PROSPECTUS OF MECHANICAL ENGINEERING UNDERGRADUATE DEGREE PROGRAMMES

Department of Mechanical Engineering,
University of Nigeria, Nsukka
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2023

UNIVERSITY OF NIGERIA

DEPARTMENT OF MECHANICAL ENGINEERING

FACULTY OF ENGINEERING

PROSPECTUS OF MECHANICAL ENGINEERING UNDERGRADUATE DEGREE PROGRAMMES

Contents

Chapter 1 – Introduction

1.1 Brief History of the Department

The Department of Mechanical Engineering grew out of the Agbebi College of Engineering (1961), graduating her own first candidates (13 in number) in June 1966. For the period 1961 – 1967 the bulk of the academic and senior technical staff were derived from the Michigan State University under a USAID agreement. Much aid was also received the through Dutch Technical Assistance Programme. The first Nigerian Senior Academic Staff joined the Department in 1964 and have grown steadily in number since then. The Mechanical Engineering Workshop/Laboratories were completed in the 1964/65 academic year and presently comprise four sections namely, the Workshop, Design and Mechanics, Thermofluids, and the Foundry/Materials sections.

Student Projects and Staff Research Activities have had a rapid upsurge in growth. These started with concerted efforts to effect physical repairs of war-damaged equipment but have since grown over the years to cover many facets of Mechanical Engineering problems. Most of these efforts have been directed to solving problems of particular relevance to Nigeria. Projects are compulsory in the final year and have included: design of unmanned aerial vehicles (UAVs), thermoelectric systems, advanced manufacturing, mechatronic systems, clean energy (solar, wind and biomass) systems, as well as computational fluid dynamic (CFD) studies.

Students and graduates of the department receive supports from various establishments and companies in the form of grants, scholarships, prizes and job opportunities. Donors include Shell B.P., Chevron, Agip, Mobil, Dangote, U.A.C., Schlumberger, NLNG, MTN, Future Concerns Limited, and many others.

1.2 Programme Philosophy

The philosophy of our programmes is to produce self-reliant and confident graduates who can bring their academic and practical backgrounds to bear on the problems of industry and the larger Nigerian society. The academic programme has been planned to challenge and encourage students towards developing ingenuity and originality in problem solving. The cornerstone of this is an early grounding in the basic engineering sciences and a strong emphasis on applied design in later years.

1.3 Programme Objectives

The objectives of the Mechanical Engineering undergraduate programmes are to prepare its graduates to:

- Actively engage in engineering practice or in other fields, such as education, science, business, public policy, politics or governance for sustainable development.
- Retain intellectual curiosity that will motivate them to pursue meaningful lifelong learning via graduate education in engineering or related fields, participation in professional development and/or industrial training courses, and/or obtain engineering certification.
- Develop successful careers as mechanical engineers and apply their mechanical engineering education to address the full range of technical and societal problems with professional engineering competence, creativity, imagination, confidence and responsibility.
- Occupy positions of increasing responsibility and/or assignments and aspire to positions of leadership within their profession for enhanced community participation and qualitative service delivery.
- Exhibit the highest ethical and professional standards, and, as agents of positive change, communicate the importance and excitement of Mechanical Engineering.

1.4 Scope

In line with modern global trends in Mechanical Engineering curriculum development, the Department is presently making vigorous attempts to teach specialist options in its academic curricula. These include options in Thermal and Fluids Engineering (Energy and Power), Design and Manufacturing Engineering, Industrial Engineering and Management Sciences, and Applied Mechanics.

1.5 Job Opportunities

Graduates of this programme will find jobs in diverse sectors – in the automobile, aerospace, biomedical, building and construction, food and beverages, manufacturing, oil and gas, power, petrochemical and process, railway and telecommunication industries. Graduates of this programme may end up as industrial systems engineers, product designers, managers, researchers, applied mathematicians, and, of course, performing a multitude of other traditional Mechanical Engineering duties. This programme offers students skills that are highly sought after and highly remunerated in industry. It will prepare them to

undertake the challenge of working on a wide range of projects, with the prospect of working with a broad spectrum of other professionals.

1.6 Admission Requirements

1.6.1 Five – Year Programme

Candidates are admitted into the five-year standard Bachelor of Engineering, B. Eng (Hons) degree in Mechanical Engineering either through the UTME entrance examination or by Direct Entry.

i. Candidates for admission through the UTME should, in addition to the general university entry requirements, have passed the Senior Secondary Certificate Exam (SSCE), General Certificate of Education (GCE) O' Level or their equivalents, with credits in at least five (5) papers, including Mathematics, Physics, Chemistry and English Language, obtained in not more than two sittings.

ii. Candidates with a recognized Ordinary National Diploma in a science or technology discipline at the minimum of Upper Credit level may be considered for Direct Entry admission on their individual merits. Such candidates must also have passed the SSCE, GCE O' Level or their equivalents, with credits in at least five (5) papers, including Mathematics, Physics, Chemistry and English Language, obtained in not more than two sittings.

1.6.2 Four – Year Programme

Candidates are admitted into the four-year standard Bachelor of Engineering, B. Eng (Hons) degree in Mechanical Engineering by Direct Entry only. In addition to the general university entry requirements, candidates for admission into the programme must have obtained the General Certificate of Education (GCE) A' Levels or its equivalents with passes in Mathematics (or Further Mathematics), Physics and Chemistry, obtained in a single sitting. Such candidates must also have passed the SSCE, GCE O' Level or their equivalents, with credits in at least five (5) papers, including Mathematics, Physics, Chemistry and English Language, obtained in not more than two sittings.

1.6.3 Three – Year Programme

Candidates are admitted into the three-year standard Bachelor of Engineering, B. Eng (Hons) degree in Mechanical Engineering by Direct Entry only. In addition to the general university entry requirements, candidates who have obtained a recognized Higher National Diploma (HND) in an Engineering or Technology discipline or its equivalent at the minimum of Upper Credit level may be considered for admission into the programme on their individual merits. Such candidates must also have passed the SSCE, GCE O' Level or their equivalents, with credits in at least five (5) papers, including Mathematics, Physics, Chemistry and English Language, obtained in not more than two sittings.

1.7 Stress Areas

General Courses	0
Engineering Drawing, Design, Workshop and Manufacturing	1
Laboratory Courses	2
Mechanics of Materials, Engineering Materials and Metallurgy	3
Mechanics of Machines, Vibrations and Control	4
Mechanics of Fluids	5
Engineering Thermodynamics	6
Heat and Mass Transfer	7
Engineering Law, Management and Economics, Technology Policy	8
Project	9

1.8 Staff

1.8.1 Academic Staff

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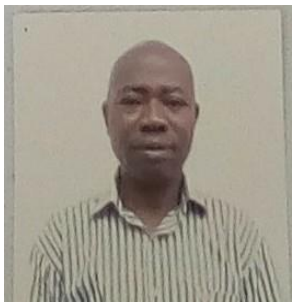

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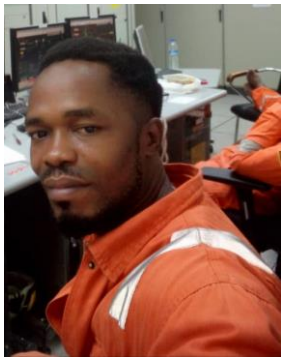

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2. Chapter 2 – Undergraduate Programmes & Course Listings

2.1 Five - Year Undergraduate Programme

2.1.1 First Year Courses

First Semester

Course No.	Course Title	Units
Required Ancilliary Courses:		
CHM 101	Basic Principles of Chemistry I	2
CHM 171	Basic Practical Chemistry	2
EGR 101	Introduction to Engineering	2
MTH 111	Elementary Mathematics I	3
MTH 121	Elementary Mathematics II	3
PHY 121	Fundamentals of Physics I	3
PHY 195	Practical Physics II	2
General Studies Courses:		
GSP 101	Use of English	2
GSP 111	The Use of Library and Study Skills	2
	Total	**21**

Second Semester

Required Ancilliary Courses:		
CHM 112	Basic Principles of Chemistry II	2
CHM 122	Basic Principles of Organic Chemistry	2
EGR 102	Applied Mechanics	3
MTH 122	Elementary Mathematics III	3
PHY 116	General Physics for Physical Science II	2
PHY 124	Fundamentals of Physics III	3
General Studies Course:		
GSP 102	Use of English II	2
	Total	**17**

2.1.2 Second Year Courses

First Semester

Course No.	Course Title	Units
Major Courses:		
MEE 211	Engineering Drawing I	2
MEE 261	Engineering Thermodynamics I	2
Required Ancilliary Courses:		
EGR 201	Materials Science	2
EGR 203	Materials Science Laboratory	1
CVE 211	Strength of Materials I	2
CVE 213	Strength of Materials Laboratory I	1
EEE 211	Basic Electrical Engineering	3
MTH 207	Advanced Mathematics VII	2
General Studies Courses:		
GSP 201	The Social Sciences	2
GSP 207	Logic, Philosophy and Human Existence	2
	Total	**19**

Second Semester

Major Courses:		
MEE 202	Computing and Programming for Mechanical Engineers	3
MEE 204	Computing and Programming Laboratory	1
MEE 212	Workshop Technology	2
Required Ancilliary Courses:		
CVE 222	Fluid Mechanics I	2
CVE 224	Fluid Mechanics Laboratory	1
EEE 252	Basic Electrical Engineering Lab/Practice	1
MTH 206	Advanced Mathematics VI	2
MTH 208	Advanced Mathematics VIII	2
General Studies Courses:		
GSP 202	Issues in Peace and Conflict Resolution Studies	2
GSP 208	Nigerian Peoples and Culture	2
	Total	**18**

2.1.3 Third Year Courses

Course No.	Course Title	Units
First Semester		
Major Courses:		
MEE 311	Manufacturing Processes	2
MEE 313	Mechanical Engineering Design I	3
MEE 315	Workshop Practice	1
MEE 321	Thermo-Fluids Laboratory I	1
MEE 323	Mechanics of Machines Laboratory I	1
MEE 341	Mechanics of Machines I	2
MEE 343	Measurement and Instrumentation	2
MEE 351	Mechanics of Fluids	2
MEE 361	Engineering Thermodynamics II	2
Required Ancilliary Courses:		
CED 341	Introduction to Entrepreneurship I	2
STA 205	Statistics for Physical Sciences and Engineering I	2
	Total	**20**

Second Semester		
Major Courses:		
MEE 312	Computer-Aided Design and Manufacture	2
MEE 314	Engineering Drawing II	2
MEE 322	Mechanics of Materials Laboratory	1
MEE 324	CAD/CAM Laboratory	1
MEE 332	Mechanics of Materials I	3
MEE 372	Heat and Mass Transfer I	2
Required Ancilliary Courses:		
CED 342	Introduction to Entrepreneurship II	2
EEE 312	Electrical Engineering II	3
EGR 302	Engineering Analysis	4
	Total	**20**

2.1.4 Fourth Year Courses

Course No.	Course Title	Units
First Semester		
Major Courses:		
MEE 413	Mechanical Engineering Design II	3
MEE 421	Thermo-Fluids Laboratory II	1
MEE 423	Mechanics of Machines Laboratory II	1
MEE 425	Heat and Mass Transfer Laboratory	1
MEE 441	Mechanics of Machines II	2
MEE 443	Automatic Control	3
MEE 451	Applied Fluid Mechanics	2
MEE 461	Engineering Thermodynamics III	2
MEE 471	Heat and Mass Transfer II	2
MEE 481	Technology Development Policy	2
Required Ancilliary Course:		
EGR 401	Computational Methods	3
	Total	**22**
Second Semester		
Major Courses:		
MEE 402	Written Technical Communication	2
MEE 404	Seminar Presentation Skills	1
MEE 412	Computer Aided Design Practice	2
Required Ancilliary Course:		
EGR 402	SIWES	10
	Total	**15**

2.1.5 Fifth Year Courses

Course No.	Course Title	Units
First Semester		
Major Courses:		
MEE 511	Applied Design	3
MEE 531	Mechanics of Materials II	3
MEE 551	Fluid Dynamics	3
MEE 561	Engineering Thermodynamics IV	3
Two (2) elective courses (6 units) should be chosen from the student's option area.		
A. Thermal and Fluids Engineering Option		
MEE 555	Aerospace Engineering Fundamentals	3
MEE 557	Fluid Power Transmission Systems	3
MEE 563	Automotive Engine Fundamentals	3
MEE 565	Fundamentals of Nuclear Engineering	3
MEE 569	Direct Energy Conversion Principles	3
MEE 572	Thermal Engineering and Advanced Heat Transfer	3
B. Design, Materials and Manufacturing Engineering Option		
MEE 513	Manufacturing and Tools Engineering	3
MEE 515	Design of Welded and Cast Structures	3
MEE 533	Engineering Metallurgy	3
MEE 541	Systems Engineering	3
MEE 543	Vibrations and Control	3
MEE 545	Mechatronics	3
MEE 547	Automobile Engineering	3
MEE 581	Quality Assurance and Reliability	3
	Total	**18**
Second Semester		
Major Courses:		
MEE 534	Materials for Engineering Applications	3
MEE 582	Engineering Law	2
MEE 584	Engineering Management	2
MEE 586	Engineering Economy	3
MEE 592	B.Eng. Project	6
One (1) elective course (3 units) should be chosen from the student's option area.		
A. Thermal and Fluids Engineering Option		
MEE 552	Computational Fluid Dynamics	3
MEE 562	Refrigeration and Air-Conditioning	3
MEE 568	Power Plant Engineering	3

B. Design, Materials and Manufacturing Engineering Option

MEE 512	Design of Pressure Vessels	3
MEE 532	Theory of Elasticity	3
MEE 536	Introduction to Composite Materials	3
	Total	**19**

2.2 Four - Year Undergraduate Programme

2.2.1 First Year Courses

First Semester

Course No.	**Course Title**	**Units**
Major Courses:		
MEE 211	Engineering Drawing I	2
MEE 261	Engineering Thermodynamics I	2
Required Ancilliary Courses:		
EGR 101	Introduction to Engineering	2
EGR 201	Materials Science	2
EGR 203	Materials Science Laboratory	1
CVE 211	Strength of Materials I	2
CVE 213	Strength of Materials Laboratory I	1
EEE 211	Basic Electrical Engineering	3
MTH 207	Advanced Mathematics VII	2
General Studies Courses:		
GSP 101	Use of English	2
GSP 111	The Use of Library and Study Skills	2
GSP 201	The Social Sciences	2
	Total	**23**

Second Semester

Major Courses:

MEE 202	Computing and Programming for Mechanical Engineers	3
MEE 204	Computing and Programming Laboratory	1
MEE 212	Workshop Technology	2

Required Ancilliary Courses:

CVE 222	Fluid Mechanics I	2
CVE 224	Fluid Mechanics Laboratory	1
EEE 252	Basic Electrical Engineering Lab/Practice	1
EGR 102	Applied Mechanics	3
MTH 206	Advanced Mathematics VI	2
MTH 208	Advanced Mathematics VIII	2

General Studies Courses:

GSP 102	Use of English II	2
GSP 202	Issues in Peace and Conflict Resolutoin Studies	2
	Total	**21**

2.2.2 Second Year Courses

Course No.	**Course Title**	**Units**
First Semester		
Major Courses:		
MEE 311	Manufacturing Processes	2
MEE 313	Mechanical Engineering Design I	3
MEE 315	Workshop Practice	1
MEE 321	Thermo-Fluids Laboratory I	1
MEE 323	Mechanics of Machines Laboratory I	1
MEE 341	Mechanics of Machines I	2
MEE 343	Measurement and Instrumentation	2
MEE 351	Mechanics of Fluids	2
MEE 361	Engineering Thermodynamics II	2

Required Ancillary Courses:

CED 341	Introduction to Entrepreneurship I	2
STA 205	Statistics for Physical Sciences and Engineering I	2

General Studies Course:

GSP 207	Logic, Philosophy and Human Existence	2
	Total	**22**

Second Semester

Major Courses:

MEE 312	Computer-Aided Design and Manufacture	2
MEE 314	Engineering Drawing II	2
MEE 322	Mechanics of Materials Laboratory	1
MEE 324	CAD/CAM Laboratory	1
MEE 332	Mechanics of Materials I	3
MEE 372	Heat and Mass Transfer I	2

Required Ancilliary Courses:

CED 342	Introduction to Entrepreneurship II	2
EEE 312	Electrical Engineering II	3
EGR 302	Engineering Analysis	4

General Studies Course:

GSP 208	Nigerian Peoples and Culture	2
	Total	**22**

2.2.3 Third Year Courses

Course No.	Course Title	Units
First Semester		
Major Courses:		
MEE 413	Mechanical Engineering Design II	3
MEE 421	Thermo-Fluids Laboratory II	1
MEE 423	Mechanics of Machines Laboratory II	1
MEE 425	Heat and Mass Transfer Laboratory	1
MEE 441	Mechanics of Machines II	2
MEE 443	Automatic Control	3
MEE 451	Applied Fluid Mechanics	2
MEE 461	Engineering Thermodynamics III	2
MEE 471	Heat and Mass Transfer II	2
MEE 481	Technology Development Policy	2
Required Ancilliary Course:		
EGR 401	Computational Methods	3
	Total	**22**
Second Semester		
Major Courses:		
MEE 402	Written Technical Communication	2
MEE 404	Seminar Presentation Skills	1
MEE 412	Computer Aided Design Practice	2
Required Ancilliary Course:		
EGR 402	SIWES	10
	Total	**15**

2.2.4 Fourth Year Courses

Course No.	Course Title	Units
First Semester		
Major Courses:		
MEE 511	Applied Design	3
MEE 531	Mechanics of Materials II	3
MEE 551	Fluid Dynamics	3
MEE 561	Engineering Thermodynamics IV	3
Two (2) elective courses (6 units) should be chosen from the student's option area.		
A. Thermal and Fluids Engineering Option		
MEE 555	Aerospace Engineering Fundamentals	3
MEE 557	Fluid Power Transmission Systems	3
MEE 563	Automotive Engine Fundamentals	3
MEE 565	Fundamentals of Nuclear Engineering	3
MEE 569	Direct Energy Conversion Principles	3
MEE 572	Thermal Engineering and Advanced Heat Transfer	3
B. Design, Materials and Manufacturing Engineering Option		
MEE 513	Manufacturing and Tools Engineering	3
MEE 515	Design of Welded and Cast Structures	3
MEE 533	Engineering Metallurgy	3
MEE 541	Systems Engineering	3
MEE 543	Vibrations and Control	3
MEE 545	Mechatronics	3
MEE 547	Automobile Engineering	3
MEE 581	Quality Assurance and Reliability	3
	Total	**18**
Second Semester		
Major Courses:		
MEE 534	Materials for Engineering Applications	3
MEE 582	Engineering Law	2
MEE 584	Engineering Management	2
MEE 586	Engineering Economy	3
MEE 592	B.Eng. Project	6
One (1) elective course (3 units) should be chosen from the student's option area.		
A. Thermal and Fluids Engineering Option		
MEE 552	Computational Fluid Dynamics	3
MEE 562	Refrigeration and Air-Conditioning	3
MEE 568	Power Plant Engineering	3

B. Design, Materials and Manufacturing Engineering Option

MEE 512	Design of Pressure Vessels	3
MEE 532	Theory of Elasticity	3
MEE 536	Introduction to Composite Materials	3
	Total	**19**

2.3 Three - Year Undergraduate Programme.

2.3.1 First Year Courses

Course No.	**Course Title**	**Units**
First Semester		
Major Courses:		
MEE 313	Mechanical Engineering Design I	3
MEE 351	Mechanics of Fluids	2
MEE 361	Engineering Thermodynamics II	2
Required Ancilliary Courses:		
CED 341	Introduction to Entrepreneurship I	2
STA 205	Statistics for Physical Sciences and Engineering I	2
MTH 207	Advanced Mathematics VII	2
General Studies Course:		
GSP 101	Use of English	2
GSP 111	The Use of Library and Study Skills	2
GSP 201	The Social Sciences	2
GSP 207	Logic, Philosophy and Human Existence	2
	Total	**21**

Second Semester

Major Courses:

MEE 202	Computing and Programming for Mechanical Engineers	3
MEE 204	Computing and Programming Laboratory	1
MEE 372	Heat and Mass Transfer I	2

Required Ancilliary Courses:		
CED 342	Introduction to Entrepreneurship II	2
MTH 206	Advanced Mathematics VI	2
MTH 208	Advanced Mathematics VIII	2
General Studies Course:		
GSP 102	Use of English II	2
GSP 202	Issues in Peace and Conflict Resolution Studies	2
GSP 208	Nigerian Peoples and Culture	2
	Total	**18**

2.3.2 Second Year Courses

Course No.	**Course Title**	**Units**
First Semester		
Major Courses:		
MEE 311	Manufacturing Processes	2
MEE 341	Mechanics of Machines I	2
MEE 343	Measurement and Instrumentation	2
MEE 413	Mechanical Engineering Design II	3
MEE 443	Automatic Control	3
MEE 451	Applied Fluid Mechanics	2
MEE 461	Engineering Thermodynamics III	2
MEE 481	Technology Development Policy	2
Required Ancilliary Course:		
EGR 401	Computational Methods	3
	Total	**21**

Second Semester

Major Courses:

MEE 312	Computer-Aided Design and Manufacture	2
MEE 324	CAD/CAM Laboratory	1
MEE 332	Mechanics of Materials I	3
MEE 402	Written Technical Communication	2
MEE 404	Seminar Presentation Skills	1
MEE 412	Computer Aided Design Practice	2

Required Ancilliary Course:

EEE 312	Electrical Engineering II	3
EGR 302	Engineering Analysis	4
	Total	**18**

2.3.3 Third Year Courses

Course No.	**Course Title**	**Units**

First Semester

Major Courses:

MEE 441	Mechanics of Machines II	2
MEE 471	Heat and Mass Transfer II	2
MEE 511	Applied Design	3
MEE 531	Mechanics of Materials II	3
MEE 551	Fluid Dynamics	3
MEE 561	Engineering Thermodynamics IV	3

One (1) elective course (3 units) should be chosen from the student's option area.

A. Thermal and Fluids Engineering Option

MEE 555	Aerospace Engineering Fundamentals	3
MEE 557	Fluid Power Transmission Systems	3
MEE 563	Automotive Engine Fundamentals	3
MEE 565	Fundamentals of Nuclear Engineering	3
MEE 569	Direct Energy Conversion Principles	3

B. Design, Materials and Manufacturing Engineering Option

MEE 513	Manufacturing and Tools Engineering	3
MEE 515	Design of Welded and Cast Structures	3
MEE 533	Engineering Metallurgy	3

MEE 541	Systems Engineering	3
MEE 545	Mechatronics	3
MEE 547	Automobile Engineering	3
MEE 581	Quality Assurance and Reliability	3
	Total	**19**

Second Semester

Major Courses:

MEE 534	Materials for Engineering Applications	3
MEE 582	Engineering Law	2
MEE 584	Engineering Management	2
MEE 586	Engineering Economy	3
MEE 592	B.Eng. Project	6

One (1) elective course (3 units) should be chosen from the student's option area.

A. Thermal and Fluids Engineering Option

MEE 552	Computational Fluid Dynamics	3
MEE 562	Refrigeration and Air-Conditioning	3
MEE 568	Power Plant Engineering	3

B. Design, Materials and Manufacturing Engineering Option

MEE 512	Design of Pressure Vessels	3
MEE 532	Theory of Elasticity	3
MEE 536	Introduction to Composite Materials	3
	Total	**19**

Chapter 3 – Course Description

3.1 1XX Series Courses

EGR 101: Introduction to Engineering **2 Units**

An overview of engineering as a profession: Historical perspective, Discipline, Remuneration, professional affiliations, professional journey, successful studentship, creativity, roles of science and Technology; Engineering and Society: The role of engineers in nation building, Negative impacts of Engineering practice and mitigation measures, professional challenges in Nigeria, reduction of professional risks; Basic information on Agricultural and Bioresources Engineering. Scope of Agricultural and Bioresources Engineering, Professional practice, Sustainable Agricultural production in Nigeria. A historic perspective of Civil Engineering, corporate personality of Civil Engineering, Civil Engineering professional practice. Basic information on Electrical Engineering, Scope of Electrical Engineering professional practice, Electric power generation in Nigeria; evolution in Electronic Engineering, Scope of Electronic Engineering Professional practice, practice of Electronic Engineering in Nigeria. Basic information on Mechanical Engineering, Scope of Mechanical Engineering professional practice, practice of Mechanical Engineering in Nigeria. Basic information on Metallurgical and Materials, Scope of Metallurgical and Materials Engineering professional practice, practice of Metallurgical and Materials Engineering.

MTH 111 General Mathematics I **3 Units**

Elementary sets Theory, Subsets, Union, Intersection, Compliments. Venn diagrams, Real Numbers, Integers. Rational and Irrational numbers. Mathematical inductions, Real sequencies and Series. Theory of quadratic equation, Binomial Theorem. Complex numbers, Algebra of complex numbers. The Argand diagram. De Moivre's Theorem, n^{th} roots of Unity. Circular measure. Trigonometric functions of angles of any magnitude. Addition and factor formulae.

MTH 121 General Mathematics **3 Units**

Function of a real variable, graphs, limits and continuity. The derivative as limits of rate of change. Differentiation, Techniques of Differentiation, Curve sketching. Integration. Definite integrals. Application of Integration to areas and volumes.

CHM 101 Basic Principles Of Chemistry I **2 Units**

An introduction to atomic structure. Development of configuration of the elements. Stoichiometry and mole concept. Electronic Theory of Valency. Chemical bonding. The periodic classification of the elements. General study of one or two representative elements or groups in the periodic Table, with emphasis on similarities and differences, based on the position of the element in the periodic Table. Radioactivity and its applications. Structure of Solids.

CHM 171 Basic Practical Chemistry 2 Units

The Theory and practice of simple volumetric and qualitative analysis. Simple organic preparations, Reactions of functional groups and physical determinations.

PHY 121 Fundamentals Of Physics I 3 Units

Units and dimensions. Vector algebra. Kinematics and dynamics of a mass point; laws of mechanics and gravitation, Kepler's Laws. Motion of rigid bodies, moment of inertia; angular momentum- conservation laws. Simple Harmonic motion. Elastic properties of solids, moduli of elasticity. Surface tension, viscosity. Fluid mechanics and hydrodynamics. Ideal gas laws. Kinetic theory of gases.

PHY 195 Practical Physics 1I 2 Units

Selected Experiments from the 100 – Level courses in Physics for Physics majors and Engineering students.

GSP 101 Use Of English I 2 Units

Man, Society and Language - The Nature, Characteristics and Functions of Language, Human Communication & Language, The English Language and the Nigerian society, World English, Levels and Varieties of English —formal, informal, standard, etc. , English in Literature and the Media

Vocabulary of English - Types , Method of Vocabulary Development , Synonyms, Antonyms, Homonyms, Acronyms, Paronyms , Affixation and other morphological processes , English Language Register, diatypes and dialects

Listening skill - The listening skill discussed as a receptive and reciprocal activity, Nature, Types, Purposes and Factors that affect Listening, Strategies and Aids for Effective Listening

Reading Skill - The concept of reading as a linguistic organization and a vehicle of communication , Reading Problems, Levels of Reading, Types of Reading, Causes and Remedies of Reading Failures, Reading Techniques & Strategies (Scanning, Skimming , Phrase reading , Intensive & Extensive reading , Exploiting the topic sentence for main ideas, Reading for details , Reading for evaluation and inference, Reading with questions – SQ3R, PR3, Methods for understanding difficult words in a reading text, Literature reading for study, analysis and comment

Speaking & Communication Skills - Nature, Process & Development, Principles of Public Speech Making and Social Interaction, The Speech Sounds of English and their Articulation, Phonetic Transcription and Practical Speech Work

Study Techniques - Choosing study venues and discussion groups , Note-taking during lectures, and from audio-visual equipment, Note-making techniques during private reading and literature search, Summary & Transcoding Techniques , Retrieving information from notes , The dictionary as a study guide

Basic Research Methods & Term Paper Writing - Research — meaning & nature , Types & Methodology, Data in the Research Process , The Research Report, Process and Techniques , Documentation in Research, Process, Types, and Methods , Abbreviations in Research Reports , The term paper as a miniature research report, Practical term paper writing

Course Evaluation & Grading - Students **must** attend at least 75% of the le ctures to qualify for examination in the course, Grades in the course will be awarded as follows: (a) 30 marks for continuous assessment, which comprises class assignments and the term paper, (b)70 marks for a final end-of-semester examination, Students **must** participate and obtain marks in the two assessment categories to earn a final grade in the course.

GSP 111 The Use of Library And Study Skills 2 Units

Overview of Library - concept, history, types and functions; Users in academic libraries – organization of university library, and library users; Library processes and procedures - Acquisition process, Cataloging and classification, LC Scheme, in-House Scheme, DDC, Serials process, circulation process; Access tools to library resources - Library catalogues, Indexes, Abstracts, Current contents, Serials catalogue/Kardex ; Categorization of sources of information in the library – forms of information sources, types of information sources; Reference sources and services – types of reference sources, functions of reference sources, reference services; Web resources and online information - Overview of databases, Online search strategies for information retrieval; Referencing and citation styles for academic research; ICT facilities in libraries; Learning skills and research reporting; Concept and types of reading; information policies.

EGR 102 Applied Mechanics 3 Units

Introduction: Force Systems, resultants, Moments, Couples. Equilibrium free body diagram, 2-dimensional force systems, equations for equilibrium, equilibrium of forces in space, internal forces, examples on simple machines, levers, pulleys, screws and threads, trusses, frames. Friction, Centroid, graphical Determination. Centre of gravity. Moment of inertia parallel axis Theorem, Moment of Inertia of plane areas, built up sections etc. Kinematics of particles and rigid bodies. Newton's laws of motion, torque, power, work energy, law of conservation and restitution. Revision.

MTH 122 Elementary Mathematics III 3 Units

Geometric representation of vectors in 1-3 dimensions. Direction cosines. Addition and Multiplications of vectors by a scalar, linear independence. Scalar and vector product of two vectors. Differentiation and Integration of vectors with respect to a scalar variable. Two-dimensional coordinate geometry. Tangents and normal. Kinematic of a particle. Components of velocity and acceleration of a particle. Moving in a plane. Force and Momentum. Newtons laws of motion under gravity, Projectile motion, resisted vertical motion of a particle, elastic string, motion of a simple pendulum. Impulse and change of Momentum. Impact of two smooth elastic spheres. Direct and Oblique impacts.

CHM 112 Basic Principles of Physical Chemistry II 2 Units

Fundamental Chemical Principles: The gas laws; Kinetic theory of gases. Colligative properties of dilute solutions. Raoults's law. Henry's law and Molar weight determination. Thermochemistry, Chemical equilibrium, law of Mass action. Reaction rate and Chemical energetic. Electrochemistry, Ionic equilibrium. Theory of acids, Bases and Indicators. Phase equilibrium study of one and Two component Systems.

PHY 116 General Physics For Physical Science II 2 Units

Heat and temperature. Calorimetry. Laws of thermodynamics. Change of state-Critical points. Heat transfer; conduction, convection and radiation. Blackbody radiation. Wave motions, longitudinal and transverse waves. Superposition of waves, interference and diffraction. Propagation of waves in material media, vibrations in solids; sound wave. Wave theory of light, polarization of light. Rectilinear propagation of light, reflection, refraction; mirrors and lenses, lens combinations, optical instruments. Doppler Effect.

PHY 124 Fundamentals of Physics III 3 Units

Electrostatics; Coulomb's Law, Gauss's Law: simple applications. Electric field, electrostatic potential. Energy in electric field, capacitance. Insulators, conductors, dielectrics; polarization. Electric current. Ohm's law, circuit analysis. Thermoelectricity. Magnetic effects of currents, Ampere's law, Applications. Permanent magnetism, Earth's magnetic field. Faraday's law of induction. Maxwell's equations. Alternating currents. A.C. circuits. Measuring devices. Motion of a charged particle in electric and magnetic fields, hall effect. Atomic and Nuclear structure. Nuclear fission and fusion. Nuclear reactors.

GSP 102 Communication In English II 3 Units

Part A: Basic Grammar: Introduction —The concept of grammar and its place in language teaching and learning, Parts of speech and their functions (treated in detail), Closed and open class items in parts of speech , Nominalization , Grammatical Structures —the phrase, the clause, the sentence, Elementary Clause Analysis , Sentence Types, Elements and Patterns , Agreement (Grammatical agreement, Notional agreement , Proximity agreement, Agreement with the correlatives, Direct and Reported Speech, Error typology, identification, and correction

Part B: Varieties of Writing - Introduction (The Meaning, Nature and Purpose of Writing, Writing Types or Genres and their Characteristics), The paragraph as the basic unit of an essay (Types, Characteristics of the Paragraph, Methods of Paragraph Development, The thesis statement), Point of view and style in writing, Qualities of a good piece of writing, Form, Diction, and Content in writing , The Mechanics of

Writing —punctuation, spelling, and capitalization

Part C: Writing Genres - Planning and choosing your theme , Deciding your genre, Choosing and developing your plot, point of view, setting and characterization, Using the language that works, Essay Writing —Narration, Description, Exposition, and Argumentation, Technical Writing , Letter Writing, Memorandum & Curriculum Vitae, Report Writing , Speech Writing , Agenda & Minutes , Book Reviews, Proposal Writing , Creative Writing , Editing your Drafts, Rewriting and producing the final draft, Writing your own story for practice, Computer-linked writing, types, style, language, and process

3.2 2XX Series Courses

MEE 202 – Computing and Programming for Mechanical Engineers 3 units
Binary, octal, hexadecimal number systems. Basic logic components, AND, OR, NOT, NOR, NAND gates. Operations on binary numbers and logic gates. Methods of running programs on computers: interactive programming, batch-processing, time sharing. Introduction of computer languages – C++, Java, Python, etc. Data types: integers, reals, strings, etc. Basic program structure, loops, branching, subroutines. Data input/output structures in various languages. Basic program design: flow charts. Introduction to matrix-based engineering computation software tools (Scilab, Matlab, GNU Octave, python, etc.)**.** Basic language elements: variables types and naming conventions, comments and continuation lines, elementary mathematical functions, pre-defined variables, dynamic type of variables**.** Working with matrices: creating matrices, special matrices, accesses matrix elements, elementary matrix operations, higher-level linear algebra operations**.** Implementing conditional statements**.** Functions: defining functions, debugging functions**.** Graphics: creating 2D plots, contour plots, 3D surface plots, modifying plot titles, axes and legends, exporting plots in vector and bitmap formats.

MEE 204 – Computing and Programming Laboratory 1 unit
Programming exercises in Python and Scilab: Matrix operations, looping and branching operations. Function exercises in Python and Scilab. Graphics exercises in Python and Scilab: 2D plots, contour plots, 3D surface plots, plot export. Capstone project.

MEE 211 – Engineering Drawing 1 2 units
Use of drawing instruments. Descriptive geometry and geometric constructions. Lettering and dimensioning. First and third angle orthogonal projections. Isometric projection. Sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Overview of computer aided drawing tools (e.g., AutoCAD, SolidWorks, etc.)

MEE 212 – Workshop Technology 2 unit
Part A (Practical):. Use of measuring instruments: Calipers, micrometers, gauges, sine bar, practice with wood planners, saws, sanders, and pattern making. Machine shop: Lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. **Part B (Theoretical):**. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes: welding, brazing and soldering. Heat treatment. Material

removal processes, machine tools, classification, simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

MEE 261 – Engineering Thermodynamics I **2 units**
Basic concepts, definitions and laws. Properties of pure substances: the two-property rule; state diagrams. The ideal gas: specific heat, polytropic processes. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's Equation) and application. Second law of thermodynamics, heat cycles and efficiencies

3.3 3XX Series Courses

MEE 311 – Manufacturing Processes *(Pre-requisite: MEE 212)* **2 units**

History of machining and machine tools: Lathes, drill press, millers and grinders. Tool geometry/signature and chip formation. Form tools and operations; gear manufacturing; thread manufacturing. Kinematic geometry of cutting processes. Machining Productivity: Machining time and Material removal rate. Machine tools drives. Turning and boring operations, drilling milling, planing, shaping and grinding processes. Abrasive machining: Grinding, Slotting and broaching, honing and lapping, and super-finishing. Determination of spindle speeds and feed speeds. Non-traditional machining Processes. Machine tool installation, testing and maintenance.

MEE 312 – Computer-Aided Design and Manufacture *(Pre-requisites: MEE 211, MEE 212)* **2 units**
Introduction to Computer Aided Design (CAD)**.** Basic data structuring technique**.** Computer graphics**.** Geometric transformation techniques. Mathematical bases for surface modeling: curves, surfaces and solids**.** Principles of solid modeling and application**.** CAD software**.** Introduction to CAM: Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems; Type of automation and benefits of soft or flexible automation**.** Automation in Material Handling and Assembly**.** CNC Machines: Introduction, classification, design and control features including interpolations**.** Numerical control and NC Part-Programming**.** Introduction to Robotics: Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications.

MEE 313 – Machine Design I *(Pre-requisites: CVE 211)* **3 units**
Principles of Design. Selection of Materials. Design and composition of cast, forged and welding housings and structures; design of plastic parts. Precautions for manufacture. Simple stress analysis. Use of threaded and non-threaded fasteners. Elastic deformation of machine parts. Design of screws. Strength under combined load; Failure theories; Repeated loading. Shaft design. Flexible mechanical elements: Couplings, clutches and brakes. Mechanical springs. Anti-friction rolling contact bearings.

MEE 314 – Engineering Drawing II *(Pre-requisite: MEE 211)* **2 units**
Part A:. Projection of lines and laminae; auxiliary views and mixed projection**.** Advanced descriptive geometry; geometric constructions and developments**.** Preparation of detailed working drawings for production; semi-detailed drawings, conventional presentation methods**.** Machine drawing: Assembly drawing of machines, devices and installation layout; itemization and part listing**.**

Part B:. Computer aided drawing practice (using the AutoCAD software or related software)**.** Introduction to AutoCAD**.** New drawing setup**.** Specifying coordinates**.** Working with layers**.** Managing object properties**.** Controlling precision**.** 2D geometries: drawing and viewing, selecting and editing 2D objects**.** Creating and editing hatches**.** Text creation and editing**.** Dimensioning**.** Plotting and printing.

MEE 315 – Workshop Practice *(Pre-requisite: MEE 212)* **1 unit**
Machine operation practice: Turning operation, gear cutting, boring (using lathe machines), drilling, shaping and slotting using the shaper. Vertical and horizontal milling with the miller. Grinding of round and flat surfaces.

MEE 321 – Thermo-Fluids Laboratory I *(Pre-requisite: CVE 224)* **1 unit**
Basic measurements: Viscosity, velocity and temperature measurements, pressure guage calibration. Hydrostatic force on a submerged surface (center of pressure). Laminar-turbulent transition in a pipe flow. Bernoulli equation. Flow meters. Software demonstrations of hydraulics and pipe flow. CFD demonstrations.

MEE 322 – Mechanics of Materials Laboratory *(Pre-requisite: EGR 202)* **1 unit**
Uncertainty analysis, statistical analysis. Tensile test of ductile and brittle materials using the Universal Testing Machine. Poisson's ratio. Torsion Testing. Bending – Modulus of Elasticity. Principal stresses and strains (Strain guage application). Beam deflection test. Column loading test. FEA demonstrations.

MEE 323 – Mechanics of Machines Laboratory I *(Pre-requisite: EGR 102)* **1 unit**
Linear acceleration trolley experiment. Angular acceleration. Wall jib crane. Simple screw jack. Weston differential pulley block. Belt friction. Compound pendulum. Flywheel.

MEE 324 – CAD/CAM Laboratory *(Pre-requisite: MEE 211, MEE 212)* **1 unit**
Introduction to SolidWorks**.** Basic SolidWorks functions**.** Advanced SolidWorks functions**.** Manual CNC programming (milling and turning)**.** Basic and advanced CAD/CAM for CNC (milling and turning)**.** Group project assignment.

MEE 332 – Mechanics of Materials I *(Pre-requisites: CE 211)* **3 units**
The concept of stress. Axially loaded members; stresses and strains; Hooke's law. Torsional loading. Bending of beams: shear force and bending moment; normal and shear stresses; shear flow. Two-dimensional stress and strain analysis. Thick and thin-walled pressure vessels. Transformation of stresses and strains, principal stresses, principal strains. Deflection under flexural loading. Statically determinate and indeterminate structures.

MEE 341 – Mechanics of Machines I *(Pre-requisites: EGR 102)* **2 units**
Simple Mechanisms. Kinematics of mechanisms. Loci, graphical analysis, instant centres, images. Kinematics of mechanisms: Graphical and analytical methods for position, velocity and acceleration

analysis. Gears: tooth geometry; involumetry; gear types; gear trains. Cams: displacement diagrams, layout, equivalent mechanisms.

MEE 343 – Measurement and Instrumentation **2 units**
Measurement principles and basic definitions. Standards. Accuracy and error analysis; measurement statistics. Instrument systems: sensing devices, transmitting devices, terminating devices. Typical systems and devices for measuring quantities such as temperature, pressure, flow, size, displacement, velocity, acceleration, force, power, torque, stress and strain. Analog methods of measurement. Digital measurement systems: Introduction to Arduino and applications. Dynamics of measurement. Data presentation and curve fitting. Team project on design, and implementation of a measurement and control device.

MEE 351 – Mechanics of Fluids *(Pre-requisite: CVE 221)* **2 units**
Kinematics of fluid motion: streamlines, velocity, acceleration, rotation and circulation. Control volume analysis: continuity, momentum, angular momentum and energy equations. The Euler and Bernoulli equations. Differential analysis. Laminar incompressible flow between parallel plates, circular tubes and circular annuli. Laminar and turbulent flow in pipes and ducts. Energy losses in pipe flows: Friction and Minor Losses. Fluid measurements: pressure, velocity and flow rates.

MEE 361 – Engineering Thermodynamics II *(Pre-requisite: MEE 261)* **2 units**
Entropy: Clausius inequality; definition of entropy; entropy data for water and refrigerants**.** Isentropic processes: Tds relations; entropy balances for closed systems and control volumes; isentropic efficiencies of turbines, nozzles and compressors. Irreversibility and availability: Definition of exergy; exergy reference environment; dead state; exergy equation. Cycle analysis, irreversibility. Vapour power cycles: Simple vapour power plant; thermal efficiency; work ratio; ideal Rankine cycle**.** Gas Power cycles: Simple gas turbine; air-standard Brayton cycle. Air-standard cycles: air-standard Otto cycle; Diesel cycle; dual cycle. Power and efficiencies.

MEE 372 – Heat and Mass Transfer I *(Pre-requisites: MEE 261, MTH 207)* **2 units**
Introduction to heat transfer mechanisms and processes. **Conduction heat transfer:** Fourier's law of conduction. energy equations of conduction; steady state 1-D conduction; boundary conditions. electrical analogy of conduction. composite bodies. thermal insulation and insulation economics. extended surfaces. **Radiation heat transfer:** generation, emission, absorption, reflection and transmission of thermal radiation. radiation properties of surfaces and materials. special surfaces: black body, gray and selective surfaces. thermal radiation exchange between surfaces; view factor tables and charts. thermal radiation exchange between black body and gray surfaces. electrical analogy of thermal radiation exchange.

3.4 4XX Series Courses

MEE 402 - Written Technical Communication *(Pre-requisites: GSP 101, GSP 102)* **2 units**
Introduction to technical reporting. Types of technical reports: Experiments; Designs; Mathematical derivations and calculations; Thesis/project proposals; Thesis/project reports, etc. General structure of technical reports: Cover page; Title page; Abstract; Dedication; Acknowledgements; Table of contents; Lists of tables and figures; Nomenclature; Introductory chapter; Central chapters; Concluding chapter; Appendices, References. Tables and figures. Equations. Language style. Report layouts: fonts, section headings, page numbering and headings. Referencing styles and plagiarism. Word processing tools for technical report writing.

MEE 404 - Seminar Presentation Skills **1 unit**
During the early weeks of the first semester of the final year, all students returning from the SIWES programme are required to present a seminar on technical experiences gained during the SIWES. During the seminar, each student is also expected to present a technical report of his/her SIWES experiences written according to the guidelines provided in the course MEE 492 (Written Technical Communication). Scores are awarded to each student based on his/her seminar presentation and report.

MEE 412 – Computer Aided Design Practice *(Pre-requisite: MEE 314, MEE 324)* **2 units**
This is a course in modern reverse-engineering**.** Each student is to select an existing machine and use an appropriate computer aided design (CAD) software to draw all the major mechanical elements of the machine, produce a parts list, as well as an assembly drawing**.** The report containing all the drawings and associated comments will be presented to the Department.

MEE 413 – Mechanical Engineering Design II *(Pre-requisite: MEE 313)* **3 units**
Journal bearings. Application of Hertz stress theory. Fluid couplings, Lubrication mechanics: Hydrodynamic theory applied to tapered wedge and journal bearings, hydrostatic lubrication applied to journal bearings. Gears, Power transmission systems. Elements of fluid power system design. Design of cylinders, pipes and pipe joints, tubes, plates and flywheel. Seals, packaging, gaskets and shields.

MEE 421 – Thermo-Fluids Laboratory II *(Pre-requisite: MEE 321)* **1 unit**
Wind tunnel lift and drag. Kaplan pump performance measurement. Turbine tests. Internal combustion engine tests. Gas turbine demonstration unit. Throttling calorimeter experiments. Marcet boiler tests. Pipeline network software tools (EPANET).

MEE 423 – Mechanics of Machines Laboratory II *(Pre-requisite: MEE 323)* **1 unit**
The slider crank experiment. Four bar mechanism. Hooks joints. Disc and cam follower experiment. Whitworth quick return mechanism. Slotted link. Scotch yoke, Geneva stop and Oldham coupling.

MEE 425 – Heat Transfer Laboratory I *(Pre-requisite: MEE 372)* **1 unit**
Conduction heat transfer through metal bars (thermal conductivity). Transient (convection) heat transfer. Forced convection heat transfer. Natural convection heat transfer. Radiation heat transfer test. Double-pipe heat exchanger tests.

MEE 441 – Mechanics of Machines II *(Pre-requisite: MEE 342)* **3 units**
Force analysis of mechanisms, fluctuation of kinetic energy and inertial effects. Complete static and dynamic analysis. Flexible shaft couplings: Belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery.

MEE 443 – Automatic Control *(Pre-requisite: ENGR 301)* **3 units**
Linear feedback control theory with emphasis on mechanical systems. Transient and frequency response. Stability. System performance, control modes; compensation methods. Analysis of hydraulic pneumatic, inertial components and systems.

MEE 451 – Applied Fluid Mechanics *(Pre-requisite: MEE 351)* **2 units**
Dimensional analysis and similitude. Introduction to Turbo machinery; characteristic curve for axial-flow and centrifugal pumps, fans, blowers, impulse and reaction turbines. Pump Selection and Application. Pipeline Systems (Series and Parallel). Open Channel Flow.

MEE 461 - Engineering Thermodynamics III *(Pre-requisite: MEE 361)* **2 units**
Multistage reciprocating compressors. Rotary compressors – centrifugal and axial-flow; stagnation properties. Simple gas turbine plant. The steam power plant. Combustion of fuels; chemistry of common hydrocarbon fuels, combustion with deficiency or excess air. Thermo-chemistry: Hess' Law of Heat Summation; Heats of combustion and reaction; Ideal adiabatic flame temperature. Reciprocating internal combustion engines.

MEE 471 – Heat and Mass Transfer II *(Pre-requisite: MEE 351, MEE 372)* **2 units**
Convection heat transfer:. Newton's law of cooling. energy equation of convection. continuity and momentum equations and their roles in convection heat transfer analysis. convection heat transfer in laminar and turbulent flows. internal and external flows. heat transfer coefficients. dimensional analysis and dimensionless groups in convection heat transfer. convection heat transfer correlations. heat exchanger analysis and design. combined modes of heat transfer.
Mass transfer:. mechanisms of mass transfer. Fick's law of mass diffusion. general diffusion law; rate equations. comparison of Fick's and Fourier's laws. equations of mass transfer in stationary systems. similarities between conduction and mass transfer in stationary systems. mass transfer coefficient. electrical analogy of mass transfer. equimolar counter diffusion. drying and humidification of solids and gases. types of dryers. evaporation. mass transfer correlations in convective systems.

MEE 481 – Technology Development Policy *(Pre-requisite: MEE 212)* **2 units**
Industrialization and economic development of developing and developed countries. Sources of funds for financial investments. Infrastructure (social and economic) standard of living. Productivity, effect of productivity and standard of living and economic development. Techniques for increasing productivity. Definition of management techniques, work study and its advantages. Basic procedure for method study, use of charts and symbols; factory/shop layout; examples of method study. Basic procedure for work measurement; time study. Ratio delay/activity, sampling method. Effects of working conditions (e.g. cleanliness, lighting, ventilation, wise, safety precautions, etc.)

3.5 5XX Series Courses

MEE 511 – Applied Design *(Pre-requisite: MEE 413)* **3 units**
Scientific Design Methodology: An appreciation of the process of engineering design; and of systematic procedures and tools usable in the design process, with particular reference to mechanical systems and devices. Topics include systematic problem definition, search for possible solutions, statical analysis of stress/strength interference, experiment planning techniques, optimum design for minimum weight and cost, management of the design process. Design Project: Students will be required to conduct a design project under supervision, using the presented techniques, and taking at least to a workable layout drawing of a device. The design should involve simple mechanical systems (e.g. testing and assembling devices, heat drive, etc) for a specified duty, analyze its operating conditions and after considering the design criteria, choose between potential solutions. Reports submitted by students should contain all calculations, a comparison of potential solutions, justification for the design finally chosen, and instructions on detail design, manufacture, testing and use.

MEE 512 – Design of Pressure Vessels *(Pre-requisite: MEE 332)* **3 units**
Overview of pressure vessels. Overview of pressure vessel design codes (e.g. the ASME Section VIII). Design philosophy. Structural design criteria; Stress/failure theories. Load categories; Failure categories; Stress categories and limits. Design of cylindrical shells, heads and covers, nozzles and openings. Fatigue assessment of pressure vessels. Bolted flange connections. Design of vessel supports. Use of pressure vessel design software. New trends in pressure vessel design.

MEE 513 – Manufacturing and Tools Engineering (*Pre-requisite: MEE 311, MEE 312)* **3 units**
Manufacturing unit processes and material considerations. Casting techniques. Solidification and heat flow theory, defect formation, casting design, metal forming. Elementary plasticity theory, plastic failure criteria, force and work calculations. Power forming techniques; theory and practices of power consolidation, design considerations. Joining techniques. Heat flow and defect formation theory, residual stresses. Machining theory and practice. Heat treatment and surface hardening. Diffusion theory, principles of wear resistance. Metrology. Additive manufacturing: (1) History and prospects of 3D printing; (2) Scientific processes; (3) Materials; Polymer, Ceramics, Metal and composites; (4) Design and Fabrication. Tools engineering: tool materials, plastic mould design, jig and fixture design principles, die design, mechanized assembly, and functional ganging. Fundamental aspects of machine tool design and control, machine tool dynamics and computer aided design.

MEE 515 – Design of Welded and Cast Structures *(Pre-requisite: MEE 332)* **3 units**
Review of elastic, plastic, and creep behavior of materials and introduction of low-cycle and multi axial stress fatigue. Welding and casting processes. Design of weldments and castings with application to pressure vessels and other structures. Analysis of industrial welding processes. Material and process selection, codes and specifications, costing equipment. Laboratory experience in the production and evaluation of weldments and castings.

MEE 531 – Mechanics of Materials II *(Pre-requisites: MEE 332)* **3 units**
Strain energy, principle of virtual work. Castigliano's theorem, principle of least work. Statically indeterminate beams. Plastic analysis. Columns – stability of elastic mechanical systems. Long straight columns effect of and conditions. Eccentric loading. The secant formula. Empirical formulae for intermediate and short columns. Impact loading.

MEE 532 – Theory of Elasticity *(Pre-requisite: MEE 332)* **3 units**
Anti-elastic bending. Theory of plates and shells. Thermal stresses. Stresses in rotating discs. Theory of elasticity. Equilibrium and compatibility equations. Airy's stress function with applications to simple problems. Crack mechanics, stress-function, approach to fracture mechanics. Direct stiffness method, the finite element method for stress analysis. Plastic theory.

MEE 533 – Engineering Metallurgy *(Pre-requisite: EGR 201)* **3 units**
Age-hardening and isothermal transformation processes, quenching and tempering, hardenability and graphitization processes. Fracture mechanics applied to metal, ceramics and polymers. Dislocation. X-ray and electron diffraction. Industrial metallurgy, corrosion and high temperature oxidation theories. Material conservation. Quenching of metals, glasses, polymers textiles, paper and wood. Transport processes; analysis of heat and mass transfer in materials processing operations.

MEE 534 – Materials for Engineering Applications *(Pre-requisite: EGR 201)* **3 units**
Metallic and non-metallic compounds: Structure, composition, mechanical and thermal properties. The modification of properties through changes in microstructure (Heat treatments). Welding Metallurgy; modern techniques of welding and applications. Weldability of industrial materials. Destructive and non-destructive testing of materials, ultrasonic and X-ray tests. Evaluation of the relevant factors in materials selection; technical and economic considerations. Materials for structural, high temperature, cryogenic, electrical, electronic and nuclear applications. Principles and economics of recycling. Current status and future prospects of important engineering materials.

MEE 536 – Introduction to Composite Materials *(Pre-requisite: EGR 201, MEE 332)* **3 units**
Introduction. Fibers and Matrices. Microstructure. Mechanics of Composite Materials. Anisotropy and Laminate Theory. Micromechanics and Interface. Strength and fracture. Thermal Response. Fabrication Techniques. Composite Designs.

MEE 541 – Systems Engineering *(Pre-requisite: MEE 443)* **3 units**
System modeling: Modeling of systems by algebraic, difference, ordinary differential equations, and partial differential equations. System simulation using analogue, hybrid and digital computers. System

optimization using differential calculus, variational calculus, linear programming and dynamic programming. System behavior: categories of systems, behavior illustrated by the study of selected mechanical, electrical, hydraulic, industrial, transportation, economic, biological and social systems. System control. Decision analysis. Estimation of input values. Utility and value analysis. Multiple objectives and criteria. Production functions and marginal analysis. Econometrics. . Evaluation of a public system.

MEE 543 – Vibrations and Control *(Pre-requisite: MEE 443)* **3 units**

Free and forced oscillations of single degree of freedom systems. Damped vibrations. Vibration isolation and measurement. Two and multiple-degrees of freedom systems. Electro-mechanical analogies. Linear systems of the first order. Response to standard inputs. The closed loop control system. Block diagram algebra. Stability analysis. Electrical systems. Dynamics of Machinery: Kinematic and dynamic analysis and synthesis of mechanisms and machines. Design and analysis considerations in reciprocating and rotating machinery. Vibrations in machinery: Vibrations of systems with more than one degree of freedom. Vibration and shock isolations; Experimental investigation of dynamic systems.

MEE 545 – Mechatronics *(Pre-requisite: MEE 343, EEE 312, MEE 443)* **3 units**

Introduction to Digital Control Systems: Analog control systems and digital control systems. Control system design and analysis. Modeling of dynamic systems. Response characteristics of a control system. Hardware (microprocessors) and software for implementing a digital controller. Design, analysis and simulation of digital control systems by MATLAB/Simulink.

Electronic Control Systems in Mechanical Engineering: Robotics and automation. Mechatronic applications: structural control, home automation, robotics. Sensors: tactile, proximity and range sensors, force and torque sensors. Actuators in control systems: system drives, hydraulic systems, DC motors, stepping motors, AC motors. Feedback devices: encoders, pulse digitizers, resolvers, inductosyn. Counting devices: flip flops, counters, decoders, digital to analog converters. Mechatronic design process.

MEE 547 – Automobile Engineering *(Pre-requisite: MEE 413)* **3 units**

Introduction to Automobiles. Vehicle Performance Characteristics and Requirements. Power-train, Transmission and Drive units. Exhaust System. Steering and Suspension System. Chassis and Body Design. Brake systems. Electrical and Lighting Systems. Safety and Comfort Features. Wheel and Tyre. NVH Considerations in Vehicle Design. Vehicle Ride and Handling Evaluation.

MEE 551 – Fluid Dynamics II *(Pre-requisite: MEE 451)* **3 units**

Navier-Stokes equations. Two-dimensional irrotational (potential) flow; the stream function and velocity potential simple flows and their superposition. Boundary layer theory; Von Karman's integral momentum equation; laminar and turbulent boundary layers, flow separation and wake, drag and lift. Compressible fluid flow; compressibility effects, isentropic flow through variable area ducts, plane normal shock waves. Flow with heat exchange and flow with friction.

MEE 552 – Computational Fluid Dynamics *(Pre-requisite: EGR 401, MEE 451)* **3 units**
Introduction to CFD and CFD softwares (OpenFOAM, ANSYS Fluent, COMSOL, StarCD, etc.). Defining a CFD problem: Creating and Importing Geometry in blockMesh. Kinematic properties of fluids and conservation laws. Navier-Stokes equations and similarity. Initial and Boundary Conditions: practical guidelines. Turbulence: basics and introduction. Turbulence: applications of models. Computational methods – discretisation. Solution Procedures. Post Processing – analysis of results. Validation and Verification.

MEE 555 – Aerospace Engineering Fundamentals *(Pre-requisite: MEE 461, MEE 451)* **3 units**
Classification of aerospace vehicles; parts of aircraft; standard atmosphere. 1-D Compressible flow aerodynamics: conservation equations, viscosity and speed of sound. Airfoils; wing aerodynamics: geometric and nomenclature, lift, drag, characteristic curves, etc., high-lift devices. Aircraft structures: materials, loads, structural elements. Aircraft instruments and systems. Aircraft propulsion: propeller propulsion; jet propulsion, air breathing propulsion cycles basics; types of jet engines (Turboprop, Turbojet, Turbofan, Ducted Fan & Ramjet). Diffusers & Nozzles. Aircraft engine selection. Flight mechanics: performances, stability and control.

MEE 557 – Fluid Power Transmission Systems *(Pre-requisite: MEE 451)* **3 units**
Properties of hydraulic fluids. Dynamic flow analysis; Hydraulic, pneumatic, and fluids systems and components; characteristic of flow and pressure control valves, actuators, position motors, pumps. Hydro-static and hydrodynamic power transmission systems. Filtration and heat control in hydraulic systems. Seals and packings. System design and circuit analysis. Introduction to pneumatics Pneumatic logic control. Applications and testing procedures.

MEE 561 – Engineering Thermodynamics IV *(Pre-requisite: MEE 461)* **3 units**
Non-ideal pure substances. Equations of state and compressibility factors. General thermodynamic relations: Maxwell's relations, T-ds equations, energy equations, Claudius Claperon equation, difference in heat capacities, Joule Thompson's coefficient. Mixtures and solutions: Ideal gas mixtures; gas-vapour mixtures; psychrometry; psychrometric chart; air-conditioning processes; cooling towers. (Fugacity and activity coefficients). Thermodynamics of chemical reactions: first law and second law analyses of reacting systems. Chemical equilibrium and Dissociation. Introduction to phase and chemical equilibrium.

MEE 562 – Refrigeration and Air-Conditioning *(Pre-requisite: MEE 461)* **3 units**
Fundamentals of vapour compression refrigeration, analysis of refrigeration cycles and equipment. Refrigerants and their properties. Absorption refrigeration systems. Low temperature refrigeration. Refrigeration Applications, Elements and Design of Refrigeration systems. Reverse application of refrigeration – heat pumps. Steady state and transient cooling load calculations. Principles of air-conditioning with emphasis on thermodynamic processes involving air, water, vapour mixtures. Production of atmospheric and thermal environments for human activity. Heat sources and climatic considerations. Comfort and physiological aspects. psychrometry and psychrometric processes. Evaluation of cooling and heating loads. Methods of reducing cooling loads. Air-conditioning systems and equipment. Ducts and fans. Chilled water and condenser water piping. Steam piping and heating systems. Air-conditioning controls. Ventilation and air-conditioning systems.

MEE 563 – Automotive Engine Fundamentals *(Pre-requisite: MEE 461)* **3 units**
Power Cycle Thermodynamics: Basics of Otto and Diesel cycle; Mixtures and Solutions. Power Plants for Automobiles: Elements of Petrol and Diesel Engines, Engine Performance curves. Piston Engine Components and Electronic Controls. Engine Tribology (Friction, Lubrication and Wear). Engine Modeling. Engine Vibration and Balance. Fuels and Combustion. Engine Exhaust Emissions: Air pollution, control measures and Euro-norms. Engine Manufacturing

MEE 565 – Fundamentals of Nuclear Engineering **3 units**
Introduction to nuclear engineering. Biological effects of radiation. Introduction of nuclear reactor engineering: radiation protection and reactor safe-guards, radiation hazards and health physics, reactor shielding principles and geometric transformation, shield design, nuclear reactions and radiations. Neutron balance. Neutrons reactor theory, homogenous and heterogeneous reactor system. Water moderated and fast reactors. Control of nuclear reactors. Thermal problems in reactor coolants, reactor structural and moderator materials. Reactor fuels: production properties, reprocessing and waste disposal. Nuclear reactor system. Application of nuclear techniques in industry and medicine.

MEE 568 – Power Plant Engineering *(Pre-requisite: MEE 461)* **3 units**
Introduction to Power Plants: energy sources, availability, resources. Fundamental combustion processes of solid, liquid and gaseous fuels. Steam power plants: steam generators, burner designs, auxiliary power station equipment. Diesel and gas turbine plants. Hydroelectric power plants: dams and plant auxiliaries; Nuclear power plants: fuels and nuclear fission, reactor types, nuclear waste. Geothermal power plants; design and operation of equipment. Alternative energy forms: solar, wind, tides, geothermal, hydrogen and biomass; performance and selection of prime movers for small power generating plants. Fundamentals of electrical generators performance and energy distribution systems.

MEE 569 – Direct Energy Conversion Principles **3 units**

Review of alternate energy conversion systems: Solar thermal systems; Wind energy systems; Ocean wave/tides systems; Geothermal systems; Hydrogen; Biomass and biomass conversion; Battery technology. Thermodynamic principles of direct energy conversion systems. Thermoelectric Generators. Solar energy conversion systems (photo and thermal); hybrid solar photo-thermal systems. Fuel cells. Thermionic systems. Magnetohydrodynamic (MHD) power generators. Energy Storage Systems.

MEE 572 – Thermal Engineering and Advanced Heat Transfer *(Pre-requisites: MEE 471)* **3 units**
Advanced heat transfer: unsteady conduction, analytical methods, graphical and numerical methods, electrical analogue circuits. Energy transfer with change of phase, iterative processes in combined modes. Solar Energy: nature of solar radiation, direct, diffuse and reflected irradiance, ephemeris transit, equation of time. Solar flux, solar collectors, applications of solar energy and prospects. Thermal management in electronic systems: Introduction to packaging and heat transfer principles, cooling technologies, thermal measurements and systems analysis, emerging electronics cooling technologies.

MEE 581 – Quality Assurance and Reliability **3 units**

Definition of Quality, Quality function, Dimensions of Quality, Quality. Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems. Introduction to Quality function deployment. Quality Assurance. Statistical Process Control. Control Charts for Variables. Control Charts for Attributes. Sampling Inspection. Reliability and Life Testing.

MEE 582 – Engineering Law **2 units**

Law of Contract: Forms of contract criteria for selecting contractors offer and acceptance of contracts. Terms of Contracts; Suppliers Duties – Damages and other Remedies. Termination/Cancellation of Contract Liquidation and Penalties, Exemption clauses, safety and Risk. Health and Safety. Duties of Employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety.

MEE 584 – Engineering Management **2 units**

General principles of management and appraisal techniques. Break through and control management theory; personnel management, labour and public relations, wages and salary administration. Production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organizing and controlling, motivation and appraisal of results.

MEE 586 – Engineering Economy **3 units**

Economic decision making in Engineering. Engineering costs and cost estimation: fixed and variable costs, recurrent and non-recurrent costs, life-cycle costs, etc; cost estimation models; estimating benefits; cash flow diagrams. Interest and Equivalence: Computing cash flows; time value of money; simple interest, compound interest, interest formulas, economic analysis with spreadsheets. Economic Methods for evaluating capital projects: Present worth analysis; Annual cash flow analysis; Rate of return analysis; Future worth analysis; Benefit-Cost ratio analysis; Payback period; Sensitivity and Breakeven analysis. Comparison of alternatives and decision analysis. Uncertainty (Risk) analysis. Taxes, tarrifs and duties. Depreciation and Replacement analysis. Inflation and price change. Minimum attractive rate of return (MARR). Public Sector economic analysis. Elements of Accounting for Engineering Economy.

MEE 592 – Project **6 units**

Final Year Projects are assigned at the beginning of each academic year. Each final year student chooses a project supervisor in consultation with the Final Year Project Coordinator. The process is entirely interactive, but the coordinator ensures that there is an even distribution of students amongst the lecturers. The final topic is decided by the student and his supervisor, selected from the fields of mechanics of solids and fluids, materials science, machine design, heat power, heat transfer, production technology, industrial engineering and management. Each student presents at least two seminars as part of his final year project, usually at the beginning and ending of the second semester. Each student is required to submit a report of his findings and undergo an oral examination. All seminars are scored by a panel of lecturers.

3.6 Service Courses

MEE 101 – Technical Drawing I **3 Units**

Use of drawing instruments. Lettering and dimensioning. Geometrical constructions Tangency, Conic sections and loci. First and Third Angle Orthographic Projections.