	Semester 1	11	12	23	17
	Semester 2	10	14	24	17
Year 2	Semester 1	15	4	19	17
	Semester 2	14	10	24	19
Year 3	Semester 1	15	6	21	18
	Semester 2	13	12	25	19
Year 4	Semester 1	10	14	24	17
	Semester 2	8	16	24	16
Totals		**96**	**88**	**184**	**140**

9.4 Course Descriptions with Outcomes and 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 also 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 process
- 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.

CIEN 121 Introduction to Civil Engineering (1-2-2)

This course provides an overview of civil engineering. The course introduces various branches of Civil Engineering, Civil Engineering structures, Technologies and equipment used in Civil Engineering Construction. 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 complex civil engineering problems by applying principles of engineering, science, and mathematics.

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

- Identify the diverse construction equipment for the execution of a particular Civil Engineering works
- Explain various Civil Engineering structures and construction technologies,
- Describe the role of the engineer in the interdisciplinary technical team
- Explain civil engineering functions, professional licensure, code of ethics, safety, the design process, teamwork, and legal responsibilities.
- Discern unethical behavior in engineering practice.
- Gain experiences in a team project.

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.
- Use computer programming languages

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 103 Introduction of Entrepreneurship (2-0-2)

This course covers 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)

CIEN 112: Design Principles and Civil Engineering in Society (1-2-2)

This course enables students gain understanding in design principles as used in Civil Engineering practices and to give students the opportunity to apply the elementary knowledge gained in their study of Civil Engineering to solve challenges in society. It orients students from a Civil Engineering design perceptive. Students are required to identify challenges that need civil engineering solutions. Students undertake a project involving collection of relevant field data and development of conceptual designs towards solving the problem.

Learning Outcome: The course introduces the student to an ability to apply engineering design 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: At the end of the course students should be able to;

- Initiate processes that help to identify societal challenges that need Civil Engineering solutions
- Gather relevant data towards solving and proposal of solutions to societal Civil Engineering challenges.
- Advance feasible Civil Engineering concepts to tackling the identified challenge.
- Comprehend the various elements of the design process.
- Integrate theoretical concepts into conceptual designs.
- Execute a simply project following standard protocols and guidelines.

CIEN 114 Computer Graphics for Civil Engineers (0-4-2)

This course introduces students to visualizing conceptual designs in graphics using AutoCAD. The course provides introduction to structural drawings, geometrical construction; orthographic projection and other projections; Descriptive geometry, intersections, and development. Structural Drawings include drawing basic structural elements in reinforced concrete buildings, general arrangement and detailing of foundations, columns, beams, Slabs and staircases; Basic highway drawings include Vertical and horizontal alignments sections, Contours. Use of AutoCAD for drawing and editing, Plotting; Computer graphics. Relevant Civil Engineering Programmes.

Learning Outcome: Introduces the student to the ability to graphically communicate effectively with other civil engineers.

Course Objective: At the end of the course students should be able to;

- Explain the different types of projections and angle of projections,
- Demonstrate skills in the development of different types of surfaces,
- Capture data and transform same into graphical representations,
- Use drafting tools to generate Civil Engineering drawings that conform to acceptable standards
- Interpret Civil Engineering drawings,

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.

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 form.

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
- Provide appropriate reference materials.

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.
- State the factors that influence innovation.
- Describe the innovation process and its stages in Engineering

YEAR TWO 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 use engineering judgment to 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 solve complex engineering problems.

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

- Produce working programmes (codes) to analyze engineering problems using MATLAB.
- 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 pproducts 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 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.

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

This course covers basic 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 complex 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.

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 in engineering.
- Discuss 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.
- How to finance entrepreneurship activity.
- How to 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 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.

CIEN 204 Engineering Surveying and Photogrammetry (2-0-2)

The course deals with the principle and practice of land surveying and7 engineering survey. It covers distance measurements, angular measurements and bearings, traverse computations and adjustments, computation of areas and volumes for earthworks and a Spirit and trigonometrical levelling, methods for setting out engineering projects, and introduction to Application of GIS and remote sensing techniques in civil works.

Learning Outcome: An ability to identify, formulate, and solve complex civil engineering problems by applying principles of engineering, science, and mathematics.

Course Objective: The objective of the course is to enable students appreciate the science and mathematics of surveying and its principles as applied in the field of Civil Engineering practice. Students should be able to do the following upon completion of the course.

- Use state of the art surveying equipment
- Demonstrate understanding of the principles of land surveying.
- Take ground measurements using approved surveying equipment.
- Gain the ability to use modern survey equipment to measure angles.
- Gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for earth works
- Demonstrate understanding of the principles of GIS and its applications.
- Demonstrate understanding of the principles of remote sensing in water and civil engineering,
- Use GIS software to produce spatial maps,

CIEN 214 Engineering Surveying Lab (0-2-1)

The course equips students with practical skills in surveying in Civil Engineering practice. Lab exercises include distance measurements, angular measurements and bearings; setting out civil engineering projects; Computation of areas and volumes for earthworks; Mass-haul curves; Setting out circular, compound, transitional and vertical curves. Use QGIS in aapplication of GIS and remote sensing techniques in civil works.

Learning Outcome: An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.

Course Objective: Students should be able to do the following upon completion of the course;

- Use surveying equipment.
- Take ground measurements using approved surveying equipment.
- Prepare layout map, road profiles and cross-sections from land surveying,
- Use equipment to measure angles.
- Use GIS software to produce spatial maps,

CIEN 222 Civil Engineering Materials (1-2 -2)

This course focuses on properties of materials used in structural engineering design and construction. This includes concrete, timber, bricks (engineering and architectural), steel, admixtures and additives; Manufacture, composition and testing of cement. Laboratory and practical work includes aggregate grading; batching concrete mix proportioning and mixing; properties of wet concrete, workability measurement, casting and testing of cubes. The structure of wood, the effects of moisture in timber, seasoning, conversion of timber, defects of timber, preservation of timber, grading of timber. Asphalt Bituminous materials-production process, cut back bitumen, bitumen emulsions, road tar, low-temperature tar, asphalts mix designs.

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

Course Objective: The objective of this course is to ensure that students have a firm grasp of the behaviour of construction materials used in Civil Engineering works. At the end of the course students should be able to;

- Explain the fundamental principles of materials science and how it applies to civil engineering materials
- Describe material properties and how these properties influence the behaviour of construction materials
- Demonstrate skills in the acquisition of relevant data on construction materials for fit for purpose examinations.
- Describe the properties of concrete, steel, timber and bricks.
- Carry out grading of aggregates.
- Batch, mix and cast concrete for general civil works and water retaining structures
- Determine the properties of the concrete mix.
- Select appropriate pipe materials for water and sanitation infrastructure.

CIEN 206 Strength of Materials (3-0-3)

This course covers deformations, stress and strain for axial and torsional loadings, bending moment and shear diagrams from transverse loads, combined stress analysis, deformation and deflection of and beams, transformation of stress and strain, principal stresses, elastic constants, column buckling, and an introduction to the analysis of statically indeterminate beams.

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:

- Calculate deformation, stress and strain for axial and torsional loadings.
- Draw and analyze shear force and bending moment diagrams for transverse loads.
- Calculate deflection, stress and strain for transverse loadings.
- Analyze column loading and buckling.
- Analyze statically determinate beams.

CIEN 216 Strength of Materials Laboratory (0-2-1)
This course covers experiments in materials science and engineering stress and strain measurements, and materials testing to obtain pertinent properties and characteristics.

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

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

- Measure engineering stress and strain
- Test engineering materials for strength, ductility, etc.
- Analyse experimental data
- Interpret experimental results.
- Develop a laboratory report.

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 engineering problems by applying principles of 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.

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, and 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.

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.

YEAR THREE COURSES

MATH 303 Engineering Statistics (3-0-3)

This coursedeals 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 equipped with the 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 mechanical 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

CIEN 301 Fluid Mechanics (3-0-3)

This course deals with the continuum concept, fluid statics, mass and momentum balances, the Bernoulli Equation, dimensional analysis, pipe flow problems, the design and the selection of pumps and the three forms of drag. Principles of boundary layer flows, compressible flow and flow measurement devices are introduced. Applications in pipe flow (e.g., Darcy-Weisbach, Hazen-Williams, Moody), open channel (Manning), pumps (e.g., power, operating point, parallel and series), flow measurement (e.g., weirs, orifices, flowmeters) and blowers (e.g., power, operating point, parallel, and series).

Learning Outcome: An ability to identify, formulate, and solve complex civil engineering problems by applying principles of engineering, science, and mathematics.

Learning Objective: At the end of the course students should be able to;

- Demonstrate understanding in basic fluid properties
- Analyse the behaviour of fluids
- Demonstrate an understanding in the application of the basic equation of hydrostatics
- Solve simple problems of the type encountered in engineering practice

CIEN 311 Fluids Mechanics Laboratory (0-2-1)
The course deals with cexperiments on venturi meter, orifice, notches and weirs; Laminar flow, Head losses, Darcy Weisbach equation, Moody diagram, Stokes law, drag coefficient, Reynolds number, and terminal velocity.

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 Objective:*At the end of the course, students should be able to:
- Analyze laboratory experimental results to demonstrate understanding of the principles of flow measurement devices (venturi meter, orifice, notches and weirs).
- Analyze laboratory experimental results to demonstrate understanding of Viscous Flow, Laminar flow, Head losses, Stokes' law, and terminal velocity.
- Use Darcy Weisbach equation and Moody diagram to carry out computations.

ELEN 301 Electrical and Electronic Circuits (2-0-2)
This course covers power and energy concepts; basic R, RC, RL, and RLC circuits; three phase circuits; ideal transformers; diodes and ideal operational amplifier circuits; and logic circuits. The Laplace transform method will be introduced and used to solve circuit problems.

Learning Outcome: 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:
- Explain electrical power and energy concepts
- Describe basic R, RC, RL, and RLC circuits
- Explain and analyze three phase circuits.
- Describe and analyze ideal transformers.
- Describe and apply ideal operational amplifier circuits.
- Describe and design logic circuits

ELEN 311 Electrical Circuits Lab (0-2-1)
This laboratory course supports the theories of Electrical Circuits and Systems (ELEN 301). The course provides opportunity for students to practice the design and analysis of electrical and electronic circuits.

Learning Outcome: 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:
- Build and analyze R, RC, RL, and RLC circuits
- Test three phase circuits
- Analyze ideal transformers.
- Apply ideal operational amplifiers.
- Build applicable logic circuits.

ECON 301 Principles of Microeconomics (2-0-2)
This course introduces 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 economic factors to 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.

CIEN 305 Structural Analysis (3-0-3)

This course deals with buildings loads, the analysis of simple structures by distinguishing between different types of loads and describing types of structural members. It covers the analysis of Column analysis, internal forces and stresses and deflection of such structures using slope deflection method and the moment distribution method.

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

Course Objective: At the end of the course students should be able to:

- Determine the forces present in simply supported structures.
- Use structural codes and standards in structural designs.
- Analyze statically determine trusses, beams and frames.
- Obtain internal loading, analyze cable and arch structures.
- Determine the influence lines for statically determinate and indeterminate structures
- Determine deflections of beams and frames using classical method
- Solve statically indeterminate structures using classical methods
- Solve statically indeterminate structures using matrix (stiffness) method.
- Use modern structural analysis software.

CIEN 315 Computer Applications in Civil Engineering (1-2-2)

This course seeks to train students in *c*omputer programming and the use of Computer softwares in civil engineering. In this course, students will acquire skills in using EPANET software, Bentley MX roads, US EPA Stormwater management software, structural design softwares, MATLAB and Geographic Information Systems.

Learning Outcome: This course enables the student to demonstrate an ability to design a system, component, or process in a civil engineering context; including principles of sustainability in design.

Course Objective: At the end of the course students should be able to;

- Identify the operational features of computer softwares used in Civil Engineering
- Use computer software for Civil Engineering designs and preparation of drawings
- Develop and program engineering analyses using Matlab/Excel
- Learn the fundamental concepts of Geographic Information Systems,

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.

CIEN 310 Construction Engineering (1-2-2)

This course focuses on construction engineering emphasizing construction technology, construction methods and equipment, general conditions and requirements including project safety and environmental health and other related topics. Construction operations and methods (e.g., lifting, rigging, dewatering and pumping, equipment production, productivity analysis and improvement, construction site establishment; Preparation of construction site and method statement, construction control and specifications, and Occupational Health and Safety measures.

Learning Outcome: This course enables the student to demonstrate an ability to explain basic concepts in construction, project management, business, public policy, and leadership.

Course Objectives: At the end of the course students should be able to;

- Explain construction operations and methods (e.g., safety, equipment, productivity analysis, temporary erosion control)
- Explain construction site establishment and site organization,
- Prepare construction site establishment and method statement,
- Explain construction control and specifications.

CIEN 302 Hydrology and Hydraulics Engineering (2-0-2)

The course equips students with knowledge and tools to undertake Engineering Hydrological Analysis and design of hydraulic systems. This is an integrated course in hydraulic designs and hydrological analysis.

Learning Outcome: This course enables the student to demonstrate an ability to design a system, component, or process in a civil engineering context; include principles of sustainability in design.

Course Objective: At the end of the course students should be able to:

- Explain the principles of the global hydrological cycle,
- Use unit hydrographs to predict design stream flows and appreciate flood control methods
- Describe the storage, movement and supply of groundwater as well as factors which contribute to groundwater quality
- Explain the structure of hydrological water balance and routing models.
- Explain and calculate extreme values of hydrological datasets
- Explain and use standard statistical methods to describe hydrological time series
- design pressure pipe systems and open-channel flow systems,

- Describe the basic elements of pump
- Generate and apply the analytical and design approaches to common water facilities such as culverts, spillways, pipe networks, sewer systems, canals, and scour and sediment transport

CIEN 312 Hydraulics Laboratory (0-2-1)

This course complements the Hydrology and Hydraulics Engineering Course. Laboratory experiments on Introduction to head loss due to friction, Minor head losses, Pipes in series, Pipes in parallel, Characteristic curves and pump selection will be conducted.

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

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

- Perform laboratory experiments on flow regimes in open channel,
- Perform laboratory experiments on pipe flows, pumps and interpret pump characteristic curves.
- Conduct field measurement of stream flow,
- Conduct field identification of effects of obstacles and wastes in channels and sudden changes in channel flow.

CIEN 304 Steel and Reinforced Concrete Designs (3-0-3)

The course focuses on design of reinforced concrete components Limit state design principles; Structural loads; Codes of practice, BS 8110, Designs of Slabs, Beams, Column and Foundation, and design of steel components

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

a. Design a system, component, or process in a civil engineering context, including principles of sustainability in design

b. Apply engineering ethics in the practice of civil engineering.

Course Objective: The course seeks to equip students with requisite skills to carry out designs for reinforced concrete structures. By the end of this course students should be able to:

- Explain the limit state design philosophy, characteristic strengths and loads, as well as partial safety factors.
- Design reinforced concrete beams satisfying both ultimate and serviceability limit states.
- Design for shear, bond and torsion of reinforced concrete elements
- Design axially loaded reinforced concrete columns.
- Design eccentrically loaded reinforced concrete columns and slender columns.
- Design column footings of buildings.
- Design staircase.
- Analyse reinforced concrete elements using stress blocks.
- Analyse and design structural steel beams that are fully laterally restrained and under lateral torsional buckling
- Analyse and design structural steel columns, under uniaxial and biaxial bending
- Analyse and design column bases and foundation design of steelworks
- Analyse and design steel connections, timber trusses and composite timber/steel connections

CIEN 306 Transportation Engineering (2-0-2)

This course focuses on modes of transportation, traffic engineering studies, Traffic control and management systems, Route location survey, geometric design, highway materials, structural design of pavement, traffic operations and safety, and pavement management systems and transportation planning.

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

a. Design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design.
b. Acquire and utilize new knowledge.

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

- Explain and undertake measurement of the element of traffic stream.
- Collect traffic flow data at intersections and midblock sections.
- Undertake a parking inventory and usage survey and analyse the data.
- Explain the traffic flow theory, traffic analysis and queuing processes.
- Determine vehicle characteristics, performance and how these influence the design and construction of pavements.
- Distinguish between the different classes of roads in Ghana and their characteristics road agencies.
- Select design controls and criteria from suitable design standards.
- Determine the proposed alignment of a route and undertake design calculations for the setting out of vertical and horizontal alignment.
- Analyse traffic and subgrade data to determine the structure of a flexible pavement.

CIEN 316 Transportation Engineering Laboratory (0-2-1)

This course focuses on practical engineering studies on traffic flow measurements, pavements studies and road drawings. The course will focus on Travel times and delay study, spot speed studies, turning movements count and peak hour factor, parking study, pedestrians and bicycles study, measurement of intersection delay, sight distance and gap study at intersections, saturation flow rates, level of service analysis, traffic impact studies. Design of road links and intersections using CAD software (Civil 3D, Bentley MX roads etc.), Road Inventory and Condition Studies on paved and gravel surfaces, Site observation/inspection of bridges and culverts,

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

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

- Conduct traffic counts to determine the fixed delay, variable delay and total travel time delay on three different routes with the same origin and destination during peak and off-peak hours.
- Conduct a spot speed study and develop cumulative speed distribution curve. The speed survey is to be conducted along a straight section of a road during off-peak hours.
- Conduct study on turning movement counts at an intersection and calculate Peak Hour Factor.
- Determine the intersection delay values at a signalized intersection during peak period.
- Determine the minimum sight distance,
- Undertake field measurement of the saturation flow rates and loss time at a signalized intersection during peak period, to determine the saturation flow rate, turning movement counts and level of service for an approach lane(s) at a signalized intersection during peak periods.
- Conduct laboratory tests on natural gravel materials and aggregates for highway construction
- Undertake analysis to determine the mix design of an asphalt mix
- Design the aggregate spread rate and bitumen spray rate for a surface dressed road.

CIEN 308 Soil and Rock Mechanics (2-0-2)

The topics covered in this course are: Particle size distribution-sieve analysis, hydrometer method; Atterberg Limits: - Soil Classification Systems- Soil Compaction, permeability tests, and consolidation test. Laboratory compaction specifications (AASHTO, Mod. AASHTO, Proctor, Mod Proctor.) Measurement of strength, Mechanical properties of rocks, uniaxial compressive strength, tensile strength, shear strength (unconfined & triaxial) and Rock mass properties.

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

Course objectives: The aim of this course is to introduce aspects of soil mechanics and provide the basics for geotechnical engineering. At the end of the course students should be able to;

- Perform basic laboratory tests on soils including permeability tests, and consolidation test.
- Estimate all the consolidation parameters necessary for the computation of settlement and determination of time required for settlement under a given load,
- Identify and classify soils, determine mass/volume phase relationships perform basic calculations related to shear strength analysis
- Determine the characteristics of compacted soils.

CIEN 318 Road Materials and Soils Laboratory (0-2-1)

This course equips students with laboratory testing skills to undertake geotechnical investigations. This course will provide laboratory experiences in soil identification, Particle size distribution, soil classification, permeability, Compaction, consolidation, indexing, and laboratory evaluation of stress and shear and bearing strength of soils, California Bearing Ratio CBR, and Test of aggregates for road construction.

Learning Outcome: 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: At the end of the course students should be able to;

- Identify the various testing equipment and how they are operated
- Apply standardized methods in the examination of geotechnical materials
- Analyse and interpret emerging results from a geotechnical investigation
- Undertake laboratory evaluation of soils for road subgrade, subbase and base construction,
- Undertake various tests to determine the classification and engineering properties for road pavement layers

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: 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:

- 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.

YEAR FOUR COURSES

CIEN 401 Quantity Surveying and Estimating (3-0-3)

This course deals with measurement of Civil Engineering works and standard methods of Measurements Abstracting and Preparation of Bill of Quantities. This course focuses on the principles of CESMM4; Mensuration of measurement, Principles of taking off measurements of Civil Engineering Works, Bills of Quantities Preparation, Work Classification, Coding and numbering of items of Work from CESMM4 Class A to Z; Measurement of works such as earthworks, concrete works, concrete ancillaries, pipework, structural metal works, road and paving works. The course also covers Estimating of all-in rate for plant and labour; contractor's overhead and profit; Rate estimating and building up unit rates for bill of quantity work items for earthworks, concrete works, concrete ancillaries, pipeworks, structural metal works, road and paving works,

Learning Outcome: This course enables students to demonstrate:

a. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
b. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.

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

- Explain the types and documents of civil engineering contracts,
- State and explain the sections of tender documents,
- Explain the use of bill of quantities for civil engineering projects,
- Explain why the need for civil engineering measurements and cost estimating,
- Use Civil Engineering Standard Method of Measurement (CESMM 4) to carry out measurements of civil engineering works,
- Take off measurements from drawings to calculate quantities of civil works.
- Prepare Bill of Quantities for civil engineering works,
- Estimate rates of civil work items and cost of civil engineering projects.

CIEN 403 Water Supply and Environmental Engineering (2-0-2)

This course covers Water Demand Estimation: Factors Affecting Water Demand; Conventional Surface Water Treatment; Development of Groundwater Resource. Water supply and Distribution: Service Reservoirs, Water Transmission, pipes and appurtenances; Network Analysis; computer applications in water distribution networks using EPANET software; Design of Sewers: Separate: Storm, Combined; Sewer appurtenances, Pumps and Pumping Stations: Appropriate Technology in Wastewater and human excreta disposal: Waste stabilisation Ponds, Onsite-technologies, water Treatment, Design of Landfills and Solid Waste Management.

Learning Outcome: This course enables students to demonstrate an ability to design a system, component, or process in a civil engineering context including principles of sustainability in design.

Course Objectives: In this course students will be equipped with skills to dutifully examine environmental processes. After this course, students should be able to;

- Explain air and water quality, point and diffuse sources of pollution and environmental sustainability,
- Determine the various environmental processes that have the ability to impact on water and WASH facilities,
- Explain water and waste characterisation, public health challenges and issues
- Explain engineering principles and concepts for the efficient design and delivery of WASH facilities.
- Design onsite sanitation technology and sewage collection system,
- Design water distribution system,
- Design integrated solid waste management system for a municipality.
- Develop innovative and implementable solutions to address sanitation.

CIEN 413 Water and Environmental Quality Laboratory (0-2-1)

The course covers selected experiments on *(1) Sludge/wastewater:* Characterisation of sludge and assessment of sludge quality, Parameters include Gram stain, coliform analysis, pH, alkalinity, hardness, DO, BOD, and control of microorganisms, total solid, volatile solids, suspended solids, *(2) Drinking Water Quality:* Water quality parameters, Characterisation and assessment of water and wastewater, WHO drinking water guidelines and targets for drinking. Description of water quality in relation to use. Improvement of water quality. *(3)Solid waste:* Characterisation and assessment of solid waste and leachate, proximate analysis, biodegradability, calorific and energy value, (4) *Soil:* Chemical and microbial characteristics of soil and (5) *Air quality:* Air pollution and noise measurement**.**

Learning Outcome: This course enables students to demonstratean ability to explain basic concepts in project management, business, public policy, and leadership.

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

- Obtain Laboratory analyses of water, wastewater and solid waste samples for water and environmental engineering designs.
- Assess the characteristics of solid waste, water, wastewater, sludge, and leachate.
- Determine chemical and microbial characteristics of soil.
- Measure and monitor air pollution and noise,

CIEN 425 Foundation Engineering (2-0-2)

The aim of this course is to equip students to be able to understand the behaviour of soils when subjected to engineering loads. It also provides knowledge of simple analysis for assessment of foundations, road pavements, slopes and retaining walls, Types of earth pressures, Slope Stability, Bearing Capacity and Foundation Designs.

Learning Outcome: This course enables students to demonstrate an ability to design a system, component, or process in a civil engineering context, including principles of sustainability in design.

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

- Analyse retaining walls and shallow foundations of buildings at failure,
- Assess the stability of slopes and retaining structures
- Perform bearing capacity analysis for spread footings of various shapes.
- Analyse layers of road pavement materials and strength requirements,

CIEN 427 Elements of Civil Engineering Practice (1-2-2)

The course engages the student in the use of Codes of ethics (professional and technical societies), Ethical and legal considerations, Professional liability, Public protection issues (e.g., licensing boards), Regulations (e.g., water, wastewater, air, solid/hazardous waste, groundwater/soils),

Learning Outcome: This course enables students to demonstrate an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.

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

- Recognize engineering professional societies in The Gambia and the Region
- Discern ethical and unethical behaviour
- Explain professional liabilities
- Discuss intellectual property laws
- Identify and discuss relevant international and national codes and regulations.
- Explain the laws relating to engineering practice in the Gambia.

CIEN 497 Civil Engineering Capstone Project I (1-4-3)

This is the first part of a two-course sequence which together prepare students for engineering practice. The course will focus on equipping students with civil major engineering project skills and 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 enables students to demonstrate the following:

a. 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.
b. an ability to communicate effectively with a range of audiences.
c. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.
d. An ability to design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design.
e. An ability to practice concepts in project management, business, public policy, and leadership.

Course Objectives: Upon completion students will be able to:

- Apply the various engineering principles and concepts in the proposal of engineering solutions to real life problems.
- Work in teams on projects and to inculcate in students the teamwork spirit.
- Appreciate the practicality of standards in the field of engineering.
- Learn from practicing engineers the current trends in the field of Civil Engineering.

ENGR 423 Entrepreneurship Project (1-4-3)

This course is a pre-requisite for the (CIEN 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.

CIEN 422 Construction Management and Systems Engineering (2-2-3)

This course deals with the concepts of construction management and application of systems engineering. Th course covers principles and practice of management; Civil engineering contracts – Elements of contract Law, General and Special Conditions of Contract, contract arbitration, Types of Civil Engineering Contract; construction project cycle; Construction scheduling/planning with CPM, contract administration and management – works supervision, valuation of works, payment certificates, variation orders, taking over, claims; work study and Operation research in construction;

Learning Outcome: This course enables students to demonstrate an ability to explain basic concepts in project management, business, public policy, and leadership.

Course Objectives: Upon completion students will be able to;

- Explain the general management principles and practice.
- Discuss the role of construction industry and project cycle.
- Explain the elements, types and conditions of civil engineering contracts and arbitration.
- Explain construction planning techniques and work programming.
- Prepare construction and work programme.
- Explain controls in site management of construction works.
- Explain the work study and operations research in construction and aanalyze system requirements into functions and design requirements.
- Develop and evaluate systems requirements in construction,

CIEN 424 Water Resource, Irrigation and Drainage Engineering (2-2-3)

The course deals with the principles and practices of Irrigation and drainage. Topics include Irrigation Engineering, Soil Water Characteristics, Irrigation Water Requirements, Irrigation Scheduling, Irrigation Water Application Methods: Surface Irrigation, Sprinkler Irrigation, Drip Irrigation, Design of simple irrigation systems, Salinity problems in irrigation; Drainage of Agricultural Lands: Importance of drainage in agriculture, Land drainage methods, Design of drainage and groundwater control systems; Maintenance of Irrigation and Drainage Systems. Runoff calculations (e.g., land use, land cover, time of concentration, duration, intensity, frequency) for reservoir sizing, Routing (e.g., channel, reservoir), and design water reservoir dam for water storage for irrigation schemes.

Learning Outcome: An ability to design a system, component, or process in at a civil engineering context including principles of sustainability in design.

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

- Explain the principles and processes necessary to effectively manage water resources
- Design water storage reservoir and earth dams for irrigation schemes,
- Design drainage and irrigation systems
- Design, test, and analyse efficiency of agricultural irrigation and drainage systems and their components,
- Troubleshoot irrigation systems.

CIEN 426 Geotechnical Engineering (2-2-3)

The course deals with the principles of the various aspects of geotechnical site investigation for construction of building and road pavements. It also discusses piles and pile foundation, caissons and braced excavation. Topics include Site Investigation: Introduction, preliminary exploration; field reconnaissance, local experience, detailed sub-surface exploration; methods permitting visual examination; in-situ examination, sampling, types of boring, borehole testing, non-borehole testing, geophysical exploration, reporting; Deep Foundations- Piles and Piled Foundations, Classification of piles, Load carrying capacity of piles, Pile driving, Settlement of single piles, Settlement of pile groups, Drilled caissons; Stability Of Excavations-Earth pressure on braced excavations Stability of excavations in soils; Tropical Soils: Introduction to unsaturated soils, Engineering implications of tropical

weathering; Rock Slope Stability Analysis: Rock strength and yield, Time dependency, Discontinuities in Rocks, Behaviour of Rock Masses; Environmental impact assessment.

Learning Outcome: This course enables students to demonstrate an ability to design a system, component, or process in a civil engineering context including principles of sustainability in design.

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

- Explain the various methods of site investigation including geophysical methods, and different means of advancing boreholes.
- Determine SPT N values as well as CBR values from field data and be able to prepare soil investigation report.
- Calculate the ultimate capacity of piles and caissons and design braced excavations.

CIEN 428 Water and Wastewater Treatment (2-2-3)

The course deals with designs of water and wastewater treatment units and environmental protection. Topics include water and wastewater characteristics; Conventional water treatment processes (e.g., clarification, disinfection, filtration, flocculation, softening, rapid mix); conventional wastewater treatment processes (e.g., activated sludge, decentralized wastewater systems, fixed-film system, disinfection, flow equalization, headworks, lagoons); Alternative treatment process (e.g., conservation and reuse, membranes, nutrient removal, ion exchange, activated carbon, air stripping); Sludge treatment and handling (e.g., land application, sludge digestion, sludge dewatering);

Learning Outcome: This course enables students to demonstrate an ability to design a system, component, or process in a civil engineering context including principles of sustainability in design.

Course Objective: At the end of this course students will be able to;

- Determine characterisation of water and wastewater.
- Discuss the properties of Physical Unit Operations: Screening, Mixing, Flocculation, Sedimentation, Filtration.
- Evaluate the properties of Chemical Unit Processes: Water softening, Disinfection, Gas Transfer, and Coagulation;
- Discuss the properties of Biological Unit Processes: Aerobic Process, Anaerobic Process, Activated Sludge Treatment Plant, Trickling Filter; Industrial Waste Management; Air Pollution; Reactor Kinetics;
- Perform jar test in the laboratory for water treatment,
- Design water and wastewater treatment units (aerators, settling tanks, and filter units)
- Describe the stages of Environmental impact assessment.

CIEN 498 Civil Engineering Capstone Project II (0-8-4)

This is the second part of the two-course sequence senior project. The course content covers Planning/Conceptual Phase: Desk Studies, Field Studies, Collection and preliminary analysis of data, Interviews/questionnaires, Design Standards/Specifications, Analysis of Options, Preliminary Engineering Design, Preliminary Cost Estimates, Overall Planning and Scheduling, Research and Model Development (if needed); Output of this Phase: Inception Report, Preliminary Engineering Report; Detailed Engineering Phase: Analysis of Chosen Option, Design Documentation and Drawings, Construction Specifications and Drawings, Final Cost Estimates and Economic Analysis, Contract Documents, Tender Documents; Output of this Phase: Draft Final Report, Final Report.

Learning Outcome (s): This course enables students to demonstrate the following:

a. 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.
b. an ability to communicate effectively with a range of audiences.

c. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.
d. An ability to design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design.
e. An ability to practice concepts in project management, business, public policy, and leadership.

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

- Apply design concepts and principles of the various types of civil engineering works
- Execute infrastructure planning and ensure effective project management cycle
- Undertake conceptual designs ensuring capacity requirement, safety, functional requirements, minimum cost, structural designs, aesthetics and general feasibility of the project,
- Design to ensure proper maintenance of civil engineering structures, facilities and projects as well as the availability of civil engineering materials used in construction.

9.5 Research Component – Describe the required research to be carried out. Objectives of this component to be stated

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 its understanding of the engineering design process from the identification of a need to product/service 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. All students are required to satisfactorily complete a minimum of twenty-four (24) weeks of industry attachment during the programme. Students will be assigned to an industry for 6 weeks at end of first year, 8 weeks at 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 provides information on the industrial internship requirements.

Table 17. Industrial 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 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 140 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.

Civil engineers commonly work in teams with colleagues from sectors such as Environmental Planning, Architecture, Community Development and Town Planning, as well as engineers from other disciplines. Some civil engineers work at construction sites, some in engineering design, government agencies, in private consulting companies, in public utilities, and in global enterprises.

The Civil 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) Structural Engineering
(2) Geotechnical Engineering
(3) Transportation Engineering
(4) Water Resources and Environmental Engineering
(5) Surveying and Construction

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 Civil Engineering programmes 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 include 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 Table 18 below.

Table 18. Teaching 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 • **OR**
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

The Civil Engineering Programme is supported by three Laboratories These are (1) Materials Testing Lab, (2) Soils Lab, and (3) Surveying Lab. The items in each lab are listed in the Table below. The Civil Engineering Programme shares Hydraulics and Fluid Mechanics Labs with the Mechanical Engineering Department. Table 19 provides equipment details in each laboratory and the workshops.

Table 19. Civil Laboratory Equipment

Table 19. Civil Engineering Laboratory and Workshop Equionent

No.	MATERIALS TESTING LAB EQUIPMENT (STRUCTURES, ROAD)	No.	SOILS LAB (ROAD AND GEOTECHNICAL)
1	Electronic Scale	1	Posthole Type Auger
3	Laboratory Platform scale	2	Dynamic Cone Penetrometer
4	Nordic Abrasion Machine	4	Plastic Wash Bottles 100ml
5	Coarse Aggregate Sieve	5	Sand Density Cone Apparatus
6	Aggregate Crushing Value (Acv) Sets	6	Soil Color Chart
7	Rapid Moisture Meter	7	Automatic CBR Test Apparatus
8	Wide Wheel Abrasion Testing Machine	8	CBR Standard Compaction Test
9	Forced Air drying oven	9	Hydraulic Universal Extruder ZI 3045
10	Sand Absorption (Abraham Cone) Sets	10	Liquid Limit Device With Counter
11	Shape Index Caliper	11	Shrinkage Limit Set
12	Length Gauge (Elongation Index BS)	12	Plastic Limit Set
13	Coarse aggregate Bulk Density Measuring	13	Liquid Limit Device (Motorised)
14	Riffler Sample Divider/Riffle Box	14	Soil Cone Penetrometer
15	Laboratory Pan Mixer	15	Laboratory Trolley
16	Vibrating Table And Moulds	16	Particle Size Sedimentation ZI 3010
17	Concrete Shrinkage And Expansion Apparatus	17	Density bottle 25ml
18	Cleveland Open Cup Flash Point Tester	18	Pycnometers 1kg jar
19	Automatic Ring And Ball Apparatus	19	Laboratory Vane Shear Apparatus
20	Automatic Digital Penetrometer	20	Direct Shear Apparatus
21	Automatic Asphalt Mixture Mixer	21	Consolidation Apparatus (Electronic
22	Ductility Testing Machine	22	Constant Volume Mould
23	Rolling Thin Film Oven	23	Swell Test Apparatus
24	Asphalt Moisture Content Tester	24	Relative Density Test Equipment
25	Servo Controled Universal Testing Machine	25	Unconfined Compression Tester
26	Cast Iron Split Moulds Aashto T23	26	Computerized Triaxial Testing System
27	C254-02 BEAM MOULD	27	Pore Pressure Apparatus 10 Kq/cm sq
28	Concrete Curing Cabinet	28	Universal Permeability Equipment
29	Concrete Cylinder Capping Device		
30	Three Gang Prism Shrinkage Moulds		**SURVEYING LAB**
31	Marshal Digital Machine 30kn	1	Plane Table Set
32	Los Angeles Materials Testing Machine	2	Hand Held Digital Compass
33	Aggregate Impact Tester with Counter Meter	3	Plan meter
34	Laboratory Mortar Mixer	4	Hand-Held GPS System
35	Cement Flow Table	5	Digital Theodolite
36	Cement Electric Flexural Tester	6	Aluminium tripods
37	Digital Length Comparator	7	Prism With Pole
38	Cement Curing Cabinet	8	Range Pole
39	Digital Mortar Setting Time Tester	9	Levelling Staves
40	Iso Standard Vicat Apparatus	10	Automatic Level
41	Concrete Pressure Air Meter	11	Total Station
42	Steel bar/rebar/ Steel pipe Bending Testing Mach.		
43	Ultrasonic Concrete Tester		
44	Core Cutting Machine		
45	Slump Test Apparatus		
46	Hydrostatic Balance		
47	Concrete Resistivity Meter		

13.0 Teaching and Learning Resources

13.1 Textbook and Reading Materials

The Table 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 provides the list of reading and reference materials for each course.

Table 20. List of Textbooks and Recommended Readings

No	Course No.	Course Title	Textbook/Readings
1	CHEM 101/ CHEM 111	Applied Chemistry/ Applied Chemistry Lab	• Chemistry: The Molecular Nature of Matter and Change, Martin Silberberg and Patricia Amateis, McGraw-Hill, 9th Edition, 2020
2	ENGL 101	English Communication	• English Language & Communication Skills, Michael Denison-George, 2020
3	ENGR 111	Introduction to ICT	• Introduction to Information & Communications Technology
4	CIEN 121	Introduction to Civil Engineering	• Engineering Fundamentals and Problem Solving, Arvid Eide and Steven Mickelson and Roland Jenison and Larry Northup, McGraw-Jill, 8th Edition, 2022 • Ethics in Engineering, Mike Martin and Qin Zhu and Roland Schinzinger, McGraw-Hill, 5th Edition, 2021.
5	ENGR 103	Introduction to Entrepreneurship	• Lecture Notes and Handouts
6	ENGR 102	Fundamentals of Materials Science	• Foundations of Materials Science and Engineering, William Smith and Javad Hashemi, McGraw-Hill, 7th Edition, 2022
7	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 • Book: Technical Writing Essentials, 2019, by Suzan Last
8	PHYS 102 PHYS 112	Applied Physics Applied Physics Lab	• Physics, Alan Giambattista, McGraw-Hill, 5th Edition, • 2019
9	CIEN 112	Design Principles and Civil Engineering in Society	• Pahl, G., Beitz, W. (2013) Engineering design: a systematic approach. Springer Science & Business Media.
10	CIEN 114	Civil Engineering Computer Graphics	• Graser, A. (2016) Learning QGIS. Packt Publishing Ltd. • Bolstad, P. (2016) GIS Fundamentals: A First Text on Geographic Information Systems. Eider Press • Attaway, S. (2016) Matlab: a practical introduction to programming and problem solving. Butterworth-Heinemann.
11	ENGR 116	Fundamentals of Innovation Project	• Customer Integration in Industrial Innovation Projects, Patricia Sandmeier, Springer Fachmedien Wiesbaden, 2008
12	MATH 201	Mathematical Analysis	• Applied Mathematics for Science and Engineering • Larry A. Glasgow, 2014

13	MATH 221	Programming with MATLAB OR Numerical Methods	• Engineering Computation: An Introduction Using MATLAB and Excel, Joseph Musto and William, Howard and Richard Williams, McGraw-Hill, 2nd Edition, 2020MATLAB for Engineering Applications, William Palm. McGraw-Hill, 4th Edition, 2018 • Applied Numerical Methods with Python for Engineers and Scientists, Steven Chapra and David Clough, McGraw-Hill, 1st Edition, 2021 • Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven Chapra, McGraw-Hill, 5th Edition, 2022 • Numerical Methods for Engineers, Steven Chapra and Raymond Canale, McGraw-Hill, 8th Edition, 2020
14	ENGR 201	Enterprise Development	• Instructor Course Notes
15	MEEN 201	Engineering Mechanics: Statics	• Engineering Mechanics: Statics, Russell Hibbeler, Prentice Hall, 2021 • 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
16	SOCI 201	Principles of Sociology	• Essential Concepts in Sociology, Philip W. Sutton and Anthony Giddens Wiley, 3rd Edition, 2021
17	MEEN 202	Engineering Mechanics: Dynamics	• Engineering Mechanics: Dynamics, Russell Hibbeler, Prentice Hall, 2021Engineering 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
18	ENGR 212	Innovations	• Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019
19	MATH 202	Differential Equations	• Differential Equations with MATLAB, Brian R. Hunt, Ronald L. Lipsman, John E. Osborn, Jonathan M. Rosenberg, 2012
20	PSYC 202	Introduction to Psychology	• Introduction to Psychology, University of Minnesota Library Publishing Edition, 2015
21	CIEN 222	Civil Engineering Materials	• Civil Engineering Materials, Peter A. Claisse, Elsevier, 2015
22	CIEN 206/216	Strength of Materials/LAB	• Mechanics of Materials, Ferdinand Beer and E. Johnston and John DeWolf and David Mazurek, McGraw-Hill, 8th Edition, 2019
23	ENGR 212	Intermediate Innovation Project I	• Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019
24	MATH 303	Engineering Statistics	• Statistics for Engineers and Scientists, William Navidi, McGraw-Hill, 6th Edition, 2023
25	ELEN 301/311	Electric Circuit Analysis/Lab	• Introduction to Electrical Circuit Analysis, Ozgur Ergul, Wiley, 2017

26	ECON 301	Principles of Microeconomics	• Microeconomics, David Besanko, Ronald Braeutigam, Wiley, 6th Edition, 2020
27	CIEN 301/311	Fluid Mechanics/LAB	• Fluid Mechanics, Frank White, McGraw-Hill, 9th edition, 2021 • Fluid Mechanics: Fundamentals and Applications, Yunus Cengel and John Cimbala, McGraw-Hill, 4th Edition, 2017
28	CIEN 303/313	Engineering Survey & Geo-information system/LAB	• Schofield, W. (2007) Engineering Surveying, Sixth Edition. Butterworth-Heinemann; 6th edition. • Cuomo, P. A (2003) Surveying Principles for Civil Engineers: Review for the Engineering Surveying Section of the California Special Civil Engineer Examination, 2nd edition. Professional Publications, Inc.; 2nd edition. • Kavanagh, B. (2008) Surveying: Principles and Applications (8th Edition.Prentice Hall; 8th edition.. • Kavanagh, B. (2008) Surveying: Principles and Applications. Prentice Hall; 8th edition.
29	CIEN 315	Structural Analysis	• Hibbler, R.C (2011) Structural Analysis, Prentice Hall; 8th Edition. • McKenzie, W.M.C (2003) Design of Structural Elements; Palgraves Macmillan. • Yang-yu, H. (1982) Elementary Theory of structures. Prentice Hall • Ramon, V. and Jarquio, P.E (2012) Structural Analysis: The analytical Method
30	ECON 302	Engineering Economic Analysis	• Engineering Economy, Leland Blank and Anthony Tarquin, McGraw-Hill, 9th Edition, 2023
31	CIEN 300	Construction Engineering	• Twort, A. C., Rees, J. G. (2012) Civil engineering: supervision and management. Springer Science & Business Media. • Hendrickson, C. Tung, A. (1989) Project Management for Construction, Prentice Hall College, Edition Facsimile
32	CIEN 302/312	Hydraulics and Hydrology/LAB	• Gribbin, J.E. (2013) Introduction to Hydraulics & Hydrology: With Applications for Stormwater Management. Nelson Education • Butler, D., Davies, J. (2004) Urban drainage. CRC Press • Gupta, R. S. (2016) Hydrology and hydraulic systems. Waveland Press • Gupta, R.S. (2016) Hydrology and hydraulic systems. Waveland Press • Houghtalen, R. J., Osman, A., Hwang, N.H. (2016) Fundamentals of hydraulic engineering systems. Prentice Hall.
33	CIEN 304	Steel and Reinforced Concrete Designs	• McKenzie, W.M.C. (2003) Design of Structural Elements. Palgrave Macmillan. • Allen, A.H. (2007) Reinforced Concrete Design to BS 8110 Simply Explained [Kindle Edition]. Taylor and Francis. • Reynolds, C. E., Steedman, J. C., Threlfall, A. J. (2007) Reinforced Concrete Designer's Handbook, Eleventh Edition. Taylor & Francis Group

			• McCormac, J. C., Csernak, S. (2011) Structural Steel Design. Prentice Hall; 5th Edition. • Chanakya, A. (2009) Design of Structural Elements: concrete, steelwork, masonry and timber design to British and Eurocode. Spon Press. 3rd Edition.
34	CIEN 306	Transportation Engineering/LAB	• Brockenbrough, R.(2009) Highway Engineering Handbook. McGraw-Hill Professional; 3rd edition • Garber, N. J., Hoel, L. A. (2009) Traffic and Highway Engineering, 4th Edition. Cengage Learning • Schoon, J. G. (2000). Geometric design projects for highways. ASCE Press. • Highway capacity manual, Transportation Research Board, 2000
35	CIEN 308/318	Soil and Rock Mechanics/LAB	• Das, B.M. (2009) Principles of Geotechnical Engineering - SI Version. CL Engineering; 7th edition. • Budhu, M. (2010) Soil Mechanics and Foundations. Wiley; 3rd edition. • Dante, F., Aguesttant, J., Roussel-Smith, L. (2007) Introduction to Soil Mechanics Laboratory Testing, CRC Press, 1st Edition. • Braja, M.D. (2002) Soil Mechanics Laboratory Manual. Oxford University Press. 6th Edition. • Craig, R. F. (2004) Craigs Soil Mechanics. 7th Edition. CRC Press, 2004. • Das, B. M. (2008) Soil Mechanics Laboratory Manual. Sixth Edition. Oxford University Press. 7th edition
36	ENGR 316	Intermediate Innovation Project II	• Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019
37	CIEN 401	Quantity Surveying and Estimating	• McGill, R. (2012) CESMM4 Civil Engineering Standard Method of Measurement. Institution of Engineering, UK, • Seeley, I. H., Frics, G. P. M (1965) Civil Engineering Quantities. 1st Edition • Hyslop, I. W., Finlay Maclennan, F. (1995) Surveying for construction. McGraw-Hill,
38	CIEN 423	Water Supply and Environmental Engineering/LAB	• Peavy, H. S., Rowe, D. R., Tchobanoglous, G. (1985) Environmental Engineering, McGraw-Hill Inc.
39	CIEN 425	Road Pavement and Foundation Engineering	• Mallick, R. B., & El-Korchi, T. (2008). Pavement engineering: principles and practice. CRC Press. (eBook - PDF) • Gunaratne, M. (2006) The foundation engineering Handbook, CRC Press, 1st Edition • Brown, R.W. (2000) Practical Foundation Engineering Handbook, McGraw-Hill Professional Publishing, 2-sub. • Cheng, L., Evett, J. B. (2013) Soils and Foundation. 8th Edition. Pearson Higher Ed,
40	CIEN 427	Elements of Civil Engineering Practice	Ethics in Engineering, Mike Martin and Qin Zhu and Roland Schinzinger, McGraw-Hill, 5th Edition, 2021.
41	CIEN 422	Construction Management and Systems Engineering	• Construction Project Management, 4th edition, Richard Clough, Glenn A. Sears, S. Keoki Sears, John Wiley & Sons, 2000

42	CIEN 424	Water Resources, Irrigation and Drainage Engineering	• Pair, C.H., Ed (1983) Irrigation. 5th Edition. The Irrigation Assoc. Silver Springs, MD.
43	CIEN 426	Geotechnical Engineering	• Das, B.M. (2009) Principles of Geotechnical Engineering - SI Version. CL Engineering; 7th edition. • Budhu, M. (2010) Soil Mechanics and Foundations. Wiley; 3rd edition.
44	CIEN 422	Construction Management and Systems Engineering	Construction Project Management, 4th edition, Richard Clough, Glenn A. Sears, S. Keoki Sears, John Wiley & Sons, 2000
45	CIEN 424	Water Resources, Irrigation and Drainage Engineering	• Pair, C.H., Ed (1983) Irrigation. 5th Edition. The Irrigation Assoc. Silver Springs, MD.
46	CIEN 428	Water and Wastewater Treatment	• Metcalf and Eddy (2004) Wastewater Engineering: Treatment and Reuse, McGraw-Hill Companies Inc, New York. • Davis, M. L. (2011) Water and Wastewater Engineering: Design Principles and Practice, McGraw-Hill Companies Inc, New York.
47	CIEN 497 CIEN 498	Civil Engineering Capstone Project	• Engineering Design, George Dieter and Linda Schmidt, McGraw-Hill, 6th Edition, 2020 • Pahl, G., Beitz, W. (2013) Engineering design: a systematic approach. Springer Science & Business Media.
48	ENGR 423	Entrepreneurship Project	• Lecture Notes and Handouts

13.2 Required teaching aids/materials

None is REQUIRED. However, instructors have access to numerous teaching aids via the laboratory equipment and components as well as those readily available on the market.

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 Civil 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.

Method of Instruction is Face-to-Face. However virtual sessions may be allowed when necessary.
Lecture Contact Hours = 96 Hours
Laboratory and Practical Hours = 88 Hours
Total Contact Hours = 184 Hours
Total Credit Hours = 140 Hours

The facilities in each classroom consider the possibility of holding virtual sessions.

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 practical work/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 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" as shown in Table 21.

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 semesters hours.

The student's transcript will show the credits and letter grades for each course, the Semester Grade Point Average (GPA) and the Cumulative Grade Point Average (CGPA).

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. 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.

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

Table 22. Available teaching staff 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	Sampson Oduro-Kwarteng (Head of Department)	M	FT	Professor	• PhD Civil Engineering (Waste Management), IHE Delft Institute for Water Education, 2011, Delft, Netherlands	Water supply and environmental engineering,	Civil engineering practice, Water supply, environmental engineering, Construction engineering, Quantity surveying,	22 years
2	Edward Mansal	M	FT	Lecturer/On Study Leave	MSc Civil Eng., PhD Civil Eng./KNUST/In-Progress	Structures	Mechanics, Structures	33 years
3	Alieu Jallow	M	FT	Lecturer/On Study Leave	MSc Civil Eng. ; PhD Civil Engineering/KNUST/In-Progress	Construction	Geotechnical, Construction	28 Years
4	Isatou Dibba	F	PT	Adjunct Lecturer	MSc Electrical/Electronic	Electronics	Introduction to EE; Electrical/Electronic Circuits	4 years
5	Gbemileke Solomon Ayedun	M	PT	Adjunct Lecturer	MSc Industrial Chemistry	Industrial Chemistry	Chemistry; Materials Science	5 years
6	Musa FM Danso	M	PT	Adjunct Lecturer	MA English Language	English Language	English Communication; Technical Report Writing	12 years
7	Alhagie Hydara	M	FT	Lecturer	MSc Mathematical Sciences	Mathematical Sciences	Calculus; Mathematics	6 years
8	Ballu Christopher Junior	M	FT	Lecturer	MSc Civil Engineering, Government Technical Institute, Sierra Leone, 2021	Civil Engineering	Engineering Graphics, Introduction to Civil Engineering	5 years
9	Ikonne Ozioma	M	FT	Senior Lecturer	PhD Business and Entrepreneurship	Entrepreneurship	Entrepreneurship	6 years

10	Gaston Mendy	M	FT	Lecturer	MSc Computer Science	Computer Science	ICT, Computer Graphics	18 years
11	Silfat A. Jubril Sanni	F	FT	Lecturer	MSc Management Information Systems	Management Information Systems	ICT, Engineering Graphics	2 years
12	Mbye Sowe	M	PT	Adjunct Lecturer	MSc Electrical Engineering	Electrical Engineering	Electrical/Electronic Circuits	2 years
13	UTO, Oghenekevwe Timothy	M	PT	Adjunct Lecturer	PhD Physics ; Federal University of Agriculture, Nigeria, 2012	Physics	Physics	4 years
14	Adefila, Adebimpe Moyosore	F	FT	Lecturer	MSc Water resources and Environmental Engineering; Ahmadu Bello University, Zaria, 2018	Water resources and Environmental Engineering	Various Civil Engineering Courses	4 years


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