
# BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

PROGRAMME

**THE GAMBIA UNIVERSITY OF APPLIED SCIENCE, ENGINEERING & TECHNOLOGY**

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

**College of Science and Engineering**
**Department of Mechanical Engineering**

## Curriculum For:
## Bachelor of Science in Mechanical Engineering

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# Bachelor of Science – Mechanical 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 programme objectives and learning outcomes, (3) the development the programme structure, (4) development and organization of content, (5) delivery and revisions based on stakeholder input, and (6) final curriculum.

### *2.1 Needs Assessment*

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

### *2.2 Formulation of Objectives and Outcomes*

The mission of the University as directed by the Ministry of Higher Education and the requirement of The World Bank 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 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 George Obeng, the Dean of Faculty of Mechanical and Chemical Engineering (geo_yaw@yahoo.com) and Professor Yaw Andoh, Head of Mechanical Engineering (pyandoh.coe@knust.edu.gh) for review and feedback. A roundtable discussion was also held with Mechanical Engineering lecturers who were visiting USET during their assignments in The Gambia. Their input and recommendations were considered in the development of the document. Additionally, a second-tier of roundtable discussion was held at the local level through MoHERST on October 27, 2022. Representatives of the following were in attendance: Ministry of Higher Education, Research, Science and Technology (MoHERST), Ministry of Basic and Secondary Education (MoBSE), FENTA Consultants, National Water and Electrity company (NAWEC), Gambia Ports Authority (GPA), University of Applied Science, Engineering and Technology (USET), and National Accreditation & Quality Assurance Authority (NAQAA). The attendees were provided with the draft document. The recommendations arising out of the discussions were considered in the development of the 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.

Mechanical Engineering

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

Bachelor of Science

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

Mechanical Engineering is the broadest of all the engineering disciplines. Mechanical Engineering involves the design, production, and operation of machinery by applying the laws of physics, principles of engineering, and mathematics, among others. Modern mechanical engineers use computers to model and analyse their designs, to develop prototypes and monitor the quality of products. Mechanical engineers play important roles in the automotive, aerospace, automation, and manufacturing industries. They design, develop, build, and test mechanical devices, tools, engines, and machines. Mechanical engineers design and manufacture products such as transmissions, engine parts, aircraft engines, gas turbines, wind turbines, compressors, robots, and machine tools. Mechanical engineering branches into a number of engineering disciplines such as automotive engineering, industrial engineering, manufacturing engineering, aerospace engineering, and marine engineering. The target group consists of Senior Secondary School students with science and technical background, experienced candidates

with technical diplomas or post-secondary degrees in other fields who wish to change their course of study to engineering.

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

***6.1 Regular Entry Requirements***

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

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

***6.2 Transfer Student Requirements***

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

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

*Notes:*

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

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

***7.1 Programme Educational Objectives (PEO)***

The Programme Educational Objectives have been developed to be consistent with the mission of the institution and the needs of the 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 two to five years after graduation from the Mechanical Engineering Programme:

(1) Demonstrate competence in the application of knowledge, technical and entrepreneurial skills as a trained mechanical 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: a) principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); b) applications of these topics to modelling, analysis, design, and realization of physical systems, components or processes; c) coverage of both thermal and mechanical systems; and d) in-depth coverage of either thermal or mechanical systems.

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

1. An ability to identify, formulate, and solve complex mechanical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply mechanical 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 apply knowledge and skills developed to model, analyse, design, and realize physical systems, components, or processes.
9. An ability to function effectively in both thermal and mechanical systems
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. The Table below shows the mapping of these two outcomes.

Table 1. Mapping of ABET and NAQAA Learning Outcomes

| No | International (ABET) | Local (NAQAA) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Acquire Knowledge and understanding | Apply Knowledge and understanding | Communication skills | Judgmental skills | Learning skills | Autonomy and responsibility |
| 1 | Identify, formulate, and solve complex engineering problems | ✓ | ✓ | | | | |
| 2 | Apply engineering design to produce solutions | | ✓ | | ✓ | | ✓ |
| 3 | Communicate effectively | | | ✓ | | ✓ | |
| 4 | Recognize ethical and professional responsibilities | | ✓ | | ✓ | | |
| 5 | Function effectively in a team | | | | | ✓ | ✓ |
| 6 | Develop and conduct appropriate engineering experiment | ✓ | ✓ | ✓ | ✓ | | ✓ |
| 7 | Acquire and apply new knowledge | | ✓ | | | ✓ | |
| 8 | Model, design and realize a physical system | | ✓ | ✓ | ✓ | | ✓ |
| 9 | Function in both mechanical and thermal systems | | ✓ | | | ✓ | |
| 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. (Mechanical Engineering) degree at USET, a candidate must satisfactorily complete the minimum number of credit units prescribed for the degree. The candidate must satisfy (1) the University General Education Requirements, (2) Basic Science and Mathematics Requirements, (3) Engineering Topics and Practice Requirements, (4) Innovation and Entrepreneurship Requirements, and (5) Internship Requirements. The Table below provides the list of categories and the credit hours required.

Table 2: BSc Mechanical Engineering Programme Categories

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

** The 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 Mechanical 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. The Table below provides 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)
***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.

Table 3. General Education Courses

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

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

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

Table 4. Required Science and Mathematics Courses

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

***9.2.3 Innovation and Entrepreneurship Requirement:*** The following Table provides a list of Innovations and Entrepreneurship Topics in the BSc Mechanical Engineering Programme.

Table 6. Innovation and Entrepreneurship Courses

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

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

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

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

The following Table provides a list of Engineering Topics in the BSc Mechanical Engineering Programme.

Table 5. Mechanical Engineering Courses

| No | Course Code | Course Title | Credit Hours |
|---|---|---|---|
| 1 | MEEN 112 | Mechanical Shop Practices | 2 |
| 2 | ENGR 113 | Engineering Graphics | 2 |
| 3 | MEEN 114 | Solid Modeling | 2 |
| 4 | MEEN 121 | Introduction to Mechanical Engineering | 2 |
| 5 | ENGR 102 | Fundamentals of Materials Science | 2 |
| 6 | MEEN 201 | Engineering Mechanics I - Statics | 3 |
| 7 | MEEN 202 | Engineering Mechanics II - Dynamics | 3 |
| 8 | MEEN 204/214 | Fundamentals of Thermodynamics/Lab | 3 |
| 9 | MEEN 206/216 | Strength of Materials/Lab | 4 |
| 10 | MEEN 301/311 | Fluid Mechanics/Lab | 4 |
| 11 | MEEN 302/312 | Applied Thermodynamics/Lab | 3 |
| 12 | MEEN 303/313 | Mechanical Engineering Materials/Lab | 3 |
| 13 | MEEN 304 | Design of Machine Members | 3 |
| 14 | MEEN 305/315 | Manufacturing Machines and Processes/Practicals | 3 |
| 15 | MEEN 306/316 | Heat Transfer /Lab | 3 |
| 16 | ELEN 301/311 | Electric Circuit Analysis/Lab | 3 |
| 17 | ELEN 322 | Electric Machines | 2 |
| 18 | MEEN 401/411 | Vibrations and Control/Lab | 3 |
| 19 | MEEN 402 | Mechatronics | 3 |
| 20 | MEEN 403/413 | Pneumatics and Hydraulics/Lab | 3 |
| 21 | MEEN 404/414 | Fluid Machinery/Lab | 3 |
| 22 | MEEN 405 | Design and Selection of Machine Elements | 3 |
| 23 | MEEN 421 | Computer Aided Design and Manufacturing | 3 |
| 24 | MEEN 422 | Air Conditioning and Refrigeration | 2 |
| 25 | MEEN 424 | Renewable Energy Technology | 2 |
| 26 | MEEN 497 | Capstone Project - Design Phase | 3 |
| 27 | MEEN 498 | Capstone Project - Prototype Phase | 4 |
| **Total Credits for Engineering Topics** | | | **76** |

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

Table 7. 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.

**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 | MEEN 121 | Introduction to Mechanical Engineering | 1 | 2 | 2 |
| 6 | ENGR 111 | Introduction to ICT | 0 | 4 | 2 |
| 7 | ENGR 113 | Engineering Graphics | 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 | MATH 102 | Calculus II | 3 | 0 | 3 |
| 2 | PHYS 102 | Applied Physics I | 3 | 0 | 3 |
| 3 | PHYS 112 | Applied Physics I Lab | 0 | 2 | 1 |
| 4 | ENGL 102 | Technical Report Writing | 2 | 0 | 2 |
| 5 | MEEN 112 | Mechanical Shop Practice | 0 | 4 | 2 |
| 6 | MEEN 114 | Solid Modeling | 0 | 4 | 2 |
| 7 | ENGR 102 | Fundamentals of Materials Science | 2 | 0 | 2 |
| 8 | ENGR 116 | Introduction to Innovation Projects | 0 | 4 | 2 |
| **Total Hours ENGR 102** | | | **10** | **14** | **17** |
| ENGR 100 First Internship | | | | **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 | MATH 202 | Mathematical Analysis | 3 | 0 | 3 |
| 2 | MEEN 202 | Engineering Mechanics II - Dynamics | 3 | 0 | 3 |
| 3 | MEEN 204 | Fundamentals of Thermodynamics | 2 | 0 | 2 |
| 4 | MEEN 214 | Thermodynamics Lab | 0 | 2 | 1 |
| 5 | MEEN 206 | Strength of Materials | 3 | 0 | 3 |
| 7 | MEEN 216 | Strength of Materials Lab | 0 | 2 | 1 |
| 8 | PSYC 202 | Principles of Psychology | 2 | 0 | 2 |
| 9 | ENGR 212 | Intermediate Innovation Project I | 0 | 4 | 2 |
| **Total Hours** | | | **13** | **8** | **17** |
| ENGR 200 Second Year Internship | | | | **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 | MEEN 301 | Fluid Mechanics | 3 | 0 | 3 |
| 3 | MEEN 311 | Fluid Mechanics Lab | 0 | 2 | 1 |
| 4 | MEEN 303 | Mechanical Engineering Materials | 2 | 0 | 2 |
| 5 | MEEN 313 | Engineering Materials Lab | 0 | 2 | 1 |
| 6 | MEEN 305 | Manufacturing Machines and Processes | 2 | 0 | 2 |
| 7 | MEEN 315 | Manufacturing Practicals | 0 | 2 | 1 |
| 8 | ELEN 301 | Electric and Electronic Circuits | 2 | 0 | 2 |
| 9 | ELEN 311 | Electric Circuits Lab | 0 | 2 | 1 |
| 10 | ECON 301 | Principles of Microeconomics | 2 | 0 | 2 |
| 11 | ENGR 301 | STEM Entrepreneurship | 2 | 0 | 2 |
| **Total Hours** | | | **16** | **8** | **20** |

**Table 13. Year 3: Semester Two**

| No | Course Code | Course Title | Lecture Hours | Lab Hours | Credit Hours |
|---|---|---|---|---|---|
| 1 | MEEN 302 | Applied Thermodynamics | 2 | 0 | 2 |
| 2 | MEEN 312 | Applied Thermodynamics Lab | 0 | 2 | 1 |
| 3 | MEEN 304 | Design of Machine Members | 3 | 0 | 3 |
| 4 | MEEN 306 | Heat Transfer | 2 | 0 | 2 |
| 5 | MEEN 316 | Heat Transfer Lab | 0 | 2 | 1 |
| 6 | ELEN 322 | Electrical and Electronic Machines | 1 | 2 | 2 |
| 7 | ECON 302 | Engineering Economic Analysis | 2 | 0 | 2 |
| 8 | ENGR 316 | Intermediate Innovation Project II | 0 | 6 | 3 |
| **Total Hours** | | | **10** | **12** | **16** |
| ENGR 300 Third Internship | | | | **400** | **0** |

**Table 14. Year 4: Semester One**

| No | Course Code | Course Title | Lecture Hours | Lab Hours | Credit Hours |
|---|---|---|---|---|---|
| 1 | MEEN 401 | Mechanical Vibrations and Control | 2 | 0 | 2 |
| 2 | MEEN 411 | Automatic Control Lab | 0 | 2 | 1 |
| 3 | MEEN 403 | Hydraulics and Pneumatics | 2 | 0 | 2 |
| 4 | MEEN 413 | Hydraulics and Pneumatics Lab | 0 | 2 | 1 |
| 5 | MEEN 405 | Design and Selection of Machine Elements | 3 | 0 | 3 |
| 6 | MEEN 421 | Computer Aided Design and Manufacturing | 2 | 2 | 3 |
| 7 | MEEN 497 | Capstone Project - Design Phase | 1 | 4 | 3 |
| 8 | ENGR 423 | Entrepreneurship Project | 1 | 4 | 3 |
| **Total Hours** | | | **11** | **14** | **18** |

**Table 15. Year 4: Semester Two**

| No | Course Code | Course Title | Lecture Hours | Lab Hours | Credit Hours |
|---|---|---|---|---|---|
| 1 | MEEN 402 | Mechatronics | 2 | 0 | 2 |
| 2 | MEEN 412 | Mechatronics Lab | 0 | 2 | 1 |
| 3 | MEEN 404 | Fluid Machinery | 2 | 0 | 2 |
| 4 | MEEN 414 | Fluid Machinery Lab | 0 | 2 | 1 |
| 5 | MEEN 422 | Air Conditioning and Refrigeration | 1 | 2 | 2 |
| 6 | MEEN 424 | Renewable Energy Technology | 1 | 2 | 2 |
| 7 | MEEN 498 | Capstone Project - Prototyping | 1 | 6 | 4 |
| **Total Credit Hours** | | | **7** | **14** | **14** |

Table 16. Programme Workload Analysis- Mechanical Engineering

| Year | Semester | No. of Courses | Lecture Hours | Lab Hours | Contact Hours | Credit Hours |
|---|---|---|---|---|---|---|
| **Year 1** | Semester 1 | 8 | 11 | 12 | 23 | 17 |
| | Semester 2 | 8 | 10 | 14 | 24 | 17 |
| **Year 2** | Semester 1 | 7 | 15 | 4 | 19 | 17 |
| | Semester 2 | 8 | 13 | 8 | 21 | 17 |
| **Year 3** | Semester 1 | 11 | 16 | 8 | 24 | 20 |
| | Semester 2 | 8 | 10 | 12 | 22 | 16 |
| **Year 4** | Semester 1 | 8 | 11 | 14 | 25 | 18 |
| | Semester 2 | 7 | 7 | 14 | 21 | 14 |
| **Totals** | | **65** | **93** | **86** | **179** | **136** |

## 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 covered.

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

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

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

**MATH 101 Calculus I (3-0-3)**

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

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

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

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

**CHEM 101 Applied Chemistry (3-0-3)**

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

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

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

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

**CHEM 111 Applied Chemistry Laboratory (0-2-1)**

This is a course which emphasizes quantitative studies of chemical reactions such as acid-base studies, redox reactions, and equilibrium reactions. Emphasis is also placed on the development of manipulative skills in the laboratory.

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

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

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

**MEEN 121 Introduction to Mechanical Engineering (1-2-2)**

This course provides an overview of mechanical engineering. The role of the engineer in the interdisciplinary technical team will be discussed. Engineering functions, professional licensure, code of ethics, safety, the design process, teamwork, and legal responsibilities will be introduced. Case studies in ethics and the application of the design process through a team project are required.

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

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

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

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

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

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

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

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

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

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

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

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

**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.

**ENGL 102 Technical Report Writing (2-0-2)**
This course includes the study and practice of the basic techniques of writing and editing scientific and technical materials. It covers elements of layout, design, and typography, giving students practice with short and long print texts and non-print texts and non-print media and referencing.

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

*Course Objectives:* By the end of the course, students will be able to:
- Explain basic technique of writing and editing of scientific and technical materials
- Explain elements of layout, design, and typography, of print material
- Practice short and long print texts, non-print texts and non-print media
- Provide appropriate reference materials.

**MEEN 112 Mechanical Shop Practice (0-4-2)**
This is a hands-on course designed to equip students with skills in a machine shop to make a mechanical device. Topics include filing, machining, tolerances, surface finish, assembly, and selection of common mechanical components. Welding and fabrication techniques are also introduced.

*Learning Outcome:* This course introduces the students to the development of physical components, systems and processes.

*Course Objectives:* Upon completion of this course, students will be able to:
- Apply safety precautions in the machine shop
- Identify basic machine tools for production
- Describe the various machine tool processes and apply them in the machine shop
- Produce free-hand sketches of the product for manufacturing in the machine shop
- Select the possible machine tools to be used for machining the product
- Use various machine tools for production including bench vice, marker, powersaw, shaping, drilling, milling, turning, treading, knurling, reaming, chamfering, and counter-sinking, welding

**MEEN 114 Solid Modeling (0-4-2)**

This is an introductory course in computer aided graphics and design for mechanical engineers. This course will familiarize students with conventions of 2-D graphical representation, introduction to various mechanical components and computer 3D solid modelling.

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

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

- Demonstrate mechanical design ideas using computer aided graphics.
- Draw with conventions of 2-D graphical representation.
- Identify various mechanical components.
- Generate computer 3D solid modelling of mechanical components and systems.

**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.

**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

**ENGR 100 First Industrial Internship**

Students are assigned to a selected industry based on his/her field of study for a period of 6 weeks. A written internship report, a logbook and attendance sheet endorsed by an industrial supervisor are required. Students receive a Satisfactory grade in order to fulfil the graduation requirement.

## SECOND YEAR COURSES

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

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

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

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

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

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

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

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

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

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

**MATH 201 Mathematical Analysis I (3-0-3)**

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

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

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

- Evaluate Vector, Scalars, Vectors and Scalar Fields
- Evaluate Products of two, three or more vectors
- Perform Vector differentiation and integration.
- Explain gradient, divergence, curl and their physical significance
- Apply three-dimensional coordinate geometry of lines and planes.
- Identify elementary functions of complex variable.

- Apply determinants and their properties.
- Solve a set of linear equations using Crammer's rule
- Apply Matrices and their properties;
- Develop and apply Eigen values and Eigen vectors.
- Apply linear programming to solve engineering problems.

**MATH 221 Numerical Methods and MATLAB (2-2-3)**
This course introduces MATLAB programming language and the applications in solving problems in linear algebra, matrix theory, and manipulation of polynomials, interpolation, differentiation and integration.

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

*Course Objectives:* By the end of the course, students will be able to:
- Produce working programmes to analyze engineering problems using MATLAB
- Apply MATLAB programming language
- Apply MATLAB programming language to solve problems in linear algebra, matrix theory
- Apply MATLAB programming language for manipulation of polynomials, interpolation, differentiation and integration.

**MEEN 201 Engineering Mechanics I – Statics (3-0-3)**
This course covers fundamental vector concepts of force, moment of a force; analytical and graphical techniques in the analysis of force and moment; conditions of equilibrium in frames, trusses, machine members under static loads; laws of friction; distributed forces, determination of centroid, mass center, area and mass moment of inertia. The course includes application of simple computer tools to solve problems.

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

*Course Objectives:* Upon successful completion of the course, students will be able to:
- Resolve forces and determine the resultant.
- Draw free body diagrams for particles.
- Apply vectors for resultant and equilibrium analysis.
- Analyze pulley systems.
- Draw free body diagrams and analyze rigid bodies and trusses.
- Draw free body diagrams and analyze machines.
- Analyze static friction situations.
- Calculate center of gravity and centroids
- Apply simple computer tools to solve problems.

**SOCI 201 Principles of Sociology (2-0-2)**
In this course, basic concepts and principles in sociology as they are used to examine patterned and recurrent forms of social behaviour will be studied. Similarities and differences between structural functionalism, conflict theory and symbolic interactionism will be covered.

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

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

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

**ENGR 201 Enterprise Development (2-0-2)**

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

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

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

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

**MATH 202 Differential Equations (3-0-3)**

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

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

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

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

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

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

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

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

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

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

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

*Learning Outcome:* This course enables students to demonstrate an ability to identify, formulate, and solve complex 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 fundamental thermodynamic principles
- Discuss the relationship among energy, heat and work.
- Evaluate thermodynamic properties of substances.
- Distinguish between real and ideal gases
- Apply first and second laws of thermodynamics from a macroscopic viewpoint
- Analyze basic thermodynamic cycles.

**MEEN 214 Fundamentals of Thermodynamics Lab (0-2-1)**

This laboratory course supports Fundamentals of Thermodynamics theory course. Experiments focus on: Mechanical Equivalent of Heat; Specific Heat Capacity of a Solid; pressure, volume, and temperature relations for a gas.

*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:

- Run experiment on Mechanical Equivalent of Heat.
- Determine the Specific Heat Capacity of a Solid.
- Run experiment to relate the pressure, volume, and temperature for a gas.
- Analyse experimental data
- Interpret experimental results.

**MEEN 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 shafts and beams, transformation of stress and strain, principal stresses, elastic constants, column buckling, and an introduction to the analysis of statically indetermina-te beams.

*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:

- 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 combined stresses.
- Analyze column loading and buckling.
- Analyze statically determinate beams.

**MEEN 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.

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

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

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

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

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

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

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

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

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

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

**ENGR 200 Second Industrial Internship**
Students are assigned to a selected industry based on his/her field of study for a period of 8 weeks. A written internship report, a logbook and attendance sheet endorsed by an industrial supervisor are required. Students receive a Satisfactory grade to fulfil the graduation requirement.

## THIRD YEAR COURSES

**MATH 303 Engineering Statistics (3-0-3)**
This course deals with data presentation and analysis, frequency distributions, probability concepts and axioms of probability. Random variables, discrete and continuous probability distributions, calculus based probability calculations, joint distributions, conditional probability and independence are covered. Independence of events is applied to engineering system reliability. Students are introduced to concepts of sampling, sampling distributions, estimation, confidence intervals, and hypothesis testing.

*Learning Outcome:* This course enables students to demonstrate an ability to identify, formulate, and solve complex 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

**MEEN 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.

*Learning Outcome:* This course enables the student 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:

- Explain the continuum concept.
- Explain differences between fluid statics and fluid dynamics.
- Describe mass and momentum balances.
- Apply the Bernoulli Equation to problem solving.
- Demonstrate an understanding of application of dimensional analysis.
- Analyze and select pumps.
- Explain the three forms of drag.
- Explain the principles of boundary layer flows.
- Identify compressible flow.
- Operate flow measurement devices.

**MEEN 311 Fluid Mechanics Laboratory (0-2-1)**
Fluids Laboratory work includes selected experiments in the area of fluid mechanics in support of the Fluid Mechanics course (MEEN 301).

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

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

- Use the Reynolds apparatus to demonstrate fluid flow
- Measure flow rate with venturi meter apparatus and orifice meter apparatus
- Determine losses in Pipe fittings and Pipe friction
- Demonstrate Free and Vortex flows
- Determine the characteristics of the Multistage centrifugal pump and the gear pump

**MEEN 303 Mechanical Engineering Materials (3-0-3)**
This course covers the role of materials in engineering; properties of materials; nonferrous and ferrous systems and applications; heat treatment and strengthening mechanisms; various polymeric, ceramic, composite materials biomaterials and their applications; failure modes; characterization; corrosion and environmental issues; group exercises involve selection of material systems with safety, environmental and manufacturing considerations.

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

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

- Explain the role of materials in engineering.
- Distinguish between nonferrous and ferrous systems and their applications.
- Discuss heat treatment and strengthening mechanisms.
- Identify various polymeric, ceramic, composite materials, biomaterials and their applications
- Explain the failure modes of various materials
- Discuss the Characteristics of various materials
- Discuss material corrosion and environmental issues
- Select alternative materials for engineering applications.

**MEEN 313 Engineering Materials Laboratory (0-2-1)**
Materials testing for mechanical, thermal, and manufacturing properties. Heat treatment and hardenability of steel.

*Learning Outcome:* This course enables students to demonstrate:

a. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.
b. An ability to communicate effectively with a range of audiences.

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

- Identify engineering materials.
- Develop experiments to test for properties of engineering materials.
- Specify heat treatment methods for steel.
- Improve the hardness and tensile strength of steels.

**MEEN 305 Manufacturing Machines and Processes (2-0-2)**
The course deals with principles, force analysis, selection of traditional manufacturing processes, and determination of machine capacity. Topics include casting, moulding, forming, particulate processing, material removal and joining. Design for manufacturing and manufacturing economics are introduced.

*Learning Outcome:* This course enables the student to demonstrate an ability to apply knowledge and skills developed to realize physical systems, components or processes.

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

- Explain principles, analysis, selection of traditional manufacturing processes
- Determine the capacity and machine tools
- Describe basic casting and molding processes and how to select them
- Describe metal cutting principles and how to select machinery.
- Describe powder processing methods and their applications.
- Select joining operations and their selection them.
- Explain the relation between design features and manufacturing operations.

**MEEN 315 Manufacturing Practicals (0-2-1)**
This laboratory course provides the student with hands-on experiences in operations such as turning and related processes, milling processes, grinding, CNC programming and operation, additive manufacturing (3D Printing).

*Learning Outcome:* This course enables the student to demonstrate an ability to apply knowledge and skills developed to realize physical systems, components or processes.

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

- Describe the functions of the parts of the Lathe and how to operate it.
- Describe the functions of the parts of the Drilling Machine and how to operate it.
- Describe the functions of the parts of the Milling Machine and how to operate it.
- Describe the functions of the parts of the Grinding and how to operate it.
- Develop basic CNC programmes and how to operate it.
- Produce a part using 3D Printing.

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

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

*Course Objectives:* By the end of the course, students will be able to:
- Explain the principles of economics related to individual segments of the society
- Explain scarcity, supply and demand,
- Discuss consumer behaviour,
- Describe business firms and market structures.
- Discuss the need for economic and market considerations in engineering.

**ENGR 301 STEM Entrepreneurship (2-0-2)**
This course covers Entrepreneurial Integrative Abilities, Spiral to application to STEM/Translational Aspects, Experiential Learning. Topics include Design Thinking, Innovation & Markets, Innovation Management, Intellectual Property Protection, Prototyping, Stakeholder Engagement, and Services as it pertains to STEM. Experiential learning activities include development of innovation spirit, Blue Ocean strategies and Value Proposition Workshop.

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

*Course Objectives:* By the end of the course, students will be able to:
- Analyze the differences in social progress in the region
- Describe the role of the entrepreneur in society
- Identify the impact of entrepreneurial innovations on national cultures.
- Develop ways to involve stakeholders in their entrepreneurship endeavors.
- Describe intellectual property rights and how to apply for patents in The Gambia.

**MEEN 302 Applied Thermodynamics (3-0-3)**
This course applies the principles of thermodynamics to real systems. The topics covered include gaseous mixtures, psychrometrics, combustion, the various power cycles and refrigeration cycles.

*Learning Outcome* :This course enables students to demonstrate an ability to function effectively in thermal systems

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

- Apply thermodynamic principles to real systems
- Explain gaseous mixtures
- Apply psychrometrics to analyze and design thermal systems
- Apply principles of combustion to design of thermal systems
- Describe, analyze and apply power cycles.
- Describe, analyze and apply refrigeration cycles.

**MEEN 312 Applied Thermodynamics Lab (0-2-1)**

This laboratory course supports the theories in Applied Thermodynamics. Topics: Composition Analysis of Gaseous Mixtures, Psychrometric Analysis of Air, Performance Analysis of an Internal Combustion Engine, Coefficient of Performance (COP) Analysis of a Refrigeration System.

*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:

- Develop and run an experiment to analyze Composition of Gaseous Mixtures
- Gain skills in psychrometric analysis of Air
- Develop and run experiment to analyze the performance of an Internal Combustion Engine
- Develop and run experiment to analyze Performance (COP) of a Refrigeration System

**MEEN 304 Design of Machine Members (3-0-3)**

This course applies stress and strain analysis to mechanical design. Emphasis is placed on the design of machine members for static and fatigue loads. Applications in design of beams, columns, axles and transmission shafts and associated components such as bearings and keys are emphasized. Other topics such as application of codes and standards, project planning, teamwork, and technical communication are also covered. Team design projects are assigned.

*Learning Outcomes:* This course enables students to demonstrate:

1, An ability to apply mechanical 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.
2. 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.
3. An ability to communicate effectively with a range of audiences.
4. Ability to recognize and rectify unethical situations.

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

- Design machine members under static loading conditions
- Desing machine members under fatigue loading conditions.
- Apply codes and standards for design of axles and transmission shafts.
- Demonstrate understanding of the design process.
- Practice teamwork, and
- Apply technical communication methods

**MEEN 306 Heat Transfer (2-0-2)**

The course covers the principles of heat conduction, convection, radiation, boiling and condensation, and heat exchangers. Design and safety aspects of heat transfer equipment are covered.

*Learning Outcome:* This course enables students to demonstrate an ability to apply design principles to the design of thermal systems such as heat exchangers.

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

- Explain and apply the principles of heat conduction.
- Explain and apply the principles of heat convection.
- Explain and apply the principles of heat radiation.
- Explain and apply the principles of boiling and condensation.
- Design various heat exchangers

**MEEN 316 Heat Transfer Lab (0-2-1)**

This laboratory course supports theories of heat transfer. The course provides the opportunity for students to apply knowledge gained in the Heat Transfer Course (MEEN 306) to design experiment to test thermal systems such as heat exchangers.

*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:

- Perform experiment with the composite wall apparatus
- Perform experiment with the lagged pipe apparatus
- Operate the heat pipe apparatus
- Experiment with the natural convection apparatus
- Experiment with the heat pipe apparatus
- Determine heat transfer in agitated vessel
- Operate the Stefan Boltzmann apparatus
- Use the critical heat flux apparatus
- Test the shell & tube heat exchanger
- Operate the plate type heat exchanger apparatus
- Determine the thermal conductivity of metal rods

**ELEN 322 Electrical and Electronic Machines (2-0-2)**

Principles of Electromagnetic Conversion. Basic Transducers. Single and Double Excitation. Transformers. DC Machines. Introduction to Polyphase Induction Machines.

*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 the principles of Electromagnetic Conversion.
- Describe basic Transducers.
- Explain Single and Double Excitation.
- Describe, analyse and select Transformers
- Describe, analyse and select DC Machines.
- Describe, analyse and select Polyphase Induction Machines.

**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.

**ENGR 300 Third Industrial Internship**

Students are assigned to a selected industry based on his/her field of study for a period of 10 weeks. A written internship report, a logbook and attendance sheet endorsed by an industrial supervisor are required. Students receive a Satisfactory grade to fulfil the graduation requirement.

## FOURTH YEAR COURSES

**MEEN 401 Mechanical Vibrations and Controls (2-0-2)**

This course applies modelling, analysis and simulation to free and forced vibrations of undamped and damped, single and multi-degree of freedom systems. It also deals with ffeedback control, control system design using root locus and frequency response methods.

*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:

- Model free and forced vibrations of damped and undamped systems
- Analyse free and forced vibrations of damped and undamped systems
- Simulate free and forced vibrations of damped and undamped systems
- Describe the basic properties of feedback control and perform stability analysis.
- Design a fundamental control system of a mechanical system.
- Explain root locus and frequency response methods.

**MEEN 411 Automatic Control Lab (0-2-1)**

This course complements the mechanical vibrations and controls (MEEN 401. Experiments include time response, frequency response and computer simulation of control actions of Proportional Control, Integral Control, Differential Control and the various combinations. Projects are assigned to investigate the scope and limitations of various controllers.

*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:

- Obtain time response of control systems.
- Determine stability conditions of control systems.
- Analyze the frequency response of control systems.
- Determine the scope and limitations of controllers.

**MEEN 403 Hydraulics and Pneumatics (2-0-2)**

This course deals with hydraulic and pneumatic circuits and systems, components of hydraulic and pneumatic control systems, and design, maintenance and safety of pneumatic and hydraulic systems.

*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:

- Describe hydraulic and pneumatic circuits and systems
- State components of hydraulic and pneumatic control systems
- Design hydraulic and pneumatic systems,
- Maintain pneumatic and hydraulic systems
- Observe safety of pneumatic and hydraulic systems

**MEEN 413 Hydraulics and Pneumatics Lab (0-2-1)**

This course supports the theories in Hydraulics and Pneumatics. Students will experiment with pneumatic circuits, hydraulic circuits, troubleshooting and maintenance.

*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:

- Analyze the performance characteristics of hydraulic circuits and systems.
- Analyze the performance characteristics of pneumatic circuits and systems.
- Test and troubleshoot hydraulic control systems.
- Test and troubleshoot pneumatic control systems.

**MEEN 405 Design and Selection of Machine Elements (3-0-3)**

This course applies principles of the various mechanical elements and design, design guidelines to select and provide specifications of machine elements. These include gears, fasteners, springs, clutches, and brakes. The course includes design of mechanical joints, eccentric loading, and weldments.

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

a. Apply mechanical 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.
b. Work in mechanical systems.

*Course Objectives:* By the end of the course, students will be able to:
- Explain the theory, design and selection of machine elements
- Apply design principles to analyse, select, and provide technical specifications for gears.
- Apply design principles to analyse, select, and provide technical specifications for bearings.
- Apply design principles to analyse, select, and provide technical specifications for fasteners.
- Apply design principles to analyse, select, and provide technical specifications for springs.
- Apply design principles to analyse, select clutches and brakes

**MEEN 421 Computer Aided Design and Manufacturing (2-2-3)**
This course covers Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and their integration. Topics include computer-aided design, process planning, Computer Numerical Control (CNC) programming and operation, Group Technology (GT), rapid prototyping, and integrated production planning and control. Design projects are assigned.

*Learning Outcome:* This course enables students to demonstrate an ability to work in mechanical systems.

*Course Objectives:* By the end of the course, students will be able to:
- Use Computer-Aided Design (CAD) software.
- Operate Computer-Aided Manufacturing (CAM) and their integration.
- Explain process planning.
- Explain Numerical Control (NC) programming and operation
- Operate Group Technology (GT)
- Operate rapid prototyping, and
- Explain integrated production planning and control

**MEEN 497 Capstone Project - Design Phase (2-2-3)**
This is the first part of a two-course sequence which together prepare students for engineering practice. This is a major team design experience. The projects are based on the knowledge and skills acquired in earlier course work and incorporates multiple design constraints. Team design projects are continued during the following semester. Team oral presentations and written reports are required.

*Learning Outcomes:* This course 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 function effectively in both thermal and mechanical systems.
e. An ability to apply knowledge and skills developed to model, analyse, design, and realize physical systems, components or processes.

*Course Objectives:* By the end of the course, students will be able to:
- Work in a team to execute a project
- Organize knowledge and skills acquired and incorporate multiple design constraints
- Design, manufacture and test a product in a team
- Work in a team to present oral project report
- Work in a team to present a written project report

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

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

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

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

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

**MEEN 402 Mechatronics (2-0-2)**

This course involves integration of mechanical, thermal, electrical and electronics engineering, programming and controls in the development of an electro-mechanical system. Topics explored include mechatronics systems control, sensors and actuators, analog and digital control, integration of sensors, actuators and microcomputers including programmable logic controllers, design and programming of industrial robots. Course project includes PCB Designs.

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

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

- Explain the programming and control of mechanical, thermal, electrical and electronics engineering systems
- Explain mechatronics systems control
- Describe sensors and actuators
- Identify analog and digital control systems
- Describe integration of sensors, actuators and microcomputers

**MEEN 412 Mechatronics Lab (0-2-1)**

This laboratory course supports the theories of Mechatronics. Experiments include: 1) Breadboard connections, LEDs, Diodes, Capacitors, Switches, Inductors etc., (using Arduino Kits); 2) Biasing circuits for BJTs and MOSFETs to control LED's; 3) Signal conditioning with Operational Amplifiers and Strain-gauges; 4) Logic gates circuits (Sensors as inputs and actuators as outputs); 5) DC Motor Control with the HBridge; 6) Introduction to C-programming for micro-controllers and PLCs.

*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:

- Test Breadboard connections, LEDs, Diodes, Capacitors, Switches, Inductors, etc.
- Analyse biasing of circuits for BJTs and MOSFETs to control LED's
- Analyse Signal conditioning with Operational Amplifiers and Strain-gauges
- Analyse Logic gates circuits (Sensors as inputs and actuators as outputs);
- Control DC Motor with the HBridge;
- Practice C-programming for micro-controllers and PLCs.

**MEEN 404 Fluid Machinery (2-0-2)**

This course deals with the theory and application for analyses and selection of turbines, pumps, fans, and compressors. Basic relations and applications: Blade theory and velocity triangles, impulse, and reaction machines. Design of turbo machinery, Positive displacement machines, and installation of pumps and turbines, and pump-system operations are covered.

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

a. Identify, formulate, and solve complex mechanical engineering problems by applying principles of engineering, science, and mathematics.
b. Work in thermal/fluid systems.

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

- Explain the theory and application of turbines, pumps, fans, and compressors.
- Explain the relations and applications of fluid machines.
- Apply the blade theory and velocity triangles,
- Explain impulse and reaction machines.
- Design turbo machines and positive displacement machines
- Install pumps and turbines.
- Operate pump-systems.

**MEEN 414 Fluid Machinery Laboratory (0-2-1)**

This laboratory course supports the theory of Fluid Machinery. Experiments include: performance characteristics study of centrifugal and axial flow pumps and fans as well as Francis and axial flow turbines under different operating conditions.

*Leaning 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:

- Determine the performance characteristics of centrifugal pumps.
- Determine the performance characteristics of axial flow pumps.
- Determine the performance characteristics of fans.
- Explain the performance characteristics of Francis turbines under various operating conditions.
- Explain the performance characteristics axial flow turbines under various operating conditions.

**MEEN 422 Air Conditioning and Refrigeration (1-2-2)**

This course covers of air conditioning and refrigeration. Practical refrigeration cycles, water refrigerators, absorption refrigerators, gas refrigeration cycles, fundamental properties of air and water vapour mixtures. Psychrometric chart and processes. Simple air conditioning systems. Air conditioning and refrigeration projects are assigned.

*Learning Outcome:* This course enables students to demonstrate an ability work in thermal/fluid systems

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

- Explain the fundamentals of air conditioning and refrigeration systems
- Describe practical refrigeration cycles,
- Identify water refrigerators,
- Describe absorption refrigerators,
- Describe gas refrigeration cycles,
- Explain the fundamental properties of air and water vapour mixtures

**MEEN 424 Renewable Energy Technology (1-2-2)**

This course deals with renewable energy conversion to fuels, heat and work. Characteristics and availability of solar radiation. Thermal design of flat plate collectors and application to water heating, distillation, etc. Photo-voltaic Conversion, sizing of PV components for DC and AC loads. Wind energy conversion, biomass conversion, ocean thermal energy conversion, tides and wave energy conversion.

*Learning Outcome:* This course enables students to demonstrate an ability to work in both thermal/fluid and mechanical systems.

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

- Explain renewable energy and their conversion to fuels, heat and work
- Discuss the characteristics and availability of solar radiation
- Design flat plate collectors for water heating and distillation
- Describe Photo-voltaic Conversion
- Size PV components for DC and AC loads

**MEEN 498 Capstone Project – Prototyping Phase (0-6-3)**

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

*Learning Outcome:* This course enables students to demonstrate:

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 function effectively in both thermal and mechanical systems.
e. An ability to apply knowledge and skills developed to model, analyse, design, and realize physical systems, components or processes.

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

- Work in a team to execute a project
- Organize knowledge and skills acquired and incorporate multiple design constraints
- Design, manufacture and test a product in a team
- Work in a team to present oral project report
- Work in a team to present a written project report

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

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

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

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

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

Industry Practical Training is a required component of the programme. All students must 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. Internship Requirements

| No | Internship | No. of Weeks | Student Requirement | Internship Grade |
|---|---|---|---|---|
| 1 | First Industrial Internship | 6 | Written Report and Industry assessment | Satisfactory (S)/Unsatisfactory(U) |
| 2 | Second Industrial Internship | 8 | Written Report and Industry assessment | Satisfactory (S)/Unsatisfactory(U) |
| 3 | Third Industrial 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 136 credit hours.

3. Successfully defend the Capstone Project.
4. Pass each subject with a minimum score of 45%.
5. Earn a minimum Cumulative GPA of 2.0.

**11.0 Employability of graduates – Give possibility of employability of students after graduation**
Mechanical engineers are employed in a variety of industries, such as: aerospace, automotive, chemical, construction, defence, electronics, consumer goods, marine, materials and metals, pharmaceuticals, rail, and utilities. Mechanical engineers can also work in non-engineering types of jobs, both within and outside of the engineering industry. These can be in areas such as finance, management, law, the military, government, medicine, research, technical sales, and technical consulting.

The Mechanical 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 and skills in the following areas:

1. Machine Design and Production Engineering
2. Fluid Mechanics and Machinery
3. Thermal Systems, Refrigeration and Air Conditioning

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

**12.2 Classroom Equipment and Resources**.
The classroom equipment 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 the table below.

Table 18. Available Classroom Resources

| ITEM | SPECIFICATION |
|---|---|
| PROJECTOR | • **Resolution:** 1920x1200 3LCD<br>• **Brightness:** 5000 ANSI Lumens<br>• **Light Source:** Laser<br>• **Throw Distance:** 2.7 m — 4.0 m<br>• **Image Size:**254cm<br>• **OR** |
| COMPUTER | I7 processor with quard core , 8 logical processors<br>HDD 1TB + /SSD 500<br>RAM 8GB +<br>8Generation |

<table>
<tr><td>CAMERA</td><td><ul><li>1080p HD video resolution</li><li>90-degree field of view</li><li>4x digital zoom</li><li>Right Light 2 Technology for a sharp video even in low-light conditions</li><li>Uvc H.264 Encoding for a smooth video stream</li></ul></td></tr>
<tr><td>SPEAKERS</td><td><table>
<tr><td>System Type</td><td>2 x 6.5inch, 2-way speaker</td></tr>
<tr><td>Frequency Response</td><td>80Hz -- 20 KHz ± 3dB</td></tr>
<tr><td>Sensitivity (1W/1M)</td><td>96dB.</td></tr>
<tr><td>Impedance</td><td>16 ohms</td></tr>
<tr><td>Rated Power</td><td>120W (RMS), 240W (PEAK).</td></tr>
<tr><td>Dispersion</td><td>90° (H) X 70° (V)</td></tr>
<tr><td rowspan="2">Drivers</td><td>LF driver 2 x 6.5' ' transducer (50mm) voice coil</td></tr>
<tr><td>HF driver 1' ' exit (34mm) voice coil.</td></tr>
<tr><td>Maximum SPL</td><td>116dB</td></tr>
<tr><td>Connectors</td><td>2 x Neutrik NL4.</td></tr>
<tr><td>Dimensions</td><td>(W) 180mm x (H) 540mm x (D) 215mm</td></tr>
</table></td></tr>
<tr><td>SOFTWARE</td><td><ul><li>Zoom for reliable, large video calls</li><li>Google Meet for G Suite users</li><li>GoToMeeting for professional features</li><li>join.me for a lightweight option</li><li>Webex for whiteboarding</li></ul></td></tr>
<tr><td>MICROPHONE</td><td><ul><li>Support Mode: Limit (1/2/3/4), FIFO (1/2/3/4)</li><li>Microphones can be operated on either their built-in rechargeable batteries</li><li>Wireless communication system</li><li>Operation distance up to 100 meters with the best condition</li><li>Builtin feedback eliminating technology which can decrease the feedba ck and noise effectively</li></ul></td></tr>
</table>

**12.3 Laboratory Equipment and Workshops**

The Mechanical Engineering Programme is supported by three (3) Workshops and five (5) Laboratories. The workshops are Automobile Workshop, Welding Shop, and Machine Shop. The Laboratories include Heat Transfer Lab, Hydraulics and Fluid Mechanics Lab, Refrigeration and Air Conditioning Lab, Thermodynamics Lab, and Applied Mechanics and Dynamics Lab. The items in each lab are listed in the Table below.

Table 19. Mechanical Laboratory and Shop Equipment

| S/N | Item Description |
|---|---|
| **Automobile Shop Equipment** | |
| 1 | 4 Stroke 6 Cylinder Petrol Engine (V-6) -- Motor Driven Actual Cut Section Working Model |
| 2 | 4 Stroke 6 Cylinder Diesel Engine -- Motor Driven Actual cut section working model |
| 3 | Car Steering System - Rack & Pinion Type |
| 4 | Car Steering System - Worm & Roller Type |
| 5 | Hydraulic Power Steering System of a Car- Actual Working Models |

| | |
|---|---|
| 6 | Synchro Mesh Gear Box with Clutch |
| 7 | Constant Mesh Gear Box (Actual Cut Section) |
| 8 | Automatic Gear Box - Actual Cut Section |
| 9 | Rear Axial Assembly with Differential Gear Fully Floating Type - Actual Cut Section Model |
| 10 | Mock Layout of Car Wiring Latest Type |
| 11 | Electronic Ignition System of An Automobile |
| 12 | Fully Automatic Battery Charger |
| 13 | Air Brake System of a Truck - Actual Working with Motorized Air Compressor |
| 14 | Anti-Lock Braking System (ABS) Trainer |
| 15 | Auto-Diagnostic tool |
| 16 | Vehicle Hoist |
| 17 | Automatic tyre changer |
| 18 | Radiator Pressure Gauge |
| 19 | Injector Cleaner |
| 20 | Wheel Balancer |
| 21 | Computerized injector tester |
| 22 | Advanced digital timing light |
| 23 | Engine Stand |
| 24 | Laser thermometer |
| 25 | Impact wrench |
| 26 | Air compressor |
| 27 | Combination Brake Lathe |
| 28 | Stand Jack |
| 29 | Waste oil collector |
| 30 | Hand tools set |
| 31 | High pressure car washer |
| 32 | Diesel fuel injector tester |
| 33 | Car AC Servicing Machine |
| 34 | Car body polisher |
| 35 | Car Vacuum cleaning machine |
| 36 | Bearing adapter kit |
| 37 | Piston ring clamp |
| 38 | Break caliper wind Back tool |
| 39 | Machinist Vise |
| 40 | Diesel smoke meter |
| 41 | Creeper |
| 42 | Auto Electrical hand tools set |
| 43 | Engine timing tools kits |
| 44 | Ball join tools set |

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| 45 | Automatic Wheel Alignment tool |
| 46 | Head and block re-surfacer |
| 47 | Digital diesel injection pump tester |
| 48 | Petrol Engine Test Bench |
| 49 | Diesel Engine Test Bench |
| 50 | Digital Hydraulic press |
| 51 | Engine Hoist |
| **Welding Shop Equipment** | |
| 52 | An Auto-Dimming Helmet |
| 53 | An Angle Grinder |
| 54 | Mig Pliers |
| 55 | Smart Mig welding machine |
| 56 | Pipe Cutting Machine |
| 57 | Welding Cutting Tool Kit |
| 58 | Hydraulic Tubing Bender |
| 59 | Stand Drilling Machine |
| 60 | Gas Welding Set |
| 61 | Bench Grinder |
| 62 | Welding clamps |
| 63 | Hand Tools |
| 64 | Leather Welding Gloves |
| 65 | Automatic Folding machine |
| 66 | Arc welding machine |
| **Machine Shop Equipment** | |
| 67 | Lathe machines |
| 68 | CNC lathe machines |
| 69 | Drilling machines |
| 70 | Turning machines |
| 71 | CNC milling machine |
| 72 | Grinding machine |
| 73 | Threading machine |
| 74 | Re-boring machine |
| 75 | End mill cutters |
| 76 | Angle grinder |
| 77 | Shaping machine |
| 78 | Band saw |
| 79 | Hand tool set |
| 80 | Machinist Vise |
| **Heat Transfer Laboratory Equipment** | |
| 81 | Composite Walls Apparatus |

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| 82 | Lagged Pipe Apparatus |
| 83 | Heat Pipe Apparatus |
| 84 | Natural Convection Apparatus |
| 85 | Forced Convection Apparatus |
| 86 | Heat Transfer in Agitated Vessel |
| 87 | Stefan Boltzmans Apparatus |
| 88 | Critical Heat Flux Apparatus |
| 89 | Shell & Tube Heat Exchanger (Water to Water) |
| 90 | Plate Type Heat Exchanger Apparatus |
| 91 | Thermal Conductivity of Metal Rod |
| 92 | Thermal Conductivity of Insulating Powder |
| **Fluid Mechanics Laboratory** | |
| 93 | Reynold's Apparatus |
| 94 | Verification of Bernoulli's Apparatus |
| 95 | Flow Over Notches Apparatus |
| 96 | Flow Measurement by Venturi meter & Orifice meter Apparatus |
| 97 | Losses in Pipe Fittings |
| 98 | Losses in Pipe Friction |
| 99 | Free & Forced Vortex Apparatus |
| 100 | Study of Flow Measurement Devices |
| 101 | Open Channel Apparatus |
| 102 | Pelton Wheel Turbine Test Setup - 1 HP |
| 103 | Francis Turbine Test Setup - 1 HP |
| 104 | Kaplan Turbine Test Setup - 1 HP |
| 105 | AC Motor & Pulley Type (1 H.P.) |
| 106 | Multistage Centrifugal Pump Test Rig |
| 107 | Gear Pump Test Rig |
| 108 | Hydraulic Ram Test Setup |
| 109 | Hydraulic Bench |
| **Refrigeration and Air Conditioning Lab** | |
| 110 | Refrigeration Trainer |
| 111 | Air Conditioning Trainer |
| 112 | Mechanical Heat Pump Trainer |
| 113 | Cold Storage Trainer |
| 114 | Refrigerant Charging Unit |
| 115 | Refrigeration & Air Conditioning Components- |
| **Thermo-Fluids Lab** | |
| 116 | Single Stage Air Compressor Test Rig |
| 117 | Centrifugal Blower Test Rig |
| 118 | Water Cooling Tower Apparatus |

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| 119 | Separating & Throttling Calorimeter with Boiler |
| 120 | Hydraulic Trainer Electrohydraulic |
| **Applied Mechanics, Dynamics Lab** | |
| 121 | Static & Dynamic Balancing Apparatus |
| 122 | Motorized Governor Apparatus |
| 123 | Cam Analysis Apparatus |
| 124 | Vibration Lab. (Complete 11 Experiment On 1 Frame) |
| 125 | Generation of Involute Gear Tooth Profile |
| 126 | Coriolis Component of Acceleration |
| 127 | Epicyclic Gear Train Holding Torque Apparatus |
| 128 | Journal Bearing Apparatus |

## 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. List of Textbooks and Recommended Readings

| No | Course No. | Course Title | Textbook/Readings |
|---|---|---|---|
| 1 | MEEN 121 | Introduction to Mechanical Engineering | Engineering Fundamentals and Problem Solving, Arvid Eide and Steven Mickelson and Roland Jenison and Larry Northup, McGraw-Jill, 8th Edition, 2022 |
| 2 | MEEN 102 | Introduction to Materials Science | Foundations of Materials Science and Engineering, William Smith and Javad Hashemi, McGraw-Hill, 7th Edition, 2022 |
| 3 | ENGL 102 | Technical Writing | Technical Writing for Engineers & Scientists, Leo Finkelstein and Jeanine Elise Aune and Leslie A. Potter McGraw-Hill, 4th Edition, 2022 |
| 4 | MATH 114 | Modeling with SolidWorks | Introduction to Solid Modeling Using SOLIDWORKS 2020, William Howard and Joseph Musto, McGraw-Hill, 16th Edition, 2020 |
| 5 | CHEM 101<br>CHEM 111 | Applied Chemistry<br>Applied Chemistry Lab | Chemistry: The Molecular Nature of Matter and Change, Martin Silberberg and Patricia Amateis, McGraw-Hill, 9th Edition, 2020 |
| 6 | ENGR 113 | Engineering Graphics | Blueprint Reading, Sam Kubba, McGraw-Hill, 1st Edition, 2008 |
| 7 | ENGR 103 | Introduction to Entrepreneurship | Lecture Notes |
| 8 | PHYS 102<br>PHYS 112 | Applied Physics<br>Applied Physics Lab | Physics, Alan Giambattista, McGraw-Hill, 5th Edition, 2019 |
| 9 | MEEN 112 | Mechanical Shop Practices | Technology Of Machine Tools, Steve Krar and Arthur Gill and Peter Smid and Robert J. Gerritsen, McGraw-Hill, 8th Edition, 2019 |
| 10 | MEEN 121 | Introduction to Mechanical Engineering | Ethics in Engineering, Mike Martin and Qin Zhu and Roland Schinzinger, McGraw-Hill, 5th Edition, 2021. |

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| 11 | ENGR 113 | Engineering Graphics | Introduction to Graphics Communications for Engineers, Gary Bertoline, McGraw-Hill, 5th Edition, 2021 |
| 12 | MATH 101<br>MATH 102 | Calculus I<br>Calculus II | Calculus, Robert T Smith and Roland Minton, McGraw-Hill, 4th Edition, 2011 |
| 13 | ENGL 101 | English Communication | English Language & Communication Skills, Michael Denison-George, 2020 |
| 14 | ENGR 111 | Introduction to ICT | Introduction to Information & Communications Technology, NOTES |
| 15 | ENGR 116 | Fundamentals of Innovation Project | Customer Integration in Industrial Innovation Projects, Patricia Sandmeier, Springer Fachmedien Wiesbaden, 2008 |
| 16 | MEEN 201 | Engineering Mechanics I: Statics | Engineering Mechanics: Statics, Russell Hibbeler, Prentice Hall, 2021 |
| 17 | MEEN 202 | Engineering Mechanics II Dynamics | Engineering Mechanics: Dynamics, Russell Hibbeler, Prentice Hall, 2021 |
| 18 | MATH 221 | Programming with MATLAB<br>OR<br>Numerical Methods | Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven Chapra, McGraw-Hill, 5th Edition, 2022 |
| 19 | ENGR 201 | Enterprise Development | Instructor Course Notes |
| 20 | MEEN 206<br>MEEN 216 | Strength of Materials<br>Strength of Materials Lab | Mechanics of Materials, Ferdinand Beer and E. Johnston and John DeWolf and David Mazurek, McGraw-Hill, 8th Edition, 2019 |
| 21 | MEEN 204<br>MEEN 214 | Fundamentals of Thermodynamics | Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, McGraw-Hill, 9th Edition, 2018 |
| 22 | MATH 202 | Differential Equations | Differential Equations with MATLAB, Brian R. Hunt, Ronald L. Lipsman, John E. Osborn, Jonathan M. Rosenberg, 2012 |
| 23 | ENGR 212 | Intermediate Innovation Project I | Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019 |
| 24 | MATH 201 | Mathematical Analysis | Applied Mathematics for Science and Engineering Larry A. Glasgow, 2014 |
| 25 | SOCI 201 | Principles of Sociology | Essential Concepts in Sociology, Philip W. Sutton and Anthony Giddens Wiley, 3rd Edition, 2021 |
| 26 | PSYC 202 | Introduction to Psychology | Introduction to Psychology, University of Minnesota Library Publishing Edition, 2015 |
| 27 | MEEN 302<br>MEEN 312 | Applied Thermodynamics | Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, McGraw-Hill, 9th Edition, 2018 |
| 28 | ECON 302 | Engineering Economic Analysis | Engineering Economy, Leland Blank and Anthony Tarquin, McGraw-Hill, 9th Edition, 2023 |
| 29 | MEEN 301<br>MEEN 311 | Fluid Mechanics<br>Fluid Mechanics Lab | Fluid Mechanics: Fundamentals and Applications, Yunus Cengel and John Cimbala, McGraw-Hill, 4th Edition, 2017 |

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|---|---|---|---|
| 30 | MATH 303 | Engineering Statistics | Statistics for Engineers and Scientists, William Navidi, McGraw-Hill, 6th Edition, 2023 |
| 31 | MEEN 306<br>MEEN 316 | Heat Transfer<br>Heat Transfer Lab | Heat and Mass Transfer: Fundamentals and Applications, Yunus Cengel and Afshin Ghajar, McGraw-Hill, 6th Edition, 2019 |
| 32 | ELEN 301/311 | Electric Circuit Analysis/Lab | Introduction to Electrical Circuit Analysis, Ozgur Ergul, Wiley, 2017 |
| 33 | ELEN 322 | Electric Machines | Electric Machines and Drives, Ned Mohan, Wiley, 2012 |
| 34 | MEEN 305/315 | Manufacturing Machines and Processes/Lab | Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Mikell Groover, Wiley, 7th edition, 2019 |
| 35 | MEEN 304 | Design of Machine Members | Shigley's Mechanical Engineering Design, McGraw-Hill, 11th edition, 2019 |
| 36 | ECON 301 | Principles of Microeconomics | Microeconomics, David Besanko, Ronald Braeutigam, Wiley, 6th Edition, 2020 |
| 37 | MEEN 303/313 | Engineering Materials | Callister's Materials Science and Engineering, Willima Callister and David Rethwisch, Wiley, 10th edition, 2020 |
| 38 | MEEN 302<br>MEEN 312 | Applied Thermodynamics | Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, McGraw-Hill, 9th Edition, 2018 |
| | ENGR 316 | Intermediate Innovation Project II | Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019 |
| 39 | MEEN 421 | Computer Aided Design and Manufacturing | Machining and CNC Technology, Michael Fitzpatrick, McGraw-Hill, 4th Edition, 2018 |
| 40 | MEEN 402 | Mechatronics | Introduction to Mechatronics and Measurement Systems, David Alciatore, McGraw-Hill, 5th Edition, 2018 |
| 41 | MEEN 403/413 | Pneumatics and Hydraulics | Hydraulics and Pneumatics, T. Jagadeesha, International Publishing House, 2015 |
| 42 | MEEN 404/414 | Fluid Machinery | Pumping Machinery Theory and Practice, Hassan Badr and Wael Ahmed, Wiley, 2016 |
| 43 | MEEN 422 | Air Conditioning and Refrigeration | Modern Refrigeration and Air Conditioning, Andrew D Althouse, Carl H Turnquist, Alfred F Bracciano, |
| 44 | MEEN 424 | Renewable Energy Technology | Renewable Energy Technologies: Advances and Emerging Trends for Sustainability, Nayan Kumar, Prabhansu, 2022 |
| 45 | MEEN 405 | Design and Selection of Machine Elements | Shigley's Mechanical Engineering Design, McGraw-Hill, 11th edition, 2019 |
| 46 | MEEN 401<br>MEEN 411 | Vibrations and Control<br>Vibrations and Control Lab | Vibration Analysis and Control, C. F. Beards, Ellis Horwood, 1995 |
| 47 | MEEN 497<br>MEEN 498 | Capstone Project | Engineering Design, George Dieter and Linda Schmidt, McGraw-Hill, 6th Edition, 2020 |

***13.2 Required teaching aids/materials***

Teaching aids are encouraged and provided per the subject area. For example, teaching aids for the automobile, thermodynamics and machine design courses include: 4 Stroke 6 Cylinder Petrol Engine (V-6) -- Motor Driven Actual Cut Section Working Model, 4 Stroke 6 Cylinder Diesel Engine -- Motor Driven Actual cut section working model, Car Steering System - Rack & Pinion Type, Car Steering System - Worm & Roller Type, Hydraulic Power Steering System of a Car- Actual Working Models, Synchro Mesh Gear Box with Clutch, Constant Mesh Gear Box (Actual Cut Section), Automatic Gear Box - Actual Cut Section, Rear Axial Assembly with Differential Gear Fully Floating Type - Actual Cut Section Model

**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 Mechanical 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 | = 93 Hours |
| Laboratory and Practical Hours | = 86 Hours |
| Total Contact Hours | = 179 Hours |
| Total Credit Hours | = 136 Hours |

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

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

| | |
|---|---|
| Continuous assessment | – 40% |
| Written Final Examination | – 60% |

Examinations and continuous assessments of laboratory and workshop practice courses may take the form of workshop/laboratory practical, open book and take-home exams, oral presentations, fabricated

products assessment, and written exams. Assessment of laboratory/workshop practice course shall consist of:

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

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

***17.1 Letter Grades***

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

Table 21. Grading Scheme

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

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

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

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

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

| No | Full Name | Sex M/F | Status FT/PT | Rank | Qualification (starting from highest indicating title of programme, institution of award, year of award and place) | Area of specialization | Courses Taught | Teaching Experience |
|---|---|---|---|---|---|---|---|---|
| **1** | Albert Kojo SUNNU | M | FT | Associate Professor | PhD Mechanical Eng, Universite du Sud, France, 2006 | Thermo-fluids and Energy systems | Fluid Mechanics, Thermodynamics, Engineering Technology | 23 years |
| **2** | Paul Victor Jattah | M | FT | Lecturer (On Study Leave) | PhD – Mech. Eng, Kwame Nkrumah University of Science and Technology, Ghana/ In Progress | Mechanical Engineering | Mechanics, Design, Manufacturing | 12 years |
| **3** | Seedy Fofana | M | FT | Lecturer (On Study Leave) | PhD – Mech. Eng, Kwame Nkrumah University of Science and Technology, Ghana/ In Progress | Mechanical Engineering | Thermodynamics, Heat Transfer, Fluid Mechanics | 13 years |
| **4** | Amadou Cham | M | FT | Lecturer (On Study Leave) | PhD- Mathematical Sciences, Kwame Nkrumah University of Science and Technology, Ghana/ In Progress | Mathematics | Calculus, Statistics, Mathematical Analysis | 13 years |
| **5** | Lamin Cham | M | FT | Lecturer (On Study Leave) | PhD – Mathematics Sciences, Kwame Nkrumah University of Science and Technology, Ghana/ In Progress | Mathematical Sciences | Calculus, Mathematical Analysis, Differential Equations | 12 years |
| **6** | Lamin Darboe | M | PT | Lecturer (On Study Leave) | PhD – Materials Eng, Kwame Nkrumah University of Science and Technology, Ghana/ In Progress | Materials Engineering | Fundamentals of Materials Science, Engineering Materisls | 1 year |
| **7** | Isatou Dibba | F | PT | Adjunct Lecturer | MSc-Photonics and Optoelectronics, National Taiwan University, 2009 | Electronics | Introduction to EE; Electrical/Electronic Circuits | 4 years |
| **8** | Gbemileke Solomon Ayedun | M | PT | Adjunct Lecturer | MSc – Industrial Chemistry, Federal University of Agriculture, 2018 | Industrial Chemistry | Chemistry; Materials Science | 5 years |
| **9** | Musa FM Danso | M | PT | Adjunct Lecturer | MA – English Language, Literature and Development Studies, University of The Gambia, 2010 | English Language | English Communication; Technical Report Writing | 12 years |
| **10** | Alhagie Hydara | M | FT | Lecturer | MSc- Mathematical Sciences, African Institute of Mathematica Sciences, Rwanda, 2020 | Mathematical Sciences | Calculus; Mathematics | 6 years |

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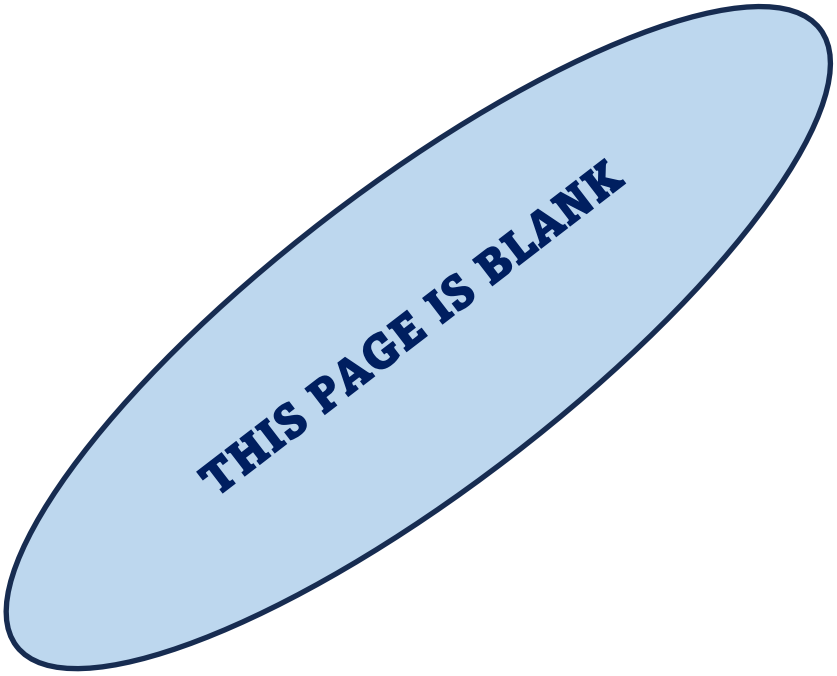
|---|---|---|---|---|---|---|---|---|
| **11** | Ballu Christopher Junior | M | FT | Lecturer | MSc; Civil Engineering, Government Technical Institute, Sierra Leone, 2021 | Civil Engineering | Engineering Graphics, Introduction to Engineering | 5 years |
| **12** | Ikonne Ozioma | M | FT | Principal Lecturer | PhD – Marketing Management, University of KwaZulu, South Africa, 2022 | Innovation and Entrepreneurship | Entrepreneurship | 6 years |
| **13** | Gaston Mendy | M | FT | Principal Lecturer | MSc Computer Science | Computer Science | ICT, Computer Graphics | 8 years |
| **14** | Silfat A. Jubril Sanni | F | FT | Principal Lecturer | MSc Computer Science | Management Information Systems | ICT, Engineering Graphics | 4 years |
| **15** | Mbye Sowe | M | PT | Adjunct Principal Lecturer | MSc – Electrical Engineering (Telecommunication), Pan African University, Pausti, 2022 | Electrical Engineering | Electrical/Electronic Circuits | 2 years |
| **16** | UTO, Oghenekevwe Timothy | M | PT | Adjunct Lecturer | PhD – Condensed Matter Physics, Federal University of Agriculture, Nigeria, 2012 | Physics | Physics | 4 years |
| **17** | Adefila, Adebimpe Moyosore | F | FT | Lecturer | MSc – Water Resources and Environment, Ahmadu Bello University, Zaria, 2018 | Water resources and Environmental Engineering | Various Civil Engineering Courses | 4 years |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