AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.

DEPARTMENT OF
METALLURGICAL AND MATERIALS ENGINEERING

FACULTY OF ENGINEERING

WELCOME

The Department of Metallurgical and Materials Engineering, Ahmadu Bello University, is one of the foremost Departments in the country in terms of imparting quality Education to students both locally and internationally. The Department has undoubtedly recorded tremendous achievements since its inception in October, 1980. The strategic location of the Department, cosmopolitan nature of its staff and students, and a robust academic culture are sources of its strength. The challenges facing the Department are indeed enormous.

We extend gratitude of the Department to all those who identified with our course. We also take great pride and pleasure in the many and varied achievements of our students through their studies, extra-curricular activities, performance beyond the University, especially via public service and altruistic activities.

Thank you.

1.0 INTRODUCTION

In the developing countries of the world, strong emphasis is being laid on the transfer of technology from the technologically advanced countries. Different approaches have been adopted by the countries concerned in this process and naturally, varying degrees of success have been achieved. The greatest obstacles in the technological developments of these countries are principally political instability and lack of the necessary human and material resources.

In Nigeria, the foundation for a sound political setup is laid, and adequate materials and human resources are available and ready to be tapped. What we lack is the development and execution of a technical blueprint for achieving the goal. In this instance, the technological development of Nigeria is now being moved from the state of complete reliance on the advanced countries of the world for the production of even our food to a state of self-sufficiency. This is seen in the Government's emphasis on food, shelter and education. Industries are geared to the supply of the necessary materials for a rapid industrialization and subsequent production of these needs. It is therefore not surprising to note the emphasis of the Federal Government on, and its commitments to the building of iron and steel plants in many parts of the country.

The training of the necessary manpower is also vigorously being pursued. The technicians are presently being trained in the numerous colleges of technology all over the country for the purpose of operating and maintaining the industrial processes and equipment. As a step further, the engineers are being trained to design and produce the specific equipment for our industries. The production of engineering materials for industrial applications is a logical development for the growth of technology in the country, and this is the basis for the training of mining and metallurgical and materials engineers. The miners dig up the metal-bearing earth (ores) from the ground while the metallurgical and materials engineers extract the metals and manufacture alloys for machine components and fabrication. Therefore, metallurgical engineering starts from ore enrichment through metals extraction, processing, shaping, finishing and listing. The training of the metallurgical and materials engineer in Ahmadu Bello University, Zaria Nigeria has been developed to cover this entire spectrum of activities.

1.1 Historical Background

Ahmadu Bello University has been in the fore front of the development of Engineering and Technological needs of the country. Apart from the fact that it has the oldest faculty of Engineering in the country, it has always looked ahead and planned for the future needs of the Nation.

The idea of establishing a Department of Metallurgical Engineering in Ahmadu Bello University dated as far back as 1965, when a concept plan was drawn up for establishing the Department, and a tentative approval was given by the then senate of the University. However, the plan was shelved in favour of the creation/development of other programmes, Medicine and Pharmaceutical Sciences, due to the dearth of Doctors and Pharmacists in the then Northern Nigeria.

Staff training geared towards establishment of the Department of Metallurgical Engineering started in the 1970/71 academic session. In October 1977, Metallurgical Engineering started as a division in the Department of Mechanical Engineering after formal approvals of the Faculty Board and the Senate. In October 1980, Metallurgical Engineering became a full-fledged/independent Department in Ahmadu Bello University, Zaria; the first set of the degree programme graduated in 1981.

In the quest for meeting up with the ever-increasing technological challenges, the Department was formally upgraded, in October 2008, to award degrees in Metallurgical and Materials Engineering. This was after satisfying necessary requirements stipulated by the Nigerian

Universities Commission (NUC), the Ahmadu Bello University Senate and the Faculty Board of Engineering.

Effective from 2008/2009 academic session, Metallurgical and Materials Engineering came into being. Under this new regime, relevant courses leading to the award of Bachelors of Engineering Degree in Metallurgical and Materials Engineering; B.Eng. (Met. and Mats.), are offered. Postgraduate programmes leading to the awards of M.Sc./Ph.D degrees in areas of specialization-Process, Physical, Materials and Mechanical-are also being offered.

1.2 Mission

To produce Metallurgical and Materials Engineering graduates of high intellectual standing, this will help in meeting the technological aspiration of Nigeria.

1.3 Vision

To be a force to reckon with in the provision of quality Metallurgical and Materials Engineers that will effectively cater for the man power requirements of the steel and allied industries.

1.4 values

Good Virtues, Hard work and Dedication.

1.5 Philosophy

To produce the needed manpower for the various metallurgical and other allied industries nationwide, the Department has established general academic requirements which shall apply to all students working towards a first degree. These requirements reflect the Department's commitment to a broad-based quality education. The main components of undergraduate programme are:

a. Core curriculum in which students concentrate on their studies and receive B.Eng. degree.
b. Electives which permit students to take courses of their choice in consultation with their academic advisers (up to a maximum of 8 C.U. throughout the student's residency).
c. General studies courses which acquaint students with the foundation of general education in the sciences, social sciences and humanities as well as inculcating in the undergraduate student, the essence of nationalism and morality.
d. The Department offers Bachelor of Engineering in Metallurgical and Materials Engineering i.e. B.Eng. (Metallurgical & Materials)

The Metallurgical and Materials Engineering (MMEN) programme emphasizes the structure, properties, processing and performance of materials and develop graduates who:

1. Have a broad- based knowledge on materials.
2. Can apply fundamental metallurgical and materials concepts to solve problems.
3. Can acquire written and oral communications skills as well as team work skills to be successful in their careers.
4. Understand the importance for self-acquisition of knowledge and continuing education.
5. Can employ their breadth of knowledge so that they are able to provide a range of solutions to a wide range of materials engineering problems and ultimately an optimal choice.

2.0 ENTRY REQUIREMENT

2.1 Admission

In order to be eligible for admission into the undergraduate (B.Eng. degree) Programme, a candidate, in addition to satisfying the University general entry requirements, must obtain at least credit passes in each of English, Mathematics, Physics and Chemistry as well as any other science subjects at the Senior Secondary School Certificate Examinations or its equivalent.

The current minimum requirements for admission into 100 level (UTME entry) and 200 level (Direct entry) in the Department of Metallurgical & Materials Engineering are as follows:

2.1.1 Joint Matriculation Examination (JME) Entry:

Applicants seeking JME entry must:

i. Have attained the age of sixteen years on the first day of October in the year of their candidature.

ii. Possess the School Certificate (SC) or the General Certificate of Education, Ordinary Level (GCE "O" Level) with passes at credit level in at least five subjects obtained at not more than two sittings and at least a credit in English Language. The five subjects should include Mathematics, Chemistry and Physics. UTME subjects are: Mathematics, Chemistry and Physics.

2.1.2 Direct Entry:

Applicants seeking direct entry should have:

i. Five SC or GCE O' level credit passes including English, Mathematics, Chemistry, Physics and any other science subject.

ii. GCE 'A' level or IJMB passes or equivalent "A" level passes in Mathematics, Chemistry and Physics.

iii. Candidates with Higher National Diploma (HND) may also be admitted into the 200 level with lower credit or 300 level with distinction or upper credit in Metallurgical & Materials Engineering. Ordinary National Diploma (OND) candidates possessing overall upper credit pass with three distinctions passes in core courses of Metallurgical & Materials Engineering including Mathematics may be admitted into 200 level. In special cases, candidates with high grades in 'O' levels plus relevant advanced professional qualification may be accepted. Such cases will be considered individually by the Faculty Board of Engineering and Senate.

3.0 THE COURSE STRUCTURE

3.1 Categories of Course

The courses within the faculty fall under the following headings:

a. Core courses
b. Cognate courses
c. Restricted electives
d. Unrestricted electives
e. Pre-requisite courses

3.1.1 Core courses

i. They are central to the degree programme in view.

ii. They are normally offered by the Department offering the degree

iii. They constitute not less than 60% (i.e., 90 Credit Units) of

all the course units that the student must take to complete the requirements for a degree in a given Department.

3.1.2 Cognate Courses

i. Cognate courses are prescribed course units from related fields which are indispensable for an understanding and appreciation of the student's major field.

3.1.3 Restricted Electives

i. These are optional courses i.e., a set of required courses from which a student is made to select one or more courses as the case may be.
ii. They are normally offered by OTHER Departments within the same Faculty.
iii. They constitute about 15% (i.e., 23 Credit Units) of all the course units required for the degree before graduating.

3.1.4 Unrestricted Electives

i. They are courses which are opted for by the student in accordance with his or her own interest.
ii. They are normally offered from OUTSIDE the Faculty
iii. The status of the unrestricted elective courses taken by a student shall be determined by the faculty
iv. They constitute about 5% (i.e., 8 Credit Units) of all the credit units of the required course units for the degree in view.

The lists of the courses specified for each level are organized on the course credit system per semester. These lists for each level are shown in tables below.

LIST OF COURSES OFFERED IN FIRST SEMESTER 100 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1.	CHEM 101	Introduction to general chemistry	2
2	CHEM 121	Introduction to inorganic chemistry	2
3	CHEM 161	Introduction to practical chemistry I	1
4	COSC 101	Programming in Basics	2
5	GENS 101	Nationalism	1
6	GENS 103	English for communication skills	2
7	MATH 101	Set Theory and Number System	2
8	MATH 103	Trigonometry and Number system	2
9	MATH 105	Differential and integral calculus	2
10	PHYS 111	Mechanics	2
11	PHYS 131	Heat and Properties of matter	2
12	PHYS 161	General Physics practical I	1
		Total	21

LIST OF COURSES OFFERED IN SECOND SEMESTER 100 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	CHEM 122	Introduction to physical chemistry II	2
2	CHEM 132	Introduction to organic chemistry	2
3	CHEM 162	Introduction to practical chemistry II	1
4	ENGG 102	Introduction to Engineering	1
5	MATH 102	Algebra	2
6	MATH 104	Conic sections and Application of calculus	2
7	MATH 106	Vectors and Dynamics	2
8	PHYS 122	Electricity, Modular and Magnetic Physics	2
9	PHYS 124	Geometric and Wave Optics	1
10	PHYS 162	General Physics practical II	1
11	STAT 102	Introduction to statistics	2
		Total	18
	ELECTIVES		
1	GENS 102	Environmental Health	1
2	GENS 104	History of Scientific Ideas	1
		Total	2

LIST OF COURSES OFFERED IN FIRST SEMESTER 200 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	CVEN 201	Introduction to structural Analysis	2
2	EEEN 201	Electrical Circuits and Field Theory	2
3	EEEN 203	Electrical Machines, Power and Installation	2
4	GENS 201	Moral Philosophy	1
5	MATH 241	Calculus I	3
6	MATH 243	Methods of Linear Algebra	2
7	MEEN 201	Engineering Graphics	2
8	MMEN 201	Fundamentals of Materials Science	2
9	WREN 201	Fluid Mechanics	2
		Total	18

LIST OF COURSES OFFERED IN SECOND SEMESTER 200 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	CHEN 202	Introduction to Engineering Management	1
2	EEEN 202	Transducers	2
3	ENGG 299	Students Works Experience Programme (SWEP)	0
4	GENS 202	Entrepreneurship and Innovation	2
5	MATH 242	Calculus II	3
6	MATH 244	Methods of Linear Algebra II	2
7	MEEN 202	Engineering Drawing	2
8	MEEN 204	Strength of Materials I	2
9	MEEN 206	Fundamentals of Dynamics	2
10	MEEN 208	thermodynamics	2
11	MMEN 242	Introduction to Biomaterials	2
		Total	20

LIST OF COURSES OFFERED IN FIRST SEMESTER 300 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	MATH 341	Differential Equations and Transforms	3
2	MEEN 301	Machine Design	2
3	MEEN 303	Machine Tools	2
4	MMEN 311	Mineral Processing	2
5	MMEN 313	Thermodynamics of Materials	2
6	MMEN 331	Mechanical Metallurgy	2
7	MMEN 347	Ceramics	2
8	MMEN 391	Laboratory Course Work I (Process)	1
9	QTYS 309	Development Economics	1
10	STAT 343	statistics	2
			19

LIST OF COURSES OFFERED IN SECOND SEMESTER 300 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	GENS 302	Business creation and Growth	2
2	MMEN 312	Theory of Metallurgical Processes	2
3	MMEN 322	Phase Transformations	2
4	MMEN 324	Crystallography	2
5	MMEN 332	Fundamentals of Materials Testing	2
6	MMEN 342	Metallurgical Analysis (Physical and Processes)	2
7	MMEN 346	Wood Technology	2
8	MMEN 392	Laboratory Course Work II (Mechanical)	1
		Total	15
	ELECTIVES		
1	MATH 342	Calculus of several variables	2
2	COSC 344	Basic computer knowledge and Fortran programming	2
		Total	4

LIST OF COURSES OFFERED IN FIRST SEMESTER 400 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	MMEN 411	Non-Ferrous Extractive Metallurgy	2
2	MMEN 413	Corrosion Engineering	2
3	MMEN 421	Physical Metallurgy	3
4	MMEN 425	Micro-structural Analysis of Materials	2
5	MMEN 431	Fundamental Working of Materials	2
6	MMEN 445	Polymer Engineering	2
7	MMEN 447	Micro and Nano processing Technology	1
8	MMEN 491	Laboratory Course Work III (Physical)	1
9	QTYS 421	Law for Engineers	1
10	STAT 443	Experimental Design and Quality control	2
			19

SECOND SEMESTER 400 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1.	MMEN 497	Students' Industrial Work Experience Scheme (SIWES)	6

LIST OF COURSES OFFERED IN FIRST SEMESTER 500 LEVEL

S/No.	Course code	Course description/Title	Credit Unit
1	CHEN 409	Financial Management	2
2	MEEN 503	Production Management I	1
3	MMEN 511	Iron and Steel Making	3
4	MMEN 523	Welding and Brazing	2
5	MMEN 533	Powder Metallurgy	2
6	MMEN 541	Furnace Technology	2
7	MMEN 543	Composites	2
8	MMEN 591	Technical Report writing	1
9	MMEN 597	Final Year Project I	3
		Total	18

LIST OF COURSES OFFERED IN SECOND SEMESTER 500 LEVEL

S/No.	Course code	Course description/Title	Credit unit
1	MEEN 502	Production Management II	2
2	MMEN 512	Process Design	2
3	MMEN 522	Foundry Technology	2
4	MMEN 532	Mechanical Working of Materials	2
5	MMEN 552	Principles of Materials Selection	2
6	MMEN 598	Final Year Project II	3
		Total	13

SUMMARY TABLE

S/No.	Level	Total Credit Unit
1	100	39
2	200	38
3	300	34
4	400	25
5	500	31
	Total	167

3.2 Curriculum

The Metallurgical and Materials Engineering (MMEN) curriculum will be organized to provide three educational components:

1. Fundamentals of metallurgical and materials, applications of the fundamentals and emphasis in one of three focus areas.

a. MMEN Basics: The basic curriculum in the Metallurgical and Materials Engineering Department will provide a background in the following topic areas:

i. Crystal structures and structural analysis: Crystal system; symmetry elements and Miller indices; atomic bonding; metallic, ceramic and polymeric structures; x-ray and electron diffraction; stereographic projection and crystal orientation; long range order defects in materials.

ii. Thermodynamics of materials: Heat and mass balances; thermodynamic laws; chemical potential and chemical

equilibrium; solution thermodynamics and solution models; partial molar and excess quantities; solid state thermodynamics; thermodynamic of surfaces etc.

iii. Phase equilibria: Phase rule; binary and ternary systems; microstructural evolution; defects in crystals; surface phenomena; phase transformations; eutectic, eutectoid, martensitic, nucleation and growth recovery; strengthening mechanisms; quantitative stereology and heat treatment.

iv. Properties of materials: Mechanical properties, chemical properties (oxidation and corrosion); electrical, magnetic and optical properties; failure analysis.

b. MMEN Applications: The course content in the Metallurgical and Materials Engineering programme emphasized the following applications:

i. Materials processing: Particulate processing, thermo- and electro-chemical materials processing, hydrometallurgical processing, synthesis of materials, deformation processing, casting and welding.

ii. Design and application of materials: Materials selection, ferrous and non-ferrous metals, ceramic materials, polymeric materials, composite materials and electronic materials.

c. MMEN Focus Areas: There are two focus areas within the Metallurgical and Materials Engineering curriculum. These are:

i. Physico-chemical processing of materials

ii. Physical-mechanical metallurgy

3.3 Course Syllabi: (Course Unit and Semester System)

3.3.1 Description of the courses:

100 LEVEL COURSES

ENGG 102: ENGINEERING PROFESSION AND INSTITUTION (1 CREDIT)

Development of professional engineering: history of technology and its effect on society, the engineering institutions, their objectives and functions. Data measurement, representation and interpretation, report writing and oral presentation of information.

GENS 102: ENVIRONMENTAL HEALTH (1 CREDIT)

Introduction to Environmental Health: Concept of Environment:

Concept of Health. Relationship between Environment and Health. Relationship between Environment and Disease. Environmental hazards and their effects on health. Environmental Hazards and Examples. Sources of Environmental Hazards. Effects on Human Health. Control of Environmental Hazard. ACCIDENT Definition: Distribution, types, human factor, causes. Control of Accident. Prevention Should Focus on: First Aid. Contributions of students to environmental protection. The need, their contributions. Leadership, Violence at Home and Society. Definition of Violence. Type of Violence. Causes of Violence. Cultural Values that Constitute Violence. Violence in the Family. Prevention and Control of Violence. Conservation of Natural Resources. Soil Air Water relationship. Soil Water Plant relationship. Plant Animal Man relationship. Environmentally friendly situation. Conservation of renewable and non-renewable natural resources. Need for environmental impact assessment studies.

200 LEVEL COURSES

CVEN201: FUNDAMENTALS OF STRUCTURAL ANALYSIS (2 CREDITS)

Concept of structural analysis. Stability and determinacy of frameworks. Analysis of statistically determinate structures. Bending moment and shear force diagrams for determinate beams. Beam deflection. Framework deflections and strain energy in frames. Suspension cables. Determinate arches, stability of gravity sections.

WREN 201: FLUID MECHANICS I (2 CREDITS)

Properties of Fluids: Pressure, viscosity, surface tension, compressibility etc. hydrostatics: Variation of pressure with position in a fluid, equilibrium of a fluid of constant density, measurement of pressure, barometer, manometer, the Bourdon gauge, thrust on plane and curved surfaces, buoyancy, stability of floating and submerged bodies.

Principles of Fluid Motion: Continuity, Bernoulli's equation, energy transformation in a constant density fluid, energy correction factor, streamlines, pressure variation perpendicular to streamlines, flow through a sharp-edged orifice, pilot tube, venturi meter, nozzle and orifice meter, notches and sharp crested weirs.

Momentum Equation: Momentum equation for steady flow, momentum correction factor, application of the momentum equation, force caused by a jet striking a surface, force caused by flow round pipe

bend, force at a surface, force at a nozzle and reaction of a jet under short wheel as an example of a simple hydraulic machine.

MEEN 201: ENGINEERING GRAPHICS (2 CREDITS)
The principles of engineering drawing, engineering lettering, figures and types of lines (BS 308 -1972, Part 1,2,3), dimensioning, useful geometrical constructions, principles of tangency, loci-conk sections (ellipse, hyperbola, parabola); cycloids, epicycloids, hypocycloids, involutes, helices, orthographic project (1st and 3rd angle orthographic projection).

MEEN 202: ENGINEERING DRAWING (2 CREDITS)
Isometric projection; free hand sketching, sections and sectional views, auxiliary projections, interpretation of surfaces, development of surfaces, screw threaded and threaded screwed fastenings, conventional representation on the threaded elements on drawing.

MEEN 204: STRENGTH OF MATERIALS (2 CREDITS)
Direct stress and stain: tension, compression. Hook's law elastic constants, strain energy, impact load, thermal stress.
Geometrical properties of areas: centroid, first and second moments of area, parallel axis theorem, product moment of area, cross sections having and not having axes of symmetry.
Simple theory of bending: Classification, bending moment and shear force diagrams, relations between bending moments, shear force and load, bending stress section modulus, strength requirements, combined bending and tension/compression, eccentric loading, unsymmetrical bending, compound bars deflection of beams.
Simple shear force: Shear stress, shear strain, Hooke's law technical shear. Torsion of circular cross-sections: Torque diagram angle of twist, shear stress due to torsion, transmission to power by shafts, helical springs. Special problems statistically indeterminate problems, thin cylinders and spheres under pressure.

MEEN 206: FUNDAMENTALS OF DYNAMICS (2 CREDITS)
Kinematics of particles: rectilinear motion, plane curvilinear motion, appropriate choice of reference frame in solving problems. Relative motion, translating axes. Kinetics of particles: Newton's second Law of Motion, Work and Kinetic energy method for deriving equations of motion, Impulse and momentum. Kinetics of systems of particles: Defining equations, Steady mass flows, Variable mass problems. Plane kinematics of rigid bodies: Absolute motion, Relative Velocity, Instantaneous centre of zero velocity, Relative

acceleration. Plane kinetics of rigid bodies: General equation of motion, Translation, Fixed-axis rotation. General plane motion, Work energy relations, Impulse and momentum equations for rigid bodies.

MEEN 208: BASIC THERMODYNAMICS (2 CREDITS)
Dimensions and Units: (S.I. Units to be Introduced): Fundamental concepts: Energy i.e., Potential, Kinetic, internal; property, state, process and cycle system and surroundings; pressure; temperature, Zeroth law, arbitrary nature of temperature, scales; equilibrium reversibility, heat and work.
First Law of Thermodynamics: As applied to closed and flow systems and in the cyclic and non-cyclic (process) forms, as well as in the differential form; Application to particular processes of constant volume; constant pressure, Isothermal, adiabatic, polytrophic and throttling; the flow energy equation and its application to turbines, compressors, nozzles, boilers, condensers, heat exchangers (treated as black boxes only).
Second Law of Thermodynamics: Definition of heat engines, Carnot cycles, thermodynamic temperature scale, entropy (as a property)
Properties of Pure Substances: Condensable fluids: T-P diagram, P-V diagram, the two-phase mixture, T-S diagram, h-s diagram, the use of property tables and diagrams
Perfect Gases: Propertiesof perfect gas; entropy changes in perfect gases.

MMEN 201: FUNDAMENTALS OF MATERIALS SCIENCE
(2 CREDITS)
Physical properties of materials: structure of atoms, bonding forces, structure of matter, including mention of wood, cement and plastics. Electrical properties of materials: electrical properties, conductors, electronic properties, semi and super-conductors, magnetic properties, dielectric properties, thermoelectricity. Mechanical properties: Tensile, hardness, impact properties of materials. Thermal properties: Thermal capacity, thermal expansion, thermal conductivity, thermo-couple phenomenon, temperature consideration in the choice of materials. Chemical properties of materials: corrosion phenomenon and its prevention. Physical Metallurgy: structure of crystalline materials, solidification, mechanical working, liquid and solid solutions, introduction to the concepts of phase and solid solutions, introduction to the concepts of phase equilibrium, micro and macro-structure of materials. Non-

metallic materials: Cement, concrete, wood, ceramics (glass, ceramic ware), plastic (wood, rubber etc) and resin.

MMEN242: INTRODUCTION TO BIOMATERIALS
(2 CREDITS)
Molecular structure, polymer synthesis reactions, protein-protein interactions, multifunctional organic materials including polymer nanoreactors, conducting polymers and virus-mediated biomineralization, molecular and cellular interactions with biomaterials are analysed in terms of unit cell processes, such as matrix synthesis, degradation, and contraction.

Wound healing and tissue remodelling following implantation in various organs. Other areas include tissue and organ regeneration; design of implants and prostheses based on control of biomaterials-tissue interactions; comparative analysis of intact, biodegradable, and bio-replaceable implants by reference to ease studies.

MATH 241: CALCULUS I (3 CREDITS)
Sequences and Functions: Infinite sequences and their limits, a short recollection of elementary functions and their properties, limits and continuity of functions of a single independent variable. Differential Calculus: Definition of thee derivative. Differentiability of a function of one independent variable; geometrical and physical interpretation of the derivative, techniques of differentiation, Rolle's theorem and the mean-value theorem, Taylor and Maclaurin's series expansion, application of differentiation; maxima and minima of function of a single independent variable, curve sketching in Cartesian rectangular coordinates, L'Hospital rule for evaluation of limits of functions in the indeterminate forms, tangents and normal, curvatures and evolutes of plane curves, Leibniz's formula, for finding the nth differential coefficient of a product of two functions. Integral calculus: indefinite integral, techniques of integration - change of variable, integration by parts and reduction formulae, integration of rational functions (standard integral and methods of partial fractions), the definite integral interpretation and properties; applications of integration, average value of a function, finding lengths of areas, plane areas, volumes of solids of revolution area of surface of revolution, pressure, etc.

MATH 242: CALCULUS II (2 CREDITS)
Infinite number series and their properties, tests of convergence complex number series. Improper integral: Improper integral of types

I, II and III. Evaluation of improper integral, convergence of improper integral, Convergence in the Cauchy Principal value, tests of convergence. Partial differentiation: partial derivatives of functions of two or three variables, total differentials and applications. Ordinary differential equations: First order differential equations with variables separable, exact equations and integrating factors: linear first order equations and those reducible to linear form. The Bernoulli equation, applications (geometrical and physical situations).

MATH 243: METHODS OF LINEAR ALGEBRA 1 (2 CREDITS)
Complex numbers: addition, multiplication, division, argand diagram, polar representation, DeMoivre's theorem. Vector Algebra: Definition of Vector and Physical examples, addition, multiplication by scalar, scalar and vector products, triple products, components, applications in geometry. Vector Analysis: Cartesian and polar coordinates in two and three dimensions. Vector functions of a real variable, continuity and differentiation, application to curves and surfaces in 3 space equation of straight lines, plane and sphere, tangent and normal to a curve, tangent plant and normal to a surface.

MATH 244: METHODS OF LINEAR ALGEBRA II (3 CREDITS)
Determinants and matrices: definition and properties of the determinant, its evaluation, matrices addition, multiplication by scalar, adjugate, inverse of non-singular matrix, rank and its evaluation. Simultaneous linear equations, consistency, linear dependence, solution (including Cramer's rule) eigen values and eigen vectors, special matrices, symmetric, skew symmetric orthogonal etc.

CHEN 202: INTRODUCTION TO MANAGEMENT (1 CREDIT)
Introduction (definition, uses and types of organization, need for management, the manager and its functions), planning, decision making, organizing, directing and leadership (motivation, communication and leadership), control.

EEEN201: ELECTRICAL CIRCUITS AND FIELD THEORY
(2 CREDIT)
Field Theory:
Electric: Electric charges, Coulomb's Law, Gauss' Law. Electric field. Electric dipoles, potentials, capacitance, work energy. Magnetic: Magnetic forces between current elements, Biot-Savart Law. Ampere's Law. Lenz's law, Lorentz Law. Motor Principle. Generator principle. Work Energy.

EEEN203: ELECTRICAL MACHINES, POWER AND INSTALLATION (2 CREDIT)

Transformers and Rotating Machines:

Basic Principles: Induction (Faraday's Laws), interaction (Biot-Savart Law), and alignment. Generalized Basic Units: Magnetic, electrical, mechanical and thermal. Qualitative analysis of the production of torque and rotation of electric machines. Generalized torque equation of electric machines and simple calculations. Transformer; Constructional features, types, connections (including 3-phase type) and application of various types. DC Machines: Constructional features, types (separately excited, shunt, series and compound), and application. Induction Machines: Constructional features, types (single phase and 3-phase), types of rotors (squirrel cage and wound or slip-ring) and application. Synchronous Machines: Constructional features, types (salient or non-salient poles types), and application. Brief Introduction and Application of Special Machines: A.C. commutator machines, general purpose machines, repulsion machine, linear motors, etc. Electric Power Generation, Transmission and Distribution Types of Power stations. Power generation and transmission problems (Flow diagram representation from generator to consumer terminals). The synchronous generation and its importance in power generation (from small types) in motor cars to huge types in power. Transmission of electric power; The H.T. overhead lines and step-up power transformers in overhead lines (330 K V lines).

Distribution of electric power using overhead lines and underground cables (show typical underground cables). The distribution transformers in power distribution and their use in the design of estates A.C. and D.C. supplies. The use of A.C. in preference to D.C., stressing the importance of the transformer. Single and three phase supplies; (delta and star connections); typical 3-phase, 4-wire distribution systems. Two wire services and typical consumer circuits. The meaning of impedance (X), volts (V), power ohms and power factor (PF) in A.C. supply systems.

Wiring System

Supply, control and distribution in buildings including; intakes, diversity, wiring circuits for lighting using loop methods, number of points on one circuit, wiring socket outlets. Conductors and cables including; main parts of cables, types of insulators and the choice of cable sizes in various types of installation. Wiring systems including: Conduct systems, rubber and PVC soothed systems; components and accessories used in wiring systems, ceiling roses, lamp holders,

switches etc.

Safety precaution including, the need for safety, the use of circuit breakers and fuses, and the importance of earthling. Illumination: Principle of illumination, definition of terms and the inverse square law. Glare and its effects. Types of lamps and lamp fittings. Principle of lighting design and illumination requirement for various types of usual tasks.

MMEN208: STUDENTS' WORK EXPERIENCE PROGRAMME (SWEP) (3 CREDITS)
Purely practical experience to be acquired at Metallurgical/Materials, Electrical, Civil, Mechanical Engineering Departments and any other engineering department.

300 LEVEL COURSES

MMEN 311: MINERAL PROCESSING (2CREDITS)
Introduction: Origin and formation of mineral deposits. Principal Ores of common metals. Discussion of the minerals' wealth of Nigeria, their locations and types. Scope, objectives and limitations of mineral dressing.
Comminution and liberation: Theory and practice of crushing and grinding. Typical equipment used, their field of application and limitations.
Sizing and classification: Principle of sizing and classification. Equipment used for laboratory and industrial sizing. Law of settling of solids in fluids. Types of classifiers. Classification as a means of sizing and concentration.
Concentration: Gravity concentration methods using jig, spirals, tables, and heavy media separators. Application and limitations of each method. Froth flotation and physicochemical principles involved therein. Flotation machines and flotation of simple ores. Electrostatic and electromagnetic methods of concentration De-watering and drying: Theory and practice of thickening, filtration and drying.
Coal/washing: Coal/shale separation, coal flotation and cleaning. Flowsheets: Simplified flowsheets for the beneficiation of simple ores of copper, tin, lead, zinc, iron, gold, and other ores of local importance. Tailing's disposal: Methods of tailings disposal and implications on ecosystem.

MMEN 312: THEORY OF METALLURGICAL PROCESSES (2 CREDITS)

Thermodynamics of solutions: A review of concepts of thermodynamics of ideal and non-ideal solutions.

Kinetics: Rate of reaction, collision theory, Arrhenius equation, order of reaction, nucleation and growth.

Diffusion: Steady state and non-steady state diffusion. Fick's laws, simple diffusion equations, chemical potential and atomic mobile at, temperature and concentration dependence of diffusion, Kirkendal effects, measurement of diffusion.

Metallurgical processes: Thermodynamics and kinetics of dissociation of solid oxides and carbonate; kinetics of metal oxidation; mechanism and kinetics of metallurgical slag formation; chemical reaction of metals and oxide melts; thermodynamics and kinetics of the formation of non-metallic inclusion in melts; electrochemistry of melts and slags.

Scope of metallurgical/materials industries

Fundamentals: Fundamental idea about decomposition, reduction and slagging. Basic principles of extraction of Cu, Zn, Pb, Al, Fe, Sn, and Au with simplified flowsheets.

Unit processes: Treatment of some important unit processes including the chemistry involved and the types of equipment used in palletizing, briquetting, sintering, roasting, smelting, converting, leaching, concentration, electrolysis and refining.

MMEN313: THERMODYNAMICS OF MATERIALS (2 CREDITS)

Review of thermodynamics part 1, treatment of the laws of thermodynamics and their applications to equilibrium and the properties of materials. Provide foundation to treat general phenomena in materials science and engineering, including chemical reactions, magnetism, polarizability, and elasticity. Develop relations pertaining to multiphase equilibria as determined by a treatment of solution thermodynamics. Develop graphical constructions that are essential for the interpretation of phase diagrams. Treatment includes electrochemical equilibria and surface thermodynamics. Introduce aspects of statistical thermodynamics as they relate to macroscopic equilibrium phenomena.

MMEN 322: PHASE TRANSFORMATIONS (2 CREDITS)

EQUILIBRIUM DIAGRAMS

Binary equilibrium diagrams: Phase rule, phase diagrams of single-phase eeutectic, peritectic, intermediate, monotectic and syntectic

alloys. Analysis of complex phase diagrams. Study of equilibrium structures.
Ternary equilibrium diagrams: representation of the phase diagrams, horizontal and vertical sections of simple systems. Solidification: Liquid-solid transformation
Nucleation and growth: atomic structure of liquids, homogenous and heterogeneous nucleation. Growth forms of crystals in the melt. Plannar and dendritic growths. Growth forms of non-metals. Freezing of metals: Cooling curves from pure zinc and alloy metals. Structure of an ingot. Non-equilibrium freezing of single-phase alloys, constitutional supper cooling, cellular structures.
Freezing of eutectic alloys: Eutectic morphology. Nucleation and growth mechanism of eutectic structures and factors influencing them. Application to metal-metal, metal-non-metal and non-metal- non-metal eutectics. Ternary eutectic structures freezing and structures of peritectic and monotectic alloys, grain shape, size and grain boundary migration, phase distribution.

SOLID-SOLID TRANSFORMATION
Solid-solid phase mixtures: Structure of solid-solid interphase surfaces (boundaries) e.g., coherent, semi-coherent and non-coherent boundaries.
Structure of alloys: Homogeneous and heterogeneous solid solution. Primary solid solutions, intermediate phase, theory of alloy phases. Solution, stability of phases and equilibria.
Order-disorder structures: Order disorder structures in alloys. Theoretical bases for order-disorder changes. Long-range and short-range order, anti-phase domains, clustering, etc.
Nucleation process: Homogeneous and heterogeneous solid-solid nucleation. Nucleation rate and C-curve. Nucleation sequence of typical precipitation processes e.g., Al-Cu, Al-Ag, etc. Nucleation at grain boundaries.
Growth mechanisms: Military and civilian transformations, rates of transformation, TTT curves. Treatment of typical growth morphologies, single phase growth from solid solutions. Widmanstantten structures. Eutectoid transformation, pearlitic growth, bainitic transformation (lower and upper bainites). Martensitic transformation, massive transformation.
Structure modification: Homogenization, spheroidization, grain refinement, annealing, age hardening, zone refining, etc.

MMEN 324: CHRYSTALLOGRAPHY (2 CREDITS)
Structure of atoms: Components of the atom, electrons, protons,

neutrons, etc. Quantum number, electronic structure of atoms, periodic table, chemical behaviour of elements, metals and non- metals.
Electronic theory: Free electron theory, atomic and molecular energy levels, energy of electronic theory in metallurgy.
Inter-atom: Aggregate of atoms, origin of inter-atom forces, homopolar and metallic bonding, structure of gases, liquid and solids.
Structure of metallic crystals: Transition from homopolar to metallic bonding, structure of crystalline solids, unit cell of the Bravais lattices, simple crystal structures, atomic packing in FCC, BCC, and HCP crystals, octahedral and tetrahedral voids, stacking faults in HCP and FCC crystals, allotropy.
Other crystals: Caesium chloride, diamond cubic, sodium chloride, zinc blend, wurtzite and selenium. Ideal and real crystals, crystal imperfections.
Stereographic projection: Notation, location of poles standard projections, rotation of poles, pole of a zone, standard triangles interplannar angles etc.
X-ray techniques: Properties and production of x-rays, continuous and characteristic spectra absorption of x-rays, filters, scattering microscopy. Application of x-ray techniques to precise lattice determination, phase diagram determination, chemical analysis, stress measurements, grain size determination, detection ordering, lattice defects and imperfections.
Electron techniques: Theory of electron diffraction and electron microscopy. Metallurgical applications. Electron micro probe analyzer principle and application.

MMEN 331: MECHANICAL METALLURGY (2 CREDITS)
Elastic deformation of metals: Principles of stresses, strains in metals. Complex stresses on two planes at right angles. Mohr's circle. Principal stresses and strains, maximum shear stresses. Distortion energy and yield criteria.
Plastic deformation of metals: Concept of plastic deformation, point defects, vacancies, interstitial and impurity atoms. Line defects, slips, twins, etc.
Dislocation theory: Review of crystal geometry, crystallographic planes and directions. Stress field and strain energy of point- defects. Dislocation types and properties. Burger's vector, stress field and strain energy of a dislocation. Forces between dislocations, partial and supper dislocations, dislocation glide and climb, jogs, interaction with vacancies, interstitials and solute atoms, dislocation density.
Plastic deformation of single crystals: Deformation by slip system of

FCC, BCC and HCP single crystals. Critical resolve stress, deformation by twinning, twin planes and directions. Stacking faults, deformation bands and kink bands. Lattice fragmentation, theoretical strength of single crystals.

Plastic deformation of polycrystalline metals: Structure grain boundaries, effect of grain size and grain boundary structure on plastic flow. Theory of yielding, necking and failure, yield and ultimate strengths. Strain rate effect, Bauschinger effect, residual stresses, internal friction, mechanical working of metals, texturing (preferred orientation), stress concentration. Hardening and strengthening by point defects, (including solution hardening), second phase particles and other phase particles structures. Work hardening.

Fracture analysis: Fracture curves in single crystals and polycrystalline metals, e.g., cleavage, shear, ductile, etc. theoretical cohesive strength. Factors affecting the initiation and propagation of cracks.

MMEN 332: FUNDAMENTALS OF MATERIALS TESTING (2 CREDITS)

Introduction: General properties of metals. Full explanation of mechanical property parameters, e.g., strength, ductility, hardness, toughness, etc. Typical mechanical property values of common metals and alloys.

TESTING OF MATERIALS

Shear testing: Transverse and torsion tests, significance of shear properties of materials.

Creep testing: Creep curves, short-term and long-term creep tests, strength.

Fatigue testing: S-N curves, fatigue limit and fatigue testing machines.

Impact testing: Notch sensitivity in materials, stress concentration effects of imperfection, notches, voids and inclusion. Impact testing machines (Izod and Charpy). Transmission of temperatures of materials.

Hardness testing: Types of testing machines (indentation tester, micro-hardness tester and shore scleroscope) and their principles. Non-destructive testing: Principles, scope and limitations of radiographic, magnetic, electric, ultrasonic and fluorescent methods including their applications.

MMEN 342: METALLURGICAL ANALYSIS (2 CREDITS)

PHYSICAL ANALYSIS

Electrical measurements: Resistance measurements and application to metallurgical measurements. Useful methods, potentiometer and bridge

methods, application in strain, load and phase transformation measurements.
Thermal analysis: Method of temperature measurements with particular references to low, ambient and high temperature measurements, principles of thermo-electric effects, pyrometers etc.
Thermal analysis in metallurgy dilatometry and D.T.A. techniques. Optical metallography: Metallographic microscopes principle and construction. Types of lenses (objectives and eye pieces) and illumination. Use of hot stage, polarized light and phase contrast. Macro-techniques, micrographic techniques in metallurgy.

CHEMICAL ANALYSIS
Introduction: The need for analysis in the metallurgical industries. Quantitative and qualitative methods of analysis.
Preparation of solutions: For analysis of ores of Fe, Pb, Sn, Mu, Cu, Al, etc; slags, fluxes, scraps, metals and alloys.
Method of analysis: Classification methods (titrimetric and gravimetric), instrumental methods.
Titrimetric methods of analysis: Qualitative and quantity methods, simple calculations in qualitative and quantitative analyses, calculation of pit of solutions, preparation of standard solution for titration.
Gravimetric method of analysis: Analyses and identification of groups: I, II, III, IV, and V cations. Specific analysis of alloys, iron ores and their slags, tin ores and their slag, fireclay and sand used for making refractories.
Analysis of metallurgical fuels: Solid fuels e.g., coal, liquid fuel, fuel gases.
Physical (instrumental method of analysis): Instrumental method of analysis such as: electrochemical colorimeter, spectrophotometric and spectrographic analyses, flare emission photometry, x-ray methods etc. Only principle and the application of the methods should be covered.

MMEN 346: WOOD TECHNOLOGY (2 CREDITS)
Introduction: General definition of wood, classes of wood: traditional wood in the group of domestic and art wares, etc; engineering or industrial wood; processing of wood; structure of wood; properties of wood e.g., mechanical, physical and chemical properties; preservation of wood for industrial use; application of wood in metallurgy e.g., pattern making in foundry.

MMEN 347: CERAMICS (2 CREDITS)
Introduction: General definition of ceramics, classes of ceramics e.g., traditional ceramics in the group of domestic and art wares, pottery etc;

engineering or industrial ceramics e.g., bricks, tiles, abrasives, dielectric insulators, semi-conductor, glass, etc.
Clays: Formation and types of clays, structures of clay minerals such as kaolin, montmorillonite, illite, etc. Clay water system, cation exchange. Reaction of firing, finishing and testing.
Silica: Nature and occurrences, types and structures of silica inversion and conversion of silica. Effects of impurities and fluxes on the properties of silica.
Ceramics: Selection and preparation of ceramics raw materials. Mixing, moulding and drying procedures. Firing of the conventional ceramics products. Blending, mixing and sintering of special ceramic products e.g., cermets and abrasives; structure and application of ceramic abrasives, insulating, magnetic and dielectric materials etc.
Glass: Definition and general properties of glass. Types and composition of different glasses and their applications. Manufacture of glass, shaping and heat-treatment of glass products. Mechanical properties of glass. Special glasses e.g., glass-metal, glass- ceramics, photo sensitive and high refractive index glasses. Refractory: Definition and general properties of refractory, types and composition of different refractory and their applications. Manufacture of refractory

MMEN391: LABORATORY COURSE WORK I: PROCESS (1 CREDIT)

MMEN 392: LABORATORY COURSE WORK II: MECHANICAL (1 CREDIT)

MATH 341: DIFFERENTIAL EQUATIONS AND TRANSFORM (3 CREDITS)
Exact equations, linear equations of first and second order with variable coefficient, geometrical interpretation, isoclines, statement of existence theorem, series solution of differential equation with non-singular points, definition of Bessel equation and Bessel function of the first kinds, definition of Legendre equation, Legendre polynomials, Fourier integral and transforms, Laplace transform and its applications to the solution of differential equations.

STAT 343: STATISTICS (2 CREDITS)
Axiomatic definition of probability, basic rules of probability, Bayes formula, Random variables, probability distributions (rectangular, hypergeometric, binomial, multinomial, poisson, normal, geometric, exponential, beta and gamma), Mathematical expectation, Mean, variance and moments, Bivariant distributions, joint, marginal and

conditional distributions, covariance. Correlation coefficient Bivariant normal distribution. Regression and correlation, method of least squares, regression curves. Random sampling, sampling distributions. Expected values, standard error and the central limit theorem. Student's t-test, X^2 and F distributions. Estimates of parameters, maximum likelihood principle, confidence intervals for mean, proportion, variance, difference of means, difference of proportions and ratio of variances. Elements of tests of hypothesis, critical region significance level, type I and II errors, power functions, testing the mean of a normal population when variance is known, testing the difference of means of two normal populations having equal but unknown variances, testing the variance of a normal population, testing the ratio of variances of two normal populations, test of independence inn consistency tables, test of goodness of lift.

COSC344: BASIC COMPUTER KNOWLEDGE AND FORTRAN PROGRAMMING (3 CREDITS)

Binary, octal and hexadecimal number series, conversion, complement of numbers, representations of negative numbers, digital computers, main functional elements of a computer (memory control and arithmetic units, input-output devices, backing storage) information in the core store, binary coded decimal fixed and floating point representations, programming languages (short summary of the machine-code, assembly, machine and problem oriented languages), the flow chart language, loops, iteration, the basic Fortran, Numerical data, Arithmetic, Arrays, Input Out control statement, segmentation of programmes, statement function, function and subroutine segments common, equivalence statements.

QTYS 309: ECONOMIC ORGANISATION (1 CREDIT)

Introduction to economics: Elementary concepts, evolution of economic activity, characteristics of modern economic concepts. Basic Economics; Economics of taxation and public expenditure, business organization, industrial concentration and government control. Location of West African industry and trade: Background of West African economy, economic planning, development problems. The banking system: Money and Capital Markets, inflation, cost- benefit analysis.

400 LEVEL COURSES

MMEN411: NON-FERROUS EXTRACTIVE METALLURGY
(2 CREDITS)

Fundamentals: General classification of metals, periodic table, industrial classification into heavy, light, minor, noble, refractory, rare-earth, disseminated and radioactive metals. Extraction of metals: Chemical reaction processes, chemical reaction involved in the extraction of specific metals by reduction, hydro-metallurgical, electro-metallurgical and pyro-metallurgical processes, limitations and factors influencing the choice of a refining process. Application: refining and typical flow sheets of extraction of specific metals. Particular reference being made to aluminium, copper, zinc, lead, tin, nickel, gold, magnesium, etc. Refining plants: A study of the design and operations of extraction equipment and plants. Problems encountered in various plants, e.g., environmental pollution, etc.

MMEN 413: CORROSION ENGINEERING (2 CREDITS)

Introduction: Definition of corrosion and corrosion engineering, corrosion damage, cost of corrosion, corrosion and society; monetary considerations and social implications, rust formation, environments, economic and environmental issues in corrosion engineering.

Principles of corrosion: Factors affecting corrosion rates; oxygen and oxidizers, velocity, temperature corrosive concentration, Galvanic coupling, metallurgical properties, Ringworm. Practical aqueous corrosion/electrochemical aspects of corrosion, thermodynamic aspects of corrosion reaction, adsorption heat, Faraday's law and Nernst equation, the basic wet corrosion cell, standard electrode potential, Galvanic and electrochemical series, reference electrode(s), SCE. Cell potential, the Daniel cell, kinetics of corrosion reactions, activation energy, Arrhenius equation, polarization, activation and concentration types, diffusion processes and the double layer, mixed potential theory, Evans diagram, E/log plots and E/pH (Pourbaix) diagrams.

Corrosion properties of some materials: Metals and alloys, ceramics, carbon and graphite, wood, non-metallics, thermoplastics, thermosets, composites.

Forms of corrosion: Galvanic/dissimilar metal corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching, erosion corrosion, stress corrosion, hydrogen embrittlement.

High temperature corrosion: Metal oxides, pilling bedworth (PB) ratio, breakaway corrosion, mechanisms of oxide film growth. Corrosion testing and monitoring; classification, purposes and general procedures

involved in corrosion testing and monitoring. Corrosion prevention and control; materials selection, alteration of environments, changing media and inhibitors, design, cathodic and anodic protection, coating and electroplating.

MMEN 415: POLYMER ENGINEERING (2 CREDITS)
This course offers an overview of engineering analysis and design techniques for synthetic polymers. Treatment of materials properties selection, mechanical characterization and processing in design of load-bearing and environment-compatible structures are covered.
Polymer structures: Introduction, hydrocarbon molecules, polymer molecules, the chemistry of polymer molecules, molecular weight, molecular shape, molecular structure, molecular configurations, copolymers, polymers crystallinity, polymer crystals.
Mechanical and thermo-mechanical characteristics: Stress-strain behaviour, deformations of semi-crystalline polymer, crystallization, melting and glass transition phenomena, thermoplastic and thermosetting polymers, visco-elasticity, deformation and elastomers, fracture of polymers.
Polymer application and processing: Polymerization, polymer additives, polymer types, plastics, elastomers.

MMEN 447: MICRO/NANO TECHNOLOGY (2 CREDITS)
Introduction to micro/nano world: Course introduction, scaling, world in micro scale, basics of IC and micro/nano fabrication, thin film coating, oxidation, diffusion/implementation, vacuum systems, CVD, sputtering, evaporation, lithography, CMOS, Etching, IC devices, IC-based micro/nano machining; sacrificial layer concept, thin films, selective wet etching, dry etching, non-Si machining. Mechanical properties of thin films: thin films, residual stress/strain, measurement techniques. Applied techniques: combined machining, flip-up structures, encapsulation, tip sharpening, wafer bonding. Non-IC based micromachining: Micro-EDM, micro-electroplating, micro stereolithography. Micro sensors & micro actuators, micro systems, nano/micro technology applications.

421: PHYSICAL METALLURGY (3 CREDITS)
Heat-treatment: Review of iron as a solvent, phase diagrams of binary iron-carbon alloy. A study of the effects of other alloying elements on the Fe-C phase diagram. As-cast structures of steels and cast irons. Basic principles of heat-treatment of plain carbon steels, cast-iron and commercially important non-ferrous alloys, annealing normalizing

hardening and tempering treatments. Pearlitic, bainite and martensitic transformations in steels. Special treatment: austempering, martempering, mar-aging, strain ageing etc. Quench media and mass effect. Measurement and control of the austenitic grain size, hardenability and its determination. Surface hardening methods and processes.

Alloy steels: Effect of alloying elements on the iron-cement diagram, properties of iron-carbon phases, transformation temperature, critical cooling rate, hardenability, tempering, carbide formation etc. Alloy steels and the special features of heat treatment adopted for each case. Role of impurities and non-metallic inclusions in steels. Aluminium base alloys: Casting: Al-Si, Al-Cu-Si and Al-Mg alloys. A close examination of various intermetallic such as, $CuAI_2$, Mg_2Si, Al-Fe-Si etc. Wrought: Al-Mg-Si and Al-Mg-Cu alloys.

Copper base alloys: (as cast and wrought)

Brasses: B & free-cutting, hot-hand, cold-working etc.

Bronzes: Tin bronzes, phosphor bronzes, bronzes containing zinc and lead, aluminium bronzes etc.

Copper-nickel, copper-chromium etc. Magnesium-base alloys (as- cast)

Bearing metals: Properties of bearing metals and general structure. Commercial bearing metals, Cu-base, white bearing metals, lead- base cadmium-base, zinc-base alloys etc.

MMEN425: MICRO-STRUCTURAL ANALYSES OF MATERIALS (2 CREDITS)

This course is essentially of a practical nature and will be best taught mainly in the laboratory. It deals with the study of the microstructure and their effects on the properties of metallic alloys. The following should be covered: Review of the basic principles of metallography specimen preparation, etching, unicroscopy, photomicrography etc; as-cast structure of non-ferrous alloys of Al, Cu, Mg, Zn, Pb, Sn etc; structure and properties of heat treated non-ferrous alloys; as-cast structure of plain carbon steels, and cast iron; effect of carbon content on the microstructure of plain carbon steels; microstructures of alloy structures e.g. tool steels, stainless steels etc; microstructure of heat-treated plain carbon steels and cast irons; effect of composition and microstructure on the mechanical properties of steels; microstructure of composites, ceramics and polymer.

MMEN 431: FUNDAMENTALS OF WORKING OF MATERIALS (2 CREDITS)

Mechanical working of metals: Principles of hot and cold working of metals, structural and property changes during hot and cold working,

nature of stresses, strains and metal flow in various metal working operations.
Heating of stock: Soaking pits and re-heating furnaces, descaling of steels, precaution to be taken during re-heating of ferrous and non-ferrous metals.

MMEN 491: LABORATORY COURSE WORK III (PHYSICAL)
(1 CREDIT)

MMEN 497: STUDENTS' INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES) (6 CREDITS)
Practical work experience to be acquired at accepted professional firms, industries, research institutes, and relevant public and private organizations

STAT 443: EXPERIMENTAL DESIGN AND CONTROL
(2 CREDITS)
Analysis of variance, randomized blocks, Latin squares, simple factorial designs, statistical quality control, control charts for means, standard deviation, image, number of proportions of defective and defects. Acceptance sampling (sampling inspection plans - examples of single, double, multiple and sequential sampling, plants) the operating characteristics (OC) curve, producers and consumers risks, average sample number (ASN) and average outgoing quality level (AOQL), Linear programming.

QTYS421: LAW FOR ENGINEERS (2 CREDITS)
Introduction to Law. Law of Contract. Law of tort. Law of Arbitration. Alternative dispute resolution. Some Aspects of Commercial Law. Some Aspects of Company Law. Copyrigt Law. Case studies.

500 LEVEL COURSES

MMEN 511: IRON AND STEEL MAKING (3 CREDITS)
Ores: Classification, distribution (world and Nigeria), evaluation and beneficiation. Physical chemistry of the blast furnace: decomposition of materials, reduction of iron oxides, direct and indirection reduction of iron in the blast furnace (equilibrium diagram of Fe-O-H should be looked at), rates of reduction by hydrogen and carbon monoxide. The effect of temperature, velocity and pressure of gases on reduction.

Physical and chemical properties of ores and how they affect rate of reduction as well as advantages and disadvantages. Mn, Si, P, S reduction and desulphurization in the blast furnace. Pig iron and slag formation, properties of slag, methods of blast furnace intensification. Blast furnace operation; irregularities (the peripheral furnace run, channelling, change hanging, cold and hot run of the furnace etc). Blast furnace equipment; ladles, torpedoes, auxiliary equipment e.g. for cleaning and utilization of blast furnace gases etc. Alternative methods of iron making; pellet production (green ball formation, its composition, binder and machine etc), sintering (flored and unflored), direct iron reduction and coke production. High Mn, pig iron production, its uses. Blast furnace design and operation; general design principle, blast furnace profile, refractories instruments, blast furnace assay calculation and thermal balance. Physical chemistry in steel making; thermodynamics oxidation reactions e.g. C, S, P, Mn etc. Deoxidation of steels by Mn, Si, Ti, Al, Si-Ca, Si-Mn etc, diffusion de-oxidation.
Deoxidation using vacuum and synthetic slags. Gases and non- metallic inclusions in steels. Steel making slags, classification of steels. Open-hearth process; principles of the open-hearth process, Bessemer processes, construction of the converters, acid and basic processes (advantages and disadvantages), modification of the processes. Oxygen process; developments of LD converters, construction of LD converter (linings and raw materials), oxidation of impurities in the LD process, steel making practice, merits and demerits of the process. Modifications KALDO, ROTOR, LD-AC processes. Electric arc furnace process (EAF), advantages of the EAF process, construction of EAF and raw materials. Technology of EAF steelmaking (basic and acid), steelmaking in induction furnaces, production of steel from sponge iron. Special treatment; iron gas (especially argon) injection, injection of powdered materials, vacuum treatment of steels (RH,DH, ladle etc). Treatment of steel with synthetic slags. Casting technology; crystallization of steel, ingot structure, types of ingots and their casting, ingot defects and their control, continuous casting of steel production and ferroalloy productions. Secondary steelmaking practice; vacuum EAF and vacuum induction furnace,

MMEN 512: PROCESS DESIGN (2 CREDITS)
Fluid flow: Viscosity and viscous fluid, the differential equations of fluid motion, turbulent flow, overall energy balances in fluid flow.
Heat transfer: Thermal conductivity and steady state conduction, unsteady state conduction of heat, convective heat transfer, radiation

heat transfer, heat transfer with phase changes.
Diffusion and mass transfer: Diffusivity and steady state diffusion, unsteady state mass transfer, mass transfer coefficients, simultaneous heat and mass transfer, coupled transport phenomena. Techniques of process analysis; staged operations, continuous flow systems, similarity criteria, dimensional analysis and modelling. Metallurgical reaction systems; single particle reaction systems, packed bed and fluidized bed system, gas bubbles in liquids, gas jet liquid systems, hydro-metallurgical systems, slag-metal reactions and steelmaking.

MMEN 522: FOUNDRY TECHNOLOGY (2 CREDITS)
Introduction: Present status and scope of foundry industry in the country. Moulding and casting processes; sand mould, permanent mould, plaster mould, shell mould, centrifugal, investment and die-casting methods, shell moulding and CO_2 processes.
Sand technology: Moulding and core sands (sand aggregate, bonding materials and special additives), mechanism of bonding, testing of foundry sands. Effects of variable properties of moulding and core sands. Sand preparation method, equipment and control. Pattern; functions and classification, pattern design and materials. Casting defects; with relevance to moulding materials, gating and risers. Solidification of casting; principles of solidification of metals and alloys, directional solidification, coring and segregation. Gases in metals; oxides, nitrides and carbides, pphosphorus, nitrogen and hydrogen. Their solubility with particular reference to sulphur and phosphorus. Melting; melting furnaces, melting and pouring practices. Ferrous foundry practices; melting, alloying, fluxing and casting practices of Al-base and Cu-base alloys. Casting defects; defects due to incorrect melting alloying practices, inspection, salvaging and finishing of castings.

MMEN 523: WELDING AND BRAZING (2 CREDITS)
Introduction: Role of welding and brazing as manufacturing processes. Welding; types of welding processes, flash, friction lector-and electro-slag welding, etc. Brief treatment of newer processes such as explosive, plasma arc and electron beam welding, welding rods and fluxes, protective atmosphere, welding defects and weldability of metals and alloys. Effect of welding processes and parameters on the structure and mechanical properties of weldments. Heat-treatment of welds.
Design and testing of welded joints: Brazing; scope and limitations, types of processes, brazing alloys, brazing of commercially important ferrous and non-ferrous metals and alloys. Soldering; processes, soldering alloys and application of soldering techniques.

MMEN532: MECHANICAL WORKING OF MATERIALS
(2 CREDITS)
Rolling of metals: Rolling mills and accessories, elements of all pass design, manufacture of rolled products. Forging and extrusion; type of forging processes, forging equipment and forging defects, roll forging and rotary swaging, types of and variables in extrusion, extrusion equipment. Miscellaneous of metal working processes; wire drawing, tube making, sheet metal forming, manufacture of wheels, axles and tyres. Explosive forming, powder metallurgy (metal powder production, compacting and sintering)

MMEN 533: POWDER METALLURGY (2 CREDITS)
Introduction: Historical background of powder metallurgy, comparison of LP/M principle of forming with other methods of forming metals viz plastic deformation of hot and cold metal, casting of molten metal and machining. General principle of powder metallurgy; various stages of powder metallurgy process (process flow sheet). Equipment; plant and equipment used to implement the various stages of production, metal powder production, different methods for the manufacturer of metal powder. Powder characterization and testing; sampling of powder, chemical tests, particle size distribution, particle shape and structure. Compacting; mixing of metal powders, behaviour of metal powders under pressure, density and stress distribution within compacts under pressure in rigid dies, automatic compacting, compacting other than in rigid dies. Sintering practice; batch and continuous types of furnaces with protective atmospheres, vacuum sintering furnaces, purposes of sintering atmosphere. Description of sintering atmospheres. Thermodynamic background of sintering atmospheres. Dimensional and weight changes in sintered products, finishing operations, machining and joining of sintered parts, electroplating and electroless plating, evaporation coating, surface treatments, impregnation treatments, combination treatment. Defects in sintered parts; special techniques to overcome limitations or defects. Product applications; application of P/M structural parts and powder forgings. Their economics and the energy requirements to produce them.

MMEN 541: FURNACE TECHONOLOGY (2 CREDITS)
Fuels; comparative study of solid, liquid and gaseous fuel and factors governing their choice, manufacture of metallurgical coke. Choice, preparation and blending of coal, types of coke ovens and recovery of

by-products fuel economy, numerical calculations on combustion and fuel efficiency Furnaces; furnace as a system involving heat generation, utilization and losses. Construction and operation of melting, reheating and kiln type of furnaces. Sources of heat loss in furnaces and their prevention, insulation, recuperation, regeneration, waste heat boilers, furnace atmosphere and control. Fuel economy and thermal efficiency of furnaces, natural, induced, force and balance draft. Calculation of natural draft, regulation of primary, secondary and excess air in furnaces. Refractories; types, properties, applications and manufacture of refractories.

MMEN552: PRINCIPLE OF MATERIALS SELECTION
(2 CREDITS)
A professional approach to stress the metallurgical view point of composition, micro-structure, heat treatment, influences of impurities, mechanical and environmental considerations involved in the following commercial methods and alloys and their application: Metals and alloys for heavy, medium and light castings; lightweight structural alloys of Al, Mg and Ti, structural steels (plain carbon, alloys steels and ultra-high strength steels), tool steels (carbon, low alloy and high speed tool steels), bearing materials (white metals, Al and Cu base materials), materials for electrical conductors, contacts and resistance (heating elements etc), magnetic material, corrosion and heat resistant alloys, alloys for low and high temperature application, alloys for forming operations.

MMEN 543: COMPOSITES (2 CREDITS)
Historical background of composites and definition of basic terms: Particle-reinforced composites, large particle composites, dispersion-strengthened composites. Fiber-reinforced composites, influence of fiber length, influence of fiber orientation and concentration. polymer-matrix composites, metal-matrix composites, ceramic-matrix composites, carbon-carbon composites, hybrid composites, processing of fiber- reinforced composites.
Principle of manufacturing with resin matrix: Fundamentals, lamination, compression moulding, pultrusion, filament winding, basic concerns. Structural composites, lamina composites, sandwich panels, test applicable to composites, physical property characterization, mechanical property characterization, micromechanics, laminar stress-strain relationships, thermal analysis. Effective moduli of composites; elementary calculations, energy methods. Macro-mechanical behaviour of a laminate, classical laminate theory, structural analysis of composite materials, bending, buckling and vibration of laminated

plates. Strength of unidirectionally reinforced lamina; longitudinal strength, transverse shear strength, lamina failure theory. Failure mechanisms, types of damage, lamina overload, edge effects, interior delamination.

MMEN591: RESEARCH/TECHNICAL REPORT WRITING
(1 CREDIT)
Nature and types of research, research process, elements of research proposal, methods of data collection and analysis, planning scientific research. Designing and administering of experiments, technical report writing and oral presentation techniques of research reports, referencing and citation.

MMEN 599: FINAL YEAR PROJECT (6 CREDITS)
This involves a research work of a chosen and approved topic of which a student is assigned a supervisor to guide him/her in the course of the research. A written and bound copy of the write up on the research will be submitted to the department at the end of the session after having defended it before the departmental board of examiners.

3.4 The Course Credit System
The course units in the Department are organized on the course credit system per semester. A semester lasts for approximately 18 weeks, including the periods of registration and examinations provided that not less than 15 weeks are devoted to actual teaching. One credit unit is the equivalent of 15 contact hours of classroom teaching or 30 hours of laboratory work. Most of the course units in the Department carry the weight of 3 or 2 credit units, suggesting that they are taught for 45 or 30 hours in the semester or 3 or 2 one-hour periods per week. In courses with strong practical component, this means that there are 15 hours of teaching and 45 hours of practical to qualify for 2 credit units or 30 hours of teaching and 45 hours of practical for 3 credit unit courses. However, there are fewer 3 credit unit courses which suggest that more work is required to be done in 45 contact hours per semester or the equivalent in terms of practical and classroom teaching.
At the end of each semester, a final examination is given to bring the course to final conclusion. The final examination in each course unit is weighted 60% of the component while CA/assignments carry the weight of 40% of total marks for the course.
No student can pass in a course unit if he/she fails to submit the CA/assignments.

3.5 Computing Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

Using an example of a 100-level student in the Department with the following results in the first semester: and second semester, the GPA and CGPA are computed as follows:

First semester

(a) Course	(b) Grades	(c) Grade points	(d) Credit Units	(e) Credit points (c*d)
PHYS 111	65(B)	4	2	8
PHYS 131	73(A)	5	2	10
PHYS 161	70(A)	5	1	5
CHEM 111	63(B)	4	2	8
STAT 101	72(A)	5	1	5
MATH 101	73(A)	5	1	5
MATH 103	67(B)	4	1	4
MATH 105	75(A)	5	1	5
MATH 107	47(D)	2	1	2
GEOL 101	41(E)	1	2	2
CHEM 121	57(C)	3	2	6
			16	60

Registered Credit Units (RCU) = 2+2+1 +1 +2+1+1+1+1 +2+2+2 = 16
Earned Credit Units (ECU) = 2+2+1 +2+1+1 +1+1 ++2+2 = 16
Thus, First Semester Grade points average (GPA) = $\frac{60}{16}$ = 3.75

Second semester

(a) Course	(b) Grades	(c) Grade points	(d) Credit Units	(e) Credit points (c*d)
PHYS 122	75(A)	5	2	10
PHYS 142	72(A)	5	1	5
PHYS 162	64(B)	4	1	4
MATH 102	69(B)	4	2	8
MATH 104	70(A)	5	2	10
MATH 106	78(A)	5	2	10
MATH 108	75(A)	5	1	5
COSC 100	72(A)	5	2	10
CHEM 112	56(C)	3	2	6
			15	68

Thus, for second semester (GPA) = $\frac{68}{}$ = 4.53

$$CGPA = \frac{\text{Previous TCP + Present CP}}{\text{Previous TRCU + Present RCU}}$$

Where:TCP: Total Credit Points
CP: Credit Points
TRCU: Total Registered Credit Units
RCU: Registered Credit Units
CGPA: Cumulative Grade Point Average

$$\text{Hence, CGPA} = \frac{60 + 68}{16 + 15} = 4.13$$

3.6 EXAMINATION GUIDELINES

3.6.1 General Guidelines

i. Examinations are normally held at the end of each semester. Examinations may take the form of written papers, oral examinations, practical, the submission of projects, any combinations of these, or any other form approved by the senate. The continuous assessment of course work should be included in determining examination results.

ii. Notwithstanding any provisions to the contrary in these regulations, the senate reserves to itself the power to decide any case on the basis of what appears to it to be fair and just in the circumstances of the case; and to approve examination results in spite of any breach of these Regulations, if the senate is satisfied that the said breach has not substantially affected the examination results.

3.6.2 Eligibility

i. In order to be admitted to any examinations a student must have been registered for the course-units to be examined and must have fulfilled any university requirements concerning residence, fees or other matters. At least 75% attendance is required in all classes, tutorials, laboratories, field/studio practical training etc, to qualify to sit for semester examinations. He/She must also have fulfilled any Faculty requirements regarding attendance at or satisfactory completion of any course-work, practical, assignments, projects or other matters. The standards necessary to satisfy these faculty requirements shall be determined from time to time by a Faculty Board on the recommendation of the appropriate departments, and any changes shall be made known to the students by the start of the relevant teaching

ii. The Registrar shall prepare examination cards with appropriate examinations numbers for issue on the application of students at least two

weeks before the semester examinations begin. These cards will be prepared on the basis of lists of students admitted by each Faculty Examination Officer, who shall certify that the students have been registered for the programme of studies shown for them and have not infringed any Faculty requirements or, so far as the Faculty Examinations Officer has information, any University requirements for admission to Examination.

iii. Before issuing an examination card to any student, the registrar shall confirm that the student has been registered in the Academic Office for the programme of study and has not infringed any University requirements for admission to examinations.

iv. It shall be the responsibility of each student to make sure that he is registered for the appropriate examinations and that he knows the dates, times and places of the examinations for which he is registered. In order to be admitted to any examinations a student must have been registered for the course units to be examined and must have fulfilled any University requirements concerning residence, fees or other matters. At least 75% attendance is required in all classes, tutorials, laboratories etc to qualify to sit for semester examinations. He must also have fulfilled any departmental requirements regarding satisfactory completion of any course work, practical, assignments, projects or other matters.

3.6.3 Conduct

i. A student shall be at the examination room at least ten minutes before the advertised time of the examination. A student is required to supply his own pens, pencils, rulers, etc.

ii. A student may be admitted up to forty-five minutes after the start of the examination but he shall not be allowed extra time. If a student arrives later than forty-five minutes after the start of the examination, an Invigilator may at his discretion admit him if he is satisfied that the student has good reasons for his lateness. The Invigilator shall report the circumstances to the Faculty Examinations Officer who shall advise the Board of Examiners which shall decide whether or not to accept the student's paper.

iii. A student may be permitted by an Invigilator to leave the examinations room during the course of an examination provided that: -

a. No student shall normally be allowed to leave during the first hour or last fifteen minutes of the examinations.

b. A student must hand his script to the Invigilator before leaving if he does not intend to return.

c. A student who leaves the examination room shall not be re-admitted unless throughout the period of his absence, he has been continually under the supervision of an Invigilator or Assistant Invigilator.

iv. A student shall bring his examination card to each examination and display it in a prominent position on his desk.

v. Each student shall complete a form bearing his number, name and signature which shall be collected by the Invigilator of each examination.

vi. During an examination, no student shall speak to any other student or, except as essential, to the Invigilator, or make any noise or disturbance.

vii. No book, printed-paper or written document or unauthorized aid may be taken into an examination room by any student, except as may be stated in the rubrics of any examination paper.

viii. A student must not during an examination directly or indirectly give assistance to any other student or permit any other student to copy from or otherwise use his papers. Similarly, a student must not directly accept assistance from any other student or use any other student's papers.

ix. If any student is found to be, or is suspected of, infringing any of the provisions of paragraphs (i) to (viii) above or in any way cheating or disturbing the conduct of the examination, a report shall be made as soon as possible to the Faculty Examinations Officer and the Dean. The Dean will cause the circumstances to be investigated and reported to the Board of Examiners, and take such steps as may be necessary for the smooth conduct of examinations. The student concerned shall be allowed to continue with the examination provided he causes no disturbance but the Board of examiners may subsequently recommend to the Faculty Board and Senate whether his paper should be accepted and as to any other action that should be taken in the case.

x. A student shall write his examination number, **not his name,** distinctly at the top of the cover of every answer book or separate sheet of paper.

xi. The use of scrap paper is not permitted. All rough work must be done in answer books and crossed neatly through, or in

supplementary answer books which must be submitted to the Invigilator. Except for the printed question paper, a student may not remove from the examination room or mutilate any paper or other material supplied.

xii. At the end of the time allotted, each student shall stop writing when instructed to do so and shall gather his scripts together in order for collection by the Invigilator,

3.8 Results

Semester grades are calculated as Grade Point Average (GPA) on the basis of A (70 -100), B (60 - 69), C (50 - 59), D (45 - 49), E (40 - 44) and F (0 - 39) which are equivalent to 5, 4, 3, 2, 1 and 0 Grade Points (GP), respectively. The approved scoring and grading system for all examinations conducted within the university is as summarized in Table 2.

Table 2: Approved scoring and grading system

(i) Credit Units	(ii) Percentage Scores	(iii) Letter Grades	(iv) Grade Points (GP)	(v) Grade Point Average (GPA)	(vi) Cumulative Average (CGPA)	(vii) Class of Degree
Vary according to contact hours assigned to each course per week per semester and according to work load carried by student	70-100	A	5	Derived by multiplying I and IV and dividing by total Credit Units	4.50-5.00	First Class
	60-69	B	4		3.50-4.49	2nd Class Upper
	50-59	C	3		2.40-3.49	2nd Class Lower
	45-49	D	2		1.50-2.39	3rd Class
	40-44	E	1		1.00-1.49	Pass
	0-39	F	0		<0.99	Fail

i. The minimum pass mark is 40% or GPA of 1.00 is required for graduation. In order to obtain an overall pass in the examinations in any year of study, a student is required to maintain a CGPA of at least 1 .00 to be in "good academic standing"; a student whose CGPA falls below 1.00 at the end of

any year of study shall be placed on probation.

ii. A student who remains on probation for two consecutive semesters and who fails to attain the status of "good academic standing" at the end of that year of study shall be withdrawn from the program of study.

iii. Failure in any course shall be recorded as such and can only be redeemed by re-taking the course as carry-over and passing the examination, but both the initial GP and the "carry-over" GP shall count towards the CGPA. Subject to the conditions for withdrawal and probation as set out above, a student may continue to re-take the failed course unit(s) at the next available opportunity provided that the total number of credit units carried during that semester does not exceed 24.

iv. A student who is absent from any examinations shall be deemed to have failed the course-units missed, unless allowed as below to sit as his first attempt. Senate on the recommendation of the relevant Faculty/School Board may allow the student to sit the missed course-units later, as his first attempt, if the absence is explained on medical grounds (including, for a female student, being more than 34 weeks pregnant), certified by an Ahmadu Bello University Medical Officer. The student's overall results for the first attempt shall then be assessed and if a supplementary examination should be taken then, the Faculty/School Board may allow this if it can be arranged in time, failing which the student shall repeat the course-units. In any case, where a student has been absent from any examination on other than medical grounds, or he was absent on medical grounds but this was not certified by an Ahmadu Bello University Medical Officer, then the Senate on the recommendation of the relevant Faculty/School Board may only allow that the student's sitting the missed course units later should be accepted as his first attempt.

v. A student who is admitted to a program of studies for a first degree without having initially fulfilled the University General Requirement in English Language shall fulfil it before graduation.

vi. The number and titles of the core and elective course-units to be examined shall be as specified in the syllabus approved by Senate.

vii. The Faculty Board may determine from time to time, on the recommendation of the Departments concerned, and shall make any change known to the affected students by the start of the relevant teaching: -

a. The method of determining continuous assessment marks.
b. The weight to be given continuous assessment marks, in the marks for each course-unit provided that the total of the continuous assessment marks for any year of studies shall fall within range from a minimum of 40% up to a maximum of 60% of the aggregate marks allowed for the year;
c. Continuous assessment which for this purpose includes routine term papers, frequent tests (formal and internal), assessment in workshop/laboratory/studio/field/clinics/medical wards/ exhibitions/ assignments etc. as may be applicable to respective disciplines;
d. At least two continuous assessment tests must be given per course for semester;
e. Continuous assessment and semester examination marked scripts must be returned to the students within reasonable time.

The first degree, shall be classified according to the student's final CGPA as follows:

CGPA		Classification of Degree
4.50- 5.00	-	First Class
3.50- 4.49	-	Second Class (Upper Division)
2.40-3.49	-	Second Class (Lower Division)
1.50-2.39	-	Third Class
1.00-1.49	-	Pass
< 1.00-	-	Fail

3.9 Notification of Results

After the Faculty Board has decided on the recommendations to be made to Senate, the Dean may publish them to the students as provisional examinations results subject to approval by Senate. The Head of Department may notify students of the letter grades and CGPA they have obtained. Transcripts of examinations results may only be issued on request to institutions of higher education and to institutional sponsors. Certificate of the award of degrees approved by the Senate shall be issued to successful graduates.

3.10 Discipline

The examinations regulations set out above bind all students, breach of which carries serious punishments prescribed as follows:

3.10.1 Withdrawal of admission from the University

The following offenses shall carry the punishment of withdrawal of admission: Impersonation at examinations. This may involve the exchange of examination numbers/names/answer sheets or the intentional use of someone else's examination number. Introduction of relevant foreign materials into the examination hall. Exchange of relevant materials in examination hall which may involve the exchange of question papers containing relevant jotting and materials, collaboration/copying from each other, exchange of answer scripts, Theft/Removal of examination scripts or materials, Mischief by fire to examination scripts or materials, copying from foreign materials, consulting foreign materials outside the examination hall, Facilitating/abetting cheating.

3.10.2 Rustication for one academic year

The following offenses shall carry the punishment of rustication for one session:

Speaking/conversation during examination, writing on question papers/scripts, bringing mobile phones into the examination hall whether switched off or on.

3.11 OUTLINE OF ACADEMIC SCHEDULES

(A) 1st Semester

Orientation and Registration

New Students	-	2 Weeks
Returning Students	-	1 Week
Lectures	-	15 Weeks
Examination	-	2 Weeks

Semester Break

(B) 2nd Semester

Registration	-	1 Week
Lectures	-	15 Weeks
Examination	-	2 Weeks

(C) Long Vacation

i. Students Work Experience Programme (SWEP): 200 Level students-8 Weeks during the long vacation of the second year

ii. Students' Industrial Work Experience Scheme (SIWES):400 Level students-24Weeks during the second semester and long vacation

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING FACULTY OF ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA

PROVISIONAL FIRST SEMESTER LECTURES TIME-TABLE

DAY	8- 9AM	9- 10 AM	10 -11AM	11- 12 PM	12-	1- 2 PM	2- 3PM	3- 4 PM	4- 5 PM
MON	MMEN425 (TA)	MMEN425 (TA)	MMEN447 (RMD) MMEN 591 (IU)	MMEN447 (RMD) MMEN591 (IU)				PRACTICAL	PRACTICAL
TUE	MMEN 311 (RAM) MMEN541 (LAI)	MMEN311 (RAM) MMEN541 (LAI)	MMEN313 (RAM) MMEN413 (AK&IA) MMEN511(IAM)	MMEN313(RAM) MMEN413 (AK&IA)			MMEN 347 (US)	MMEN 347 (US)	PRACTICAL
WED	MMEN411 (FA) MMEN533 (JOG)	MMEN411 (FA) MMEN533 (JOG)	MMEN 391 (IA)	MMEN 391 (IA)				PRACTICAL	PRACTICAL
THUI	MMEN331 (JOG) MMEN431 (IU), MMEN523(ETD)	MMEN331 (JOG) MMEN431 (IU), MMEN523 (ETD)	MMEN445 (RAM) MMEN543 (AAA)	MMEN445 (RAM) MMEN543 (AAA)				PRACTICAL	PRACTICAL
FRI	MMEN421 (KAB)	MMEN421 (KAB)	MMEN491 (OA)	MMEN491 (OA)				PRACTICAL	PRACTICAL

PROVISIONAL SECOND SEMESTER LECTURES TIME-TABLE

DAY	8 -9AM	9- 10 AM	10- 11AM	11- 12 PM	12- 1PM	1- 2 PM	2- 3 PM	3- 4 PM	4- 5 PM
MON	MEEN 502 (ME) MMEN 324 (TA)	MEEN 502 (ME) MMEN 324 (TA)	MMEN 552 (AAA) MMEN 312 (FA)	MMEN 552 (AAA) MMEN 312 (FA)		**B**	LABORATORY	LABORATORY	LABORATORY
TUE	MMEN512 (IAM)	MMEN512 (IAM) MMEN 242	MMEN 552 (OA) MMEN 392 (DTG)	MMEN 552 (OA) MMEN 392 (DTG)		**R**	LABORATORY	LABORATORY	LABORATORY
WED	MMEN532 (JOG) MMEN342 (TA)	MMEN 532 (JOG) MMEN 342 (TA)				**E**	LABORATORY	LABORATORY	LABORATORY
THU			MMEN 322 (RMD)	MMEN 322 (RMD)		**A**	LABORATORY	LABORATORY	LABORATORY
FRI						**K**			

3.12 REGISTRATION GUIDELINES

i. Fresh students must come with originals of relevant documents to the faculty to collect admission letters after being screened. Successful candidates would be informed of the procedure for registration with the Academic Office, the Faculty and the Department.

ii. Students should note the time and schedule of registration and be in possession of proper identification documents at all times.

iii. Students should consult with their advisors before filling the course registration form.

iv. Pre-requisite and/or co-requisite must be satisfied for courses that

require such

v. All courses are registered at an officially designated centre, except otherwise stated.
vi. Unrestricted electives chosen outside those listed must be approved by the department
vii. Minimum and maximum credit units registered for full time student is 12 and 24 units respectively.
viii. At registration, a student is required to pay the NACES student dues, and buy departmental publications and also settle other charges as may be required from time to time.
ix. Late registration, usually granted after normal registration period, attracts a penalty and does not last beyond a quarter of the semester period.
x. De-registration and registration of additional courses continues through the period of late registration.
xi. De-registration of research project, with consent of the supervisor, is not allowed beyond second semester registration period.
xii. Registration problems associated with ill health may be entertained.
xiii. If, as a result of ill-health, a student is likely to be late for registration, the department should be informed early enough and, upon resumption, supporting evidence(s) must be presented. Application for deferment must be made to/through the department, in time, for such request to be tendered for consideration by appropriate bodies.
xiv. A student is regarded as registered only when the necessary registration forms have been submitted to the departmental registration officer.
xv. A student who fails to register for two consecutive semesters shall be deemed to have voluntarily withdrawn from the course.

3.13 GENERAL ADMINISTRATION OF PROGRAMME

The Head of Department (HoD), who is responsible for the over-all

administration of the Department, is appointed by the Vice- Chancellor in each instance for a fixed period of time.

3.13.1 Administration of Students

a. Student Academic Advising

Apart from the open channel of communication between students and staff and the HoD, each student is allocated to an academic staff for academic counselling. A list of academic advisor/advises is normally published in the Department each session.

b. Handling of Academic Grievances

The department has a senior academic staff as the welfare officer. Each student has an academic staff as an adviser. Students have direct access to each of the Departmental staff and the Head of Department apart from the University's Dean of Students' Affairs. Student's grievances can thus be sorted out directly with individual staff. However, in the event of an unsatisfactory attention, students can take their grievances to the Head of Department who has a responsibility to take up the matter or discuss it at the Departmental meeting. Should the need arise, he may refer the matter to the Dean or the Faculty Board which may also make reference to Senate, in case of a purely academic matter or to the Dean of students' Affairs in case of other matters.

3.14 DEPARTMENTAL STAFF

3.14.1 Academic Staff

S/No.	Name of Staff member	Rank	Qualifications
1	Prof. I. A. Madugu.	Professor	M.Eng., M.Sc., Ph.D., MNSE, MNMS, R. Engr. COREN
2	Prof. S.A Yaro	Professor	M.Sc.,Ph.D., MNSE, MNMS, COMEG,R. Engr. COREN
3	Prof. O. Aponbiede	Professor	M.SC, Ph.D., MNSE, MNMS, R. Engr. COREN
4	Prof. E.T. Dauda	Professor	B.Eng., M.Sc., Ph.D., MNSE, MNMS, R. Engr. COREN
5	Prof. R.A. Mohammed	Professor	B.Sc., M.Sc.,Ph.D, MNSE, MNMS, R. Engr. COREN
6	Prof. T. Ause	Professor	M.Sc., Ph.D,MNSE, MNMS
7	Prof. A. Kasim	Professor	B.Eng., M.Sc,Ph.D, MNMS R. Engr. COREN
8	Prof. M. Abdulmalik	Professor	B.Eng., M.Sc.,Ph.D, MNSE, MNMS, R. Engr. COREN
9	Prof. F. Asuke	Professor	B.Eng., M.Sc., Ph.D, MNMS R. Engr. COREN
10	Prof. T. D. George	Professor	B.Eng., M.Sc., Ph.D, MNMS, COMEG
11	Prof. U. Shehu	Professor	B.Sc., M.Sc., Ph.D, MNMS, R. Engr. COREN
12	Prof. K.A. Bello	Professor	B.Eng., M.Sc., Ph.D MNMS R. Engr. COREN
13	Dr. E.O.A Damisa	Reader	B.Sc., M.Sc., Ph.D, MNMS, COMEG

14	Dr. A.A. Adebisi	Reader	B.Eng., M.Sc., Ph.D MNMS, R. Engr. COREN
15	Dr. J. O. Gaminana	Reader	B.Eng., M.Sc., Ph.D MNMS
16	Dr. R. M. Dodo	Reader	B.Eng. M.Sc.,Ph.D. R. Engr. COREN
17	Dr. L. Isah	Senior Lecturer	B.Eng. M.Sc.,Ph.D. R. Engr. COREN
18	Gebi A. Ibrahim	Lecturer I	B.Eng. M.Sc.,
19	Dr. Usman Ibrahim	Lecturer I	B.Eng., M.Sc, R. Engr. COREN.
20	Dr. Zahraddeen Musa	Lecturer I	B.Eng. M.Sc.,
21	I.I. Abubakar	Lecturer I	B.Eng. M.Sc.,
22	Dr. A.A. Musa	Lecturer I	B.Eng. M.Sc., R. Engr. COREN
23	Abdullahi Ibrahim	Lecturer II	B.Eng. M.Sc.,
24	A. A. Muhammad	Asst. Lecturer	B.Eng.
25	U. L. Lawal	Asst. Lecturer	B.Eng.

3.14.2 Non-Academic Staff (Technical)

S/No.	Name	Rank
1	Mr. E.O. Ochuokpa	Chief Technical Officer
2	Mr. Y. Mohammed	Chief Technical Officer
3	Mr. Abdulrauf Abdu	Chief Technical Officer
4	Mr. Garba Ibrahim Zamani	Chief Technical Officer
5	Mr. Y.M. Abdullahi	Chief Technical Officer
6	Mr. S. U. Mohammad	Chief Technical Officer
7	Mr. Shehu Aliyu Abubakar	Senior Technical Officer
8	Mr. Umar Abdullahi	Senior Technical Officer
9	Mr. Haruna Ahmad Aliyu	Senior Technical Officer
10	Mr. Umar Salmanu	Senior Technical Officer
11	Mr. Sani Mohammed	Senior Technical Officer
12	Mr. Adnan Usman Muhammad	Senior Technical Officer
13	Mr. David Zang	Senior Foreman
14	Y. M. Dauda	Senior craftsman
15	Suleiman Mustapha	Senior Craftsman
16	Aliyu Babangida	craftsman

3.14.3 Non-Academic Staff (Administrative)

S/No.	NAME	RANK
1	Salihu Yunusa	Senior Office Assistant
2	Mr. Mamuda Mohammed	Senior Office Assistant
3	Mr. A.B. Musa	Senior Chief Driver/Mechanic

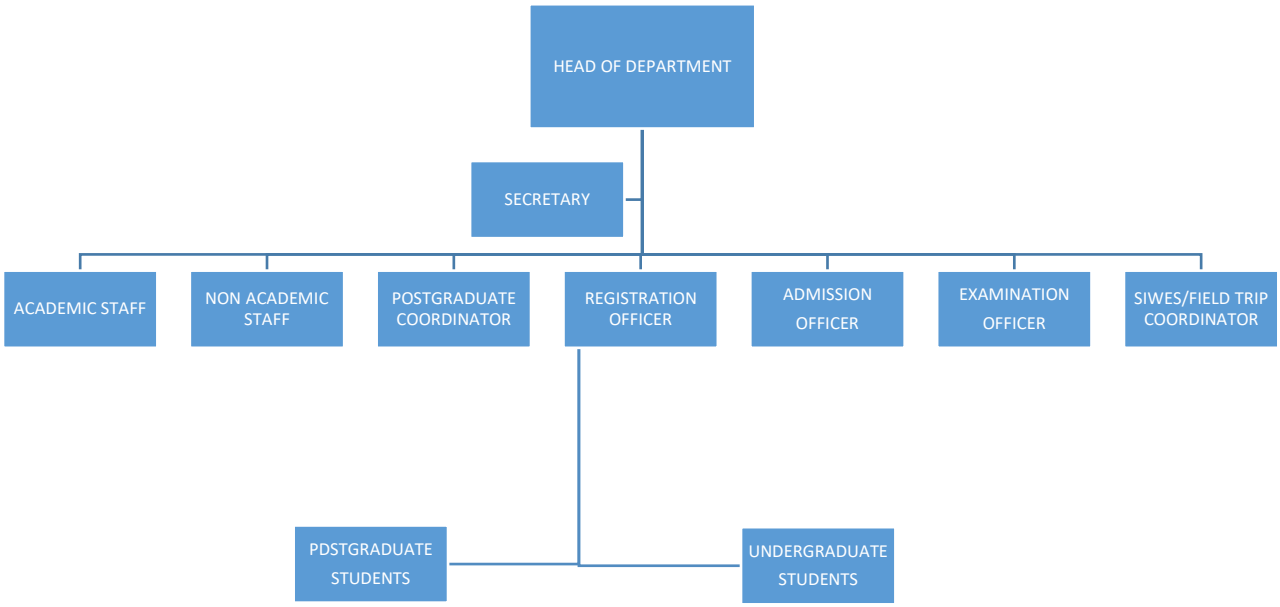

Figure 1: Organogram of the Department.