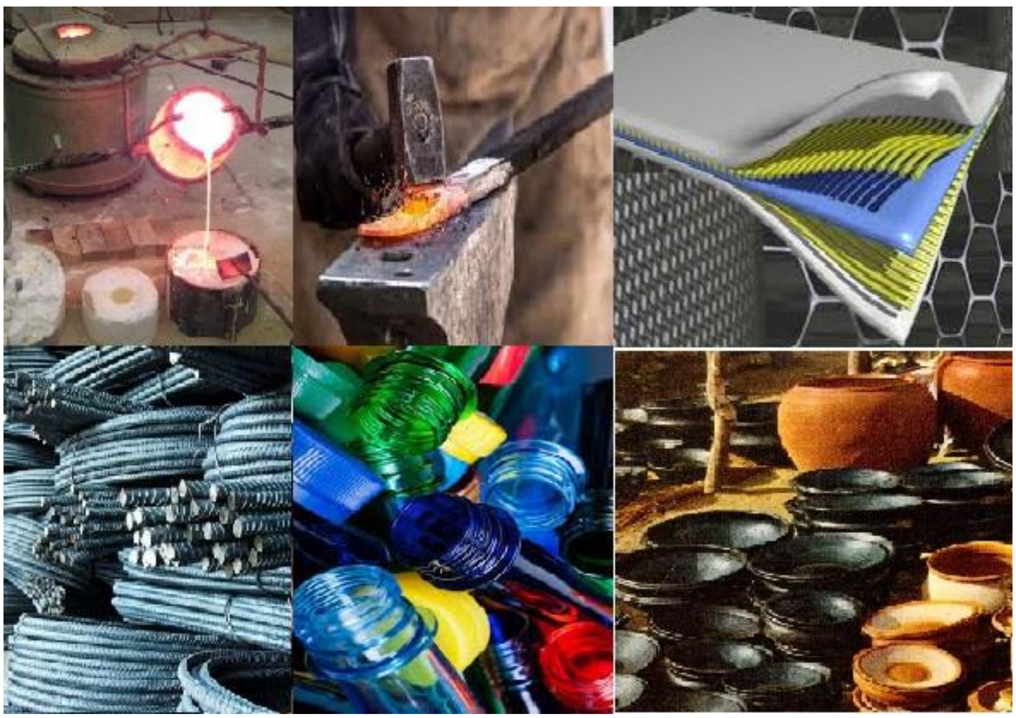
UNIVERSITY OF ILORIN, NIGERIA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MATERIALS AND METALLURGICAL ENGINEERING



B.Eng. Materials and Metallurgical Engineering

The Core Curriculum and Minimum Academic Standards for the Nigerian University System (CCMAS)

2023

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UNIVERSITY OF ILORIN, ILORIN, NIGERIA

BRIEF HISTORY

The University of Ilorin is one of the second-generation universities established by a Decree of the Federal Military Government in August 1975. It was initially an affiliated College of the University of Ibadan, known as the University College, Ilorin and attained full autonomous status as University in October, 1977. The University, which started with three (3) Faculties has grown in leaps and bounds to attain its present expansion to sixteen (16) Faculties. Starting with 200 students, the University presently has a total number of 50,833 students. The University runs and awards certificates in the following programmes: Diploma, Undergraduate Degree, Postgraduate Diploma, and Postgraduate Degree. In addition, the University currently has a total number of 3,652 staff members (both academic and non-teaching). The University, as part of its prowess as a citadel of learning, has won to its credit, several medals and awards in both academic and extra-curricular activities, nationally and internationally. The University of Ilorin emerged as the overall best institution at the Fourth Edition (2021/2022 – 2022/2023) of the Joint Admissions and Matriculation Board (JAMB) **NATIONAL TERTIARY ADMISSION PERFORMANCE- MERIT AWARD (NATAP-M)**.

MISSION STATEMENT

To provide a world-class environment for learning, research, and community service.

VISION STATEMENT

To be an International Centre of Excellence in learning, research, probity, and service to humanity.

MOTTO: Probitas Doctrina (Probity and Scholarship)

COLOURS: Deep Blue, Green, Golden, and White

MASCOT: Eagle Wide Span

PRINCIPAL OFFICERS OF THE UNIVERSITY

The Vice-Chancellor
Professor Wahab Olasupo Egbewole, ***SAN***
LL.B (Hons) (Ile-Ife); B.L. (Lagos); LL.M (Ile-Ife); Ph.D. (Ilorin); *FCArb, Fspsp, fciml (USA), fnipr*

The Deputy Vice-Chancellor (Academic)
Professor Olubunmi Abayomi Omotesho
B.Sc., M.Sc., Ph.D. (Ibadan), *FNAE, FNAAE, fciml (USA)*

The Deputy Vice-Chancellor (Management Services)
Professor Sulaiman Folorunsho Ambali
DVM, M.Sc., Ph.D. (Zaria), *FSASS, FSEAN, fciml (USA)*

The Deputy Vice-Chancellor (Research, Technology & Innovation)
Professor Adegboyega Adisa Fawole
MB;BS (Ilorin), *FWACS, fciml* (USA)

The Registrar
Mr. Mansur Adeleke Alfanla
B.A. Comb. Hons. (Kano), LL.B. (Ilorin), B.L. (Abuja), LL.M. (Ilorin), *fciml (USA)*

The Ag. Bursar
Mr. Oba Abdulbarki
B.Sc. (ABU, Zaria), ACA

The University Librarian
Dr. Kamal Tunde Omopupa
B.A. (LS) (Kano), MILR (Ilorin), MLIS (Ibadan), Ph.D. (SA), *fciml (USA)*

FACULTY OF ENGINEERING AND TECHNOLOGY

History of the Faculty of Engineering and Technology, University of Ilorin

The Faculty of Engineering and Technology at the University of Ilorin was established in September 1978, with the primary objective of providing a robust institutional framework for training engineers capable of driving the technological development of Nigeria and the world. From its inception, the faculty has fostered a conducive environment for the education of undergraduate engineering students and has facilitated cutting-edge research activities among its academic staff. Over the years, the faculty has expanded its programs to include postgraduate training, offering master's and doctoral degrees in various engineering disciplines.

Departments and Growth

At its founding, the faculty started with three departments: Civil Engineering, Electrical Engineering, and Mechanical Engineering, alongside a Central Engineering Workshop, which was established in 1979 to provide hands-on training and practical experience to all engineering students. The faculty's academic and research programmes were designed to attract students with strong backgrounds in mathematics and physical sciences, with an emphasis on logical, imaginative, and creative problem-solving skills.

The faculty's commitment to academic excellence and research has led to the expansion of its programmes over the years. In 1982, the Department of Agricultural Engineering was established as the faculty's fourth department. Subsequent additions include:

- Department of Chemical Engineering (2008/2009)
- Department of Materials and Metallurgical Engineering (2010)
- Department of Water Resources and Environmental Engineering (2013)
- Department of Computer Engineering (2014)
- Department of Biomedical Engineering (2015)
- Department of Food Engineering (2014/2015)

As of the 2020/2021 academic session, the Faculty of Engineering and Technology had grown to host 3,351 undergraduate students across its ten departments. The faculty has been led by a series of distinguished Deans since its inception. Below is a list of the past and present Deans:

1. Prof. V.O.S. Olunloyo (Mechanical Engineering, 1978-1980)
2. Prof. I.E. Owolabi (Electrical and Electronics Engineering, 1980-1984)
3. Prof. B.J. Olufeagba (Electrical and Electronics Engineering, 1984-1988)
4. Prof. S.O. Adeyemi (Civil Engineering, 1988-1990)
5. Prof. J.S.O. Adeniyi (Mechanical Engineering, 1990-1994)
6. Prof. F.L. Bello-Ochende (Mechanical Engineering, 1994-1998)
7. Prof. K.C. Oni (Agricultural and Biosystems Engineering, 1998-2001)

8. Prof. O.A. Adetifa (Civil Engineering, 2001-2005)
9. Prof. B.F. Sule (Civil Engineering, 2005-2009)
10. Prof. J.O. Olorunmaiye (Mechanical Engineering, 2009-2013)
11. Prof. Y.A. Jimoh (Civil Engineering, 2013-2017)
12. Prof. D.S. Ogunniyi (Chemical Engineering, 2017-2021)
13. Prof. O.A. Lasode (Mechanical Engineering, 2021-2023)
14. Prof. J.K. Odusote (Materials and Metallurgical Engineering, 2023-present)

The faculty has also benefited from the support of dedicated administrative staff, including several Senior Registry staff who have served as Faculty Officers. These officers play a crucial role in facilitating the activities of students from admission to graduation and supporting staff from recruitment to retirement. Notable present Faculty Officers include Mrs. Docars D. Adu, Muktar Lukman Abiodun, A.B. Shuaib, Oluseun Jolayemi, A.J. Anate, Abdulateef Bello, Hassana Adegbite, Dr. A.S. Alawaye, A.O. Shuaib, Grace A. Abajo, Mrs. Adeniyi, Adetola Oluwakemi, J.K. Omotosho, Mrs. Nimotallahi Ismail, Lamidi Helen and A.M. Adisa who currently serves in the role. The Faculty of Engineering and Technology hosts an annual international conference known as the Faculty of Engineering and Technology International Conference (FETiCON). Additionally, the Faculty publishes the Nigerian Journal of Technological Development, a Q4 journal indexed in Scopus and Scimago, which highlights research and innovations in engineering and technology.

The Faculty of Engineering and Technology continues to strive towards improving the quality of education and research offered to its students. Through regular curriculum reviews and a focus on innovative research, the faculty aims to remain at the forefront of engineering education in Nigeria and beyond, contributing to both national development and the global engineering community.

VISION STATEMENT

To be a world-class Engineering and Technological centre for innovations in learning, research, probity and service to humanity.

MISSION STATEMENT

To provide Engineering and Technological environment for learning, research and community service.

DEPARTMENT OF MATERIALS AND METALLURGICAL ENGINEERING

Historical Background

Department went through NUC verification exercise in May 2011 and the programme name, Materials and Metallurgical Engineering (MME) was approved. The Department currently has students' population of about 254. There are currently seventeen (14) core Lecturers and one (4) adjunct staff. The 100 Level students are consistently taught by the Faculty of Physical Sciences and 200 Level students go through general engineering courses domiciled in different Departments in the Faculty of Engineering and Technology.

The Department has a purposely built edifice which housed lecture rooms, staff offices and laboratories. The University is determined to adequately equip the new laboratories to NUC accreditation standards. With plans in place to achieve this objective, we presently enjoy inter-departmental collaboration with Geology, Chemical, Civil and Mechanical Engineering Departments as well as Central workshop and research laboratories on a range of laboratory facilities for teaching and research purposes. The Department Foundry facilities which housed, melting furnaces, sand and mould preparation shop, pattern shop and machining shop has been relocated to the Department arena from the former location at the Ilorin Centre for Appropriate Technology (ICATEC) by the University permanent site (PS) main gate. The Department also has full access to the facilities recently procured by Materials Development and Performance Laboratory (MDPL) research group through Tertiary Education Trust Fund (TETFund) grants.

The Department of Materials and Metallurgical Engineering has witnessed appreciable development over the last four years, it is hoped that the Department will continue in its giant stride to witness more growth and development to be a centre of excellence in human capacity building for Nigeria and the world over.

VISION STATEMENT

To be a world-class department and centre of excellence in learning, teaching, research, innovation, and ethical standard practices in Materials and Metallurgical Engineering for sustainable development in serving humanity.

MISSION STATEMENT

To provide a world-class Materials and Metallurgical Engineering environment for learning, research, innovation and community development to address national and global challenges.

Staff List of the Department

S/No.	Name	Rank	Qualifications	Area of Specialization
1.	J. A. Adebisi	Reader/Ag. Head	Ph.D, M.Sc. (Lagos), B. Eng. (Akure), R.Eng	Advanced Ceramics, Modeling & Simulation, Materials Characterization
2.	J. K. Odusote	Professor	PhD (Witwatersrand), M.Sc. (Ibadan); PGDE. (Ijagun); B.Sc; (Ife). MNSE, R.Eng	Corrosion, Materials development and characterization
3.	Y. L. Shuaib-Babata	Professor	Ph.D. (FUTM); M.Eng., B.Eng, (Ilorin); PGDE, MNSE, R. Eng.	Casting technology, Corrosion, Materials Characterization, Manufacturing, Design and Fabrication
4	I. I. Ahmed	Professor	PhD, M.Sc. (Manchester); B.Eng. (Zaria). MNSE, R.Eng.	Materials Performance and Degradation, Corrosion
5	Rasheedat M. Mahamood	Professor	Ph.D. (Johannesburg); M.Eng. (Ilorin); B.Eng. (FUTM); R. Engr.	Functionally Graded Materials, Laser Metal Processing and Materials
6	K. O. Yusuf	Professor	BEng (Minna); MEng (Ilorin), Ph.D. (Ilorin)	Soil and Water Engineering
7	T.A. Ishola	Reader	BEng, MEng, (Ilorin); Ph. D. (UPM)	Food Machine Design and Automation
8	E.O. Ajala	Reader	BTech, (Ogbomoso), MSc. (Ife), Ph.D. (Minna)	Biochemical Engineering
9	J.A. Adeniran	Reader	BTech (Ogbomoso); MSc (Lagos); Ph.D. (Ogbomoso)	Environmental Engineering, Climate Change
10	A.G. Adeniyi	Reader	BTech, MTech, Ph.D. (Ogbomoso)	Process System Engineering, Process and Product Development
11	A. I. Abdullateef	Reader	BEng, (OSUA); MEng. (BENIN); Ph.D. (IIUM, Malaysia)	Power Engineering
12	Y. O. Busari	Senior Lecturer	B. Eng. (Ilorin), M. Sc (Unilag), Ph.D. (Malaysia), MNSE, R.Eng.	Materials Characterisation, Welding and Fabrication of materials
13	A. O. Otuoze	Senior Lecturer	B. Eng. (Ilorin), M. Sc (Benin), Ph.D. (Malaysia), MNSE, R.Eng.	Power machines
14	O.S. Zakariyya	Senior Lecturer	BEng (Zaira); MSc (EMU, Famagusta, Cyprus); PhD (Zaira)	Digital Image Processing

15	H. U. Hambali	Senior Lecturer	BEng (Maiduguri); MSc (Zaria); Ph.D. (UTM, Johor Bahru)	Catalysis of Petrochemicals production and Wastewater treatment
16	Mary A. Ajala	Senior Lecturer	BTech; MTech; (Ogbomoso); Ph.D. (Minna)	Environmental Engineering
17	M. O. Iyanda	Senior Lecturer	BEng, MEng, Ph.D. (Ilorin),	Farm Power
18	A.B. Rabiu	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin)	Thermo fluid
19	O.T. Popoola	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin)	Thermo fluid
20	I. N. Aremu	Lecturer I	M.Sc. (Ukraine.) R.Eng.	Iron and Steel Making, Materials Characterization
21	T. Yahaya	Lecturer I	M. Eng, B. Eng. (Ilorin), MNSE	Mechanical behaviour of materials, Engineering design and fabrication
22	I. O. Ambali	Lecturer I	M.Sc., B. Sc. (Unilag), MNSE, R.Eng.	Materials Characterisation, Mechanical behaviour of materials
23	K. S. Ajao	Lecturer I	M. Eng, B. Eng. (Ilorin), R.Eng.	Mechanical behaviour of materials, Composite material, Engineering design and fabrication
24	Zainab T. Yaqub	Lecturer I	BSc, (Lagos); MTech, (Johannesburg); Ph.D. (Johannesburg)	Biochemical Engineering
25	M.A. Amoloye	Lecturer I	BEng (Bauchi); MTech (Ogbomoso); Ph.D. (Ilorin	Process System Engineering, Process and Product Development
26	Y. O. Babatunde	Lecturer I	BEng, MEng. (Ilorin), Ph.D. (PAUSTI, Kenya)	Structures
27	J. O. Adegbola	Lecturer II	M. Eng., B. Eng. (Ilorin), MNSE, R.Eng	Mechanical behaviour of materials / Materials Characterization
28	R. A. Yahya	Senior Technologist	B. Eng. (Zaria), PGDE (Kaduna), M. Eng. (Ilorin)	Materials Characterization and Corrosion
29	R. K.Abdulrazaq	Technologist I	B.Sc. (ABU)	Ceramics and glass technology
30	Suliat M. Ismail	Technologist I	HND, ND	Physical metallurgy
31	A. D. Abdulraheem	Technologist II	B.Eng. (Ilorin)	Materials processing and Characterization
32	S. O. Awojobi	Assistant Chief Technical Officer	HND, ND, City & Guild II, R.Tech.	Foundry

33	S. A. Olarewaju	Senior Laboratory Supervisor	ND, HND	Mining Technology
34	S. S. Hassan	Laboratory Assistant	O' Level Certificate (NECO)	
35	Olayide O. Shehaye	Executive Officer	NCE	
36	Risikatu O. Oyedepo	Caretaker	SSCE	

B.Eng. Materials and Metallurgical Engineering

1 Introduction

1.1 Background

Materials and Metallurgical Engineering Department was established in 2010 and has been running in line with existing Departments in the Faculty of Engineering and Technology. Materials and Metallurgical engineering remains the bedrock of all engineering and its expertise is indispensable in engineering profession. Therefore, the growing need for skilled manpower in Materials and Metallurgical Engineering industries in areas of design, testing and supervisory roles necessitated its establishment. Bachelor degree (B. Eng.) in Materials and Metallurgical Engineering is awarded to deserving students worthy in learning and character, in three key options currently available in the Department. Candidates have the choice to choose, based on their interest, from the following options namely: Electrochemistry and corrosion; Metallurgy (ferrous and nonferrous), and Engineering Materials (composite materials, nanomaterials, and biomaterials). The programme operates on full time study mode within study duration of five and three academic sessions, for university tertiary matriculation entry (UTME) and direct entry (DE), to 100-Level and 200-Level respectively. The minimum of 162 credit units must be registered and passed by UTME and 200L DE students, while a minimum of 115 credit units must be registered and passed by 300L DE students, before students can be graduated and awarded B. Eng. (Materials and Metallurgical Engineering). The University generally runs semester systems (Harmattan and Rain Semesters) for academic training and laboratory practical. However, Students' Works Experience Programme (SWEP) and Students' Industrial Work Experience Scheme (I) (SIWES I) are conducted at the end of 200 level and 300 level, respectively. Rain semester of 400 level is exclusively reserved for Student Industrial Work Experience Scheme (II) (SIWES II) often referred to as Industrial training.

The Department of Materials and Metallurgical Engineering handbook for undergraduate students contained additional useful information required to be fully equipped for getting the best out of the programme. The handbook contained amongst other things, the philosophy and objectives of the programme, the admission requirement, courses contents and all the necessary information required for successful completion of the Bachelor degree in Materials and Metallurgical Engineering within the stipulated 5 years period. The handbook is a working tool and a must read for all students. Every new and returning student should endeavour to have a copy and make full use of the handbook.

1.2 Philosophy and Objectives

The programme strives to consistently provide excellence in learning, research and service through globally relevant curricula that guarantee materials and metallurgical graduates with strong scientific and engineering problem-solving knowledge appropriate for understanding the link between the underlying structure and the processing, properties and performance of materials development and applications. The philosophy of Bachelor of Engineering degree in Materials and Metallurgical Engineering are as follow:

i. production of resourceful Engineers with sound academic training and suitably adequate practical knowledge, for sustainability of National policy on industrialization and indigenization of technology.

ii. training on analytical reasoning, creative innovation and entrepreneurship skills for sustainable growth of indigenous metallurgical and materials industries; and self-reliability,
iii. establish synergy between fundamental knowledge of engineering at undergraduate level and industrial work experience;
iv. dissemination of knowledge for establishment of a solid foundation for postgraduate education and competence against emerging national technological challenges through research and development.

The aim of the programme is to impart theoretical and research training required for the award of Bachelor of Engineering (B.Eng.) degree in Materials and Metallurgical Engineering.
The main objectives of the programme include production of materials and metallurgical engineers with independent capability to:

i. design engineering projects and supervise their implementation.
ii. provide required manpower for development and sustainability of indigenous materials and metallurgical industries that are rapidly developing including the Oil and Polymer industries;
iii. exercise original creative thought, maintain good professional judgement and accept responsibility for the consequence of an informed decision;
iv. provide jobs and become self-reliant entrepreneur;
v. impart training on prudent and professional management of man, materials and machine/equipment without compromise to moral; ethical; legal; and, health and safety obligations; and,
vi. prepare younger generation, for further academic studies at postgraduate levels.

The objectives of the Materials and Metallurgical Engineering programmes are to:

1. train the students through integrated learning in classroom, laboratories and field trips to the industry;
2. provide sound academic foundation as basis for the pursuit of higher degrees (M.Sc., M.Phil. and Ph.D.);
3. provide the learners with a fundamental knowledge base associated with Materials Processing, properties, performance, selection and application in relation to the underlying structure;
4. produce graduates that will be competently involved in the practice of Metallurgical and Materials Engineering or perform successfully as members of professional teams or capable of pursuing graduate studies;
5. develop in the learners adequate and appropriate experimental design and implementation, and technical report writing skills for the purpose of disseminating information on Metallurgical and Materials Engineering;
6. enable the graduates to apply the core concepts of Metallurgical and Materials Engineering to solving engineering problems; and
7. ensure sustainable research and development culture in consonance with trends in the metallurgical and materials industry, public service and the global community; and
8. produce graduates that understand professional and ethical responsibilities of a metallurgical and materials engineering field.

1.3 Employability Skills

The graduates of this programme will acquire a well-balanced engineering education with emphasis on Materials and Metallurgical Engineering in order to meet the needs of industry, academia, government and the society. The graduates will be engineered to innovate in materials, energy, electronics, medicine,

communications, transportation, recreation, structural and domestic fields. The graduates are expected to display outstanding skills ranging from synthesis, processing, design and development to manufacturing, performance, reclamation and recycling of materials.
Materials and Metallurgical engineers produced should be competent and technically equipped to develop materials suitable for the needs of the various sectors of human life while eliminating/minimising environmental pollution and degradation through development of technologies for safe and healthy recycling of wastes. They should also be able to provide technical services needed to run and maintain industries and establishments such as, iron/steel based industries, aluminium based industries, materials, materials testing laboratories, power metallurgy firm, ceramic industries, polymer production firm, automobile industries, aviation industries, maritime firm for repair, maintenance, construction of ships and boats, oil and gas industries, defence industry, electronics (semi-conductors), energy, communication, rehabilitative medicine (biomedical), consulting, research and development. They should have the capability for self-employment and engaging in entrepreneurship'

1.4 21st Century Skills

The Materials and Metallurgical Engineering programme involves the development of 21st century skills as listed below:

1. critical thinking/problem solving/decision making;
2. collaboration (teamwork);
3. communication;
4. creativity and innovation;
5. information literacy;
6. learning to learn/metacognition;
7. citizenship (local and global);
8. Ability to handle high professional and ethical responsibilities; and
9. Ability to work effectively and efficiently with interdisciplinary teams.

1.5 Unique Features of the Programme

The current Materials and Metallurgical Engineering programme compares very well in content to similar programmes in other universities around the world, some of which have been running Materials and Metallurgical Engineering programme for more than a century and are top ranking among institutions for higher learning worldwide. The entrepreneurship and innovation training injected into this programme will give the graduates of this programme the needed entrepreneurial skills which is a new innovation. The strengthening of Industrial Training (IT) is another innovation and uniqueness of this new curriculum.

2 Admission Requirements

Materials and Metallurgical Engineering programme candidates are admitted into the degree programme in either of the following two ways:
1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

2.1 Unified Tertiary Matriculation Entry (UTME) Entry Mode

Candidates seeking UTME entry mode into 100 level are required to obtain at minimum credit level passes in Senior School Certificate (SSC) in at least five (5) subjects in nationally recognized examinations at one sitting, which should include English Language, Mathematics, Physics, Chemistry and any other acceptable subjects. It is also desirable for candidates to pass Further Mathematics and Technical Drawing at credit level. In addition, candidates must attain a satisfactory cut off mark in the entrance examination conducted by Joint Admission and Matriculation Board (JAMB). Post-UTME screening may also be conducted by University of Ilorin and a pass is also a requirement.

2.2 Direct Entry (DE) Mode

In addition to O'level and Post-UTME requirements, either of the following

- (i) A level IJMB, JUPEB or approved equivalent pass in Mathematics, (Pure or/and Applied), Physics, and Chemistry with a minimum of 10 points
- (ii) OND (Upper Credits) in relevant discipline‡ with at least one year post diploma experience.

Special consideration is available for DE candidates who possess in addition to O'level and Post-UTME requirements, either of the following:

- (i) HND in a relevant engineering discipline‡ at lower Credit level from recognized Polytechnic or College of Technology after NYSC may be admitted into 200 level.
- (ii) First Degree from Physical Sciences at Second Class Lower division may be admitted into 200 level
- (iii) HND in relevant Engineering discipline, at Distinction or Upper Credits level in addition to Upper Credit in OND from recognized Polytechnic or College of Technology after NYSC may be admitted into 300 level.
- (iv) First Degree Honours in Engineering discipline may be admitted into 300 level

Table 1: Admission Requirement

Course	Requirements		UTME subjects	Special Consideration (Waiver Remarks)
	UTME	DE		
Department of Materials and Metallurgical Engineering	UTME candidates are required to obtain "O'Level credits in Five (5) subjects which should include English Language, Mathematics, Physics, Chemistry and any other subjects.	In addition to 'O' level and Post-UTME requirements, either of the following (i) 'A' level IJMB, JUPEB or approved equivalent pass in Mathematics, (Pure or/and Applied), Physics, and Chemistry with a minimum of 8 points (ii) ND (Upper Credits) in **Relevant Discipline**ǂ with at least one year post diploma experience.	English Language, Mathematics, Physics, Chemistry. Post-UTME screening may also be conducted and passing is also a requirement for admission.	**Direct Entry:** In addition to 'O' level and Post-UTME requirements, candidates with any of the following qualifications may be considered: **(i)** HND in a relevant Engineering discipline at lower Credit level from recognized Polytechnic or College of Technology after NYSC may be admitted into 200 level. **(ii)** First Degree from Physical Sciences at Second Class Lower division may be admitted into 200 level **(iii)** HND in relevant Engineering discipline, at Distinction or Upper Credits level from recognized Polytechnic or College of Technology after NYSC may be admitted into 300 level. **(iv)** First Degree Honours in Engineering discipline may be admitted into 300 level **UTME:** Candidates who passed Further Mathematics and Technical Drawing at Credit levels stand at an advantage.

ǂ**Relevant Discipline include-**
Chemical Engineering Technology, Foundry Engineering Technology, Glass/Ceramics Technology, Mechanical Engineering Technology, Metallurgy, Mineral Processing Engineering Technology, Mineral Resources Engineering Technology, Biomedical Engineering Technology, Polymer Technology, Welding and Fabrication Technology, Wood and Paper Technology

2.3 Inter/Intra-University Transfer Mode

Students are able to transfer from another recognized university into 200 level courses, provided they have the relevantǂ qualifications. The university is to be satisfied that the grades obtained by such candidate are acceptable in addition to the following:

1. Suitability based on the prevailing Unilorin admission requirements at the year of admission into his previous University;
2. Minimum CGPA of 3.00;
3. Payment of the prevailing Transfer/Acceptance fee;
4. Good conduct; and
5. Spend a minimum of two sessions in the University before graduation.

3 Duration of the Programme

The duration for Bachelor degree in Materials and Metallurgical Engineering is as follow:

i. UTME entry mode: Minimum of five (5) academic sessions and maximum of seven (7) academic sessions for candidates admitted into 100 level.
ii. DE entry mode: minimum of four (4) academic sessions and maximum of six (6) academic sessions for candidates admitted into 200 level. While a candidate admitted into 300 level has a minimum of three (3) academic sessions and maximum of five (5) academic sessions.

4 Graduation Requirements

Materials and metallurgical engineering runs on a modularised system, commonly referred to as course system. All courses are subdivided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. One credit course is equivalent to one hour per week per semester of 15 weeks (15 hours in a semester) for lectures, while for practical courses, it is equivalent to 3 hours of laboratory/studio/workshop work per week per semester of 15 weeks (45 hours in a semester).

The following regulations shall govern the conditions for the award of honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for a minimum of 120 and a maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. Candidates admitted through the Direct entry mode at 300-Level shall have registered for a minimum of 90 and a maximum of 120 units of courses during a 3–year engineering degree programme. Such candidates shall have spent a minimum of 6 academic semesters.
4. The minimum and maximum credit load per semester is 15 and 26 credit units, respectively.
5. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective/optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
6. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and 4 credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME, 13 semesters in the case of Direct Entry students who entered at 200-Level and 11 semesters in the case of Direct Entry students who entered at 300-Level.

Global Course Structure

Level	GST/ ENT	Basic Sciences	Faculty/ (GET)	Departmental (MME)	SIWES courses	Total Units
100	4	25	3	2	-	34
200	4	-	31	4	3	42
300	4	-	21	21	4	50
400	-	-	4	21	4	29
500	-	-	5	36	-	41
Total	12	25	64	84	11*	196

*All 11 SIWES and 2 units of Engineering Valuation are credited in the 2nd Semester of 400- Level, and not included in CCMAS Credit units

4.1 Definition of Course System

The courses are arranged in levels of academic progress. There are five levels of courses numbered: 101-199; 201-299; 301-399; 401-499; and, 501-599. The course code comprises three alphabets and three number characters. The first three codes signify the degree programme/department. From the last three codes, the first code represents the level of course between 100-500 level, and the last two digits represent the course numbering, e.g. MME 441 is a 400 level course with number 41. Harmattan semester courses take odd numbers while rain semester courses are numbered in even codes.

4.1.1 Registration for Courses

Registration for courses is done online and will be followed by signing of the print-out form with the level adviser and faculty officer. Registration must be done during the first two weeks of the Harmattan semester and late registration attracts a penalty. Late Registration closes at the end of the 4th week of the first Semester after which a student is deemed to have voluntarily withdrawn. No student is allowed to re-register for a course already passed. It is the responsibility of students to ensure all core courses and minimum elective courses in the department, and required courses in other departments are registered and passed, otherwise they will not be able to graduate. Students should ensure there is adequate interaction with their level adviser for information about graduation requirements and the number of credits they need to pass to meet the minimum graduation requirements. Carryover courses must be registered first before new courses. Please note that Rain semester carryover courses may be archived by level advisers at the request of some 400L students who may not be available to attend lectures and examinations during the Rain semester as a result of their absence for SIWES programme. Limited provision is allowed for changes in registered courses through “add and drop” forms.

4.1.2 Add and Drop Form

In cases where students want to add or drop courses, the following procedures should be followed.

- Students are to attach a copy of their course forms to the Add and Drop Form.
- In cases where the credit loading is going to exceed the maximum of 24 credits, kindly attach to the Add and Drop Form, a copy of the course registration and Dean's approval of the extra Credit(s) for a maximum of 26 credits per semester.
- The minimum credit allowed is 15 credits, except for spill over students whose minimum is 5 Credits.
- Forms not accompanied with necessary documents that would allow the Academic Support Services validate the claim made in the application would not be treated.
- Students are not allowed to add or re-register courses failed during the same session.

All Registration and Add and Drop Forms must be duly signed by the Dean of the Faculty, the Head of Department and the Faculty Officer.

4.2 Course Structure

At the commencement of each session, students are required to register for specific courses. Courses taught at different levels are designed to systematically build up the students' knowledge on Materials and Metallurgical Engineering. Courses are identified by Codes, Course title, Course status and Credits units. The number of credits attached to a course signifies the weight and time allotment to teaching the course. E. g. MME 331 is assigned with 3 credit units. This means 45 hours of lecture per semester (3 hours per week of 15 weeks semester) or 30 hours of lectures and 45 hours of practical in a semester. As a measure of workload, one credit unit means one hour of lecture or one hour of tutorial per week per semester, two hours of seminar, three hours of laboratory practical/field work, studio practice and four weeks of industrial training. Any change in course structure is subject to approval by the University senate. The course status is categorized as:

- Core course (C): Compulsory courses domiciled in the department that must be offered and passed to graduate

- Required (R): Compulsory courses domicile in other departments particularly in the faculty that must be taken different levels of study and must be passed before graduation

- Elective (E): courses that student offers within or outside the faculty, student may graduate without passing elective courses provided the minimum credit units for the programme has been attained.

- Pre-requisite courses (PR): courses that must be offered and passed before registering a higher level course.

4.3 Grading of Courses

The semester examination carries a maximum mark of 70% while continuous assessment carries a minimum mark of 30%. There are sometimes a few courses that are permitted to use a different ratio sometimes due to practical or project-based content of such courses. Continuous assessment is made up of class attendance/quiz/test/assignment. It is at the discretion of the lecturer to choose what makes up continuous assessment. As a rule, a student must satisfy a minimum of 70% attendance at lectures before he or she is allowed to sit for the semester examination.

The University of Ilorin operates a 5-point grading system. The following letter grades have been adopted

Table 2: Grade point system

Mark %	GRADE	POINT
70 -100	**A**	5
60-69	**B**	4
50-59	**C**	3
45-49	**D**	2
40-44	**E**	1
0-39	**F**	0

4.3.1 Absence from University Examinations

(a) Absence from an examination shall normally result in failure of the course. However, upon a written application, a student who has been absent from an examination with reasonable excuse (supported by a certificate issued by the Director of Health Services, if it is on the grounds of ill-health or proven cases of emergency/accident) may obtain permission of the Faculty Board to write a make-up in the subsequent examination.

(b) A grade of Incomplete (I) shall be awarded in a course to a student who completed the course except that he/she was absent from final examination in that course.

(c) Any student who obtains permission of the Faculty Board to write a make-up examination must take the examination before the end of third week of the following Semester, thereafter a change of grade from incomplete result would be made to reflect his new grade.

(d) However, a grade of Incomplete (I) shall revert to a Failure (F) by the end of the third week of the following Semester if the student has not applied for or has failed to obtain the permission of the Faculty Board for a make-up examination.

(e) Student's actual attendance at lectures, tutorials, practicals, etc. is to be recorded. Any student who fails to attend up to 75% of any of the above shall not normally be allowed to sit for the examination in that course.

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

The following are the basic tools that are needed to be understood before students are able to calculate his/her results correctly:

- Total Credits Offered (TCO): This is the term used to describe the total sum of all credit units allotted to the courses registered by the student. For example, a student who registered for 5 courses in a semester with each course having a credit unit of 2 each will have a TCO of 10 credits.
- Total Credits Passed (TCP): This is the term used to describe the total number of all credit units allotted to the courses registered and passed by the student. For example, for a student who registered for 5 courses in a semester with each course having a credit unit of 2, but only passed 4 of the courses. The TCP will be 8 credits, while TCO remains 10 and
- Total Credits Failed (TCF): the total credit failed from the above anecdote is 2 credits.

- Total Weighted Points (TWP): This is the total sum of the product of grade point and credit weight/unit of all courses registered. For example, the student who registered for 5 courses with 2 credit units and passed with 2 'A', 2 'B' and 1 'F'. The TWP calculation is as follow: (5 x 2 + 5 x 2 + 4 x 2 + 4 x 2 + 0 x 2 = 36)
- Grade Point Average (GPA): This is the ratio of TWP and TCO in a particular semester. The GPA from the above example is 36/10 = 3.60

Harmattan Semester				
Courses	Credit Unit	Grade	Weighted Point	GPA
PHY 112	3	C	3 x 3 = 9	= TWP/TCO = 37/11 = 3.36
CHE 111	3	A	5 x 3 = 15	
MME 123	2	B	4 x 2 = 8	
MME 124	1	A	5 x 1 = 5	
CHE 126	2	F	0 x 2 = 0	
	TCO = 11		TWP = 37	

Rain Semester					CGPA
Courses	Credit Unit	Grade	Weighted Point	GPA	
PHY 122	3	F	0 x 3 = 0	= TWP/TCO = 18/10 = 1.80	= (37+18)/(11+10) = 55/21 = 2.61
CHE 121	1	A	5 x 1 = 5		
MME 133	2	B	4 x 2 = 8		
MME 134	1	A	5 x 1 = 5		
CHE 136	3	F	0 x 3 = 0		
	TCO = 10		TWP = 18		

- Cumulative Grade Point Average (CGPA): It is the summation of TWP for all semesters to date divided by the summation of all the TCO's of the semesters under consideration. The correct CGPA from the above tables is 2.61 at the end of Rain Semester. This is not the same as the average of Harmattan and Rain semesters' GPA i.e. (3.36+1.80)/2 = 2.58.
- The highest CGPA obtainable is 5.00, while the minimum obtainable CGPA is 0. The final CGPA obtained by the student at the end of the undergraduate degree programme determines the class of degree he/she graduates with.

4.4 Graduation Requirements

4.4.1 Goodstanding Requirement for Progression from 100L to 200L

In order for a student to proceed from 100 level to 200 level, the following minimum requirements must be met at the end of 100 level:

1. Satisfy the good standing requirement means a student must have passed minimum of:
    - 9 credits in Mathematics
    - 9 credits in Physics
    - 6 credits in Chemistry
2. Obtain a Cumulative Grade Point Average of not less than 2.00

Any student who fails to meet these two conditions is withdrawn from the Faculty of Engineering and Technology. A student withdrawn but having a CGPA of 1.5 and above may seek transfer to another faculty.

In addition to satisfying other University regulation, the student must have fulfilled the following to be qualified for graduation:

- Student must have passed all the general studies courses (GST)
- Completed Student Work Experience Programme (SWEP)
- Completed Student Industrial Works Experience Scheme (SIWES)
- Management, Economics and Entrepreneurship Skill
- The summary of the credit units that must be passed before graduation is as follows:

Level	**UTME**	**DE (200L)**	**DE (300L)**
100 Level	34	-	-
200 Level	42	51	-
300 Level	50	50	57
400 Level	29	29	29
500 Level	42	42	42
Total	**197 Credits**	**172 Credits**	**128 Credits**

4.5 Degree Classification

The class of degree and the correspondent range of the CGPA is tabulated below:

Cumulative Grade Point Average (CGPA)	Class of Degree
4.50 – 5.00	First Class (Honours)
3.50 – 4.49	2nd Class Upper Division (Honours)
2.40 – 3.49	2nd Class Lower Division (Honours)
1.50 – 2.39	3rd Class (Honours)
1.00 – 1.49	Pass

Students who transfer from other universities shall be credited with only those courses deemed relevant to the programme, which they have already passed prior to their transfer. Such students shall however be required to pass the minimum number of units specified for graduation for the number of sessions the student has spent in the faculty. Students shall spend not less than two academic sessions in the faculty to earn a degree.

4.6 Probation

A student whose CGPA is below 1.5 at the end of a particular year of study, earns a period of probation for one academic session. A student while on probation is allowed to register for courses at the next higher level in addition to his/her carryover courses provided that maximum of 18 credit units per semester is not exceeded and the prerequisite courses for the higher level courses have been passed.

4.7 Withdrawal

Withdrawal from the programme can be voluntary or due to poor academic performance resulting from Grade Point Average (GPA) below 2.00 at 100 level or not meeting specified credit passes in relevant subjects (9 credits in Mathematics, 9 credits in Physics and 6 credits in Chemistry). However, students withdrawn from faculty of Engineering and Technology having CGPA between 1.5 and 2.00 may seek for transfer to another relevant programme at another faculty within the university. Voluntary withdrawal must be communicated to the University officially. A student with a consistent CGPA below 1.5 at the end of his probationary period shall be advised to withdraw from the programme. Students must maintain good academic standing at all times to remain and be relevant in the degree pursuit.

Fresh 200/300 level students, (including transferred students) with CGPA of less than 1.5 shall not be on probation and shall be required to withdraw from the University.

4.7.1 Continuous Absence from the University

Students who are absent from the University for upwards of six weeks in a semester without written official permission, shall normally be deemed to have withdrawn from the University.

4.7.2 Late Registration

Late Registration closes at the end of the 4^{th} week of the first Semester after which a student is deemed to have voluntarily withdrawn.

5 Evaluation

There are four different ways of evaluating the performance of students namely: practical, tutorials, continuous assessments and examinations.

5.1 Practical

Laboratory practical is quite important in training of Engineering and Technology students, hence 9 hours of laboratory practical which is equivalent to 3 credits will be covered by students weekly and this corresponds to 135 hours per semester. All practical classes are assessed, scored and must be passed. The experiments to be conducted in the practical components of the courses are designed in the right quantity and quality to enrich the grasp of the theoretical foundation of the courses.

5.2 Tutorials

Tutorials are also available in proportion to one hour of tutorial for every four hours of lecture. This allows students to freely interact with colleagues and lecturers during question and answer sessions. In some cases, postgraduate students may be employed to help in giving tutorials to undergraduate students and this may help facilitate a veritable training ground for academic career.

5.3 Continuous Assessments

Students are tested on a continuous basis and the nature of the test could be computer based test (CBT), essays test or practical exercise. The assessments are graded according to the following:

i. The maximum score for continuous assessment is 40% of the total final marks for courses which are primarily theoretical.
ii. Courses that are partly theoretical and partly practical would have a CA score of 50% of the final marks.
iii. While courses that are entirely practical, would have a CA score of 100%.

5.4 Examination, Ethics, and Discipline

5.4.1 Examinations:

In addition to continuous assessment, final examinations are conducted at the end of the semester. The score for the examination would not be less than 60%. Students should be at the examination venue at least 30 minutes before the commencement of the examination. Every student should check himself/ herself before coming to the venue.

- His/her calculator should not contain information relevant to the examination
- Student should ensure that their handkerchiefs does not contain incriminating items
- Do not bring purse, cell phone/ handset, bag, etc. into the examination venue. Beware of examination malpractice; make sure you are not caught during the examination with any incriminating material. **It may result in total expulsion**.
- All students are expected to come long into the examination hall with the following documents:
  - Duly signed coloured course registration form(s) (Laminated)
  - Current I.D Card
  - Writing materials
- All students are to ensure they abide by the following rules:
  - Lending of writing materials is not allowed
  - No written note will be entertained as a replacement to the course registration form and I.D. card
  - Use of organizers and computerized calculators is not allowed.

Examination malpractices should be avoided as they constitute a very serious offence. Suspects are made to face the Faculty Examination Malpractices Committee and if found guilty, they are to further defend themselves before the University Students Disciplinary Committee. Any guilty verdict attracts severe punishments including expulsion.

5.4.2 Results Publication and Allied Complaints

Results are published on the student portal after it has been approved by the Department, Faculty and University senate. However, there are occasional cases of missing results or wrongly computed results. Students can report such cases to their level adviser who will subsequently arrange that a “Result Request Form” be filled. When a student is in doubt about his/her score, the University allows for a re-mark of such scripts following specified official steps through the academic office.

5.4.3 External Examiner

The external examiner system applies only to the undergraduate final year student courses and projects. This is done to certify the overall performance of the graduating students, as well as the quality of facilities and teaching in the faculty. In this case, a lecturer of reputable experience from another credible university is invited for the examination of final year students' courses and projects report. The assessment of students' projects usually involved project defense and oral presentation.

5.4.4 SIWES Rating and Assessment

In engineering degree programmes, industrial attachment is very crucial and therefore a prerequisite for graduation. The three industrial training programme include:

i. Student work experience programme (SWEP) which is done at the end of 200 level
ii. Student industrial work experience scheme I (SIWES I) which is done during the long vacation at the end of 300 level
iii. Student industrial work experience scheme II (SIWES II) which is done during rain semester and long vacation at the end of 400 level

5.5 Students Evaluation of Courses

The Department has a mechanism in place to enable students the privilege to evaluate courses delivered to them at the end of each semester. This is an integral component of the course credit system and it serves as feedback mechanism for achieving the following:

i. Improvement in the effectiveness of course delivery
ii. Continually update of lecture materials to incorporate emerging new concepts
iii. Effective usage of teaching aids and tools to maximise impact of knowledge on students
iv. Improvement in students' performance through effective delivery of tutorials, timely in presentation of continuous assessment and high quality examination.

The completed response/questionnaire is professionally analysed and results will be discussed with the course lecturer towards improvement in course delivery in all ramifications.

5.6 Lecture Room and General Ethics

5.6.1 Lecture Room Ethics

Students are expected to comfort themselves and maintain a high degree of silence in the class-rooms and academic arena. All handsets are to be switched-off during lectures. A breach of the above rules will attract appropriate penalties.

5.6.2 Consultation Hours with Lecturers

In the University system, Lecturers maintain a flexible work time schedule. It is advisable to consult the departmental lecturers in their offices between the hours of 9.00 a.m. and 3.00 p.m. Some lecturers do indicate recommended consultation hours taking cognizance of their lecture hours and other responsibilities.

5.6.3 Information Dissemination Channels

Passage of information from the departmental office or other sources is often by display on official notice boards. Students may sometimes be communicated via their emails, WhatsApp platform, cell phones or

Class representatives. Arbitrary display of papers on doors or other unauthorised places are however not allowed.

5.6.4 Computer and Internet Facilities

All engineering students are expected to have personal computers such as laptops. The urgent need for this arises at 200 level when students must be trained on Computer-Aided Drawings. Other rooms exist in the faculty with limited Computers. Wireless internet services exist at the Departmental building and over the campus through Wi-Fi connection. Students are encouraged to avail themselves of these opportunities.

6 Library and Information Resources

The university main library has sufficient books and studying materials to cater for staff and student needs in all faculties including Engineering and Technology. The available materials include: current journals; handbooks; text books; manuals; codes of practice; standards and specifications etc. in sufficient numbers. The faculty of Engineering and Technology library is located at block 8 and it is open to all students of the faculty of Engineering and Technology. Again, there is provision for ICT-based access to electronic resources at the university e-library adjacent to the departmental building. The departmental library is also available for use by students. Departmental library is stocked with books in soft and hard copies. There are limited number of computers from which electronic books could be assessed during the working hour. The departmental library is also connected to the internet and the available computers could be used for academic browsing only. It is punishable to use university gadgets for illicit activities with or without internet access.

7 Academic Programme

The Department awards Bachelor of Engineering (B.Eng.) in Materials and Metallurgical Engineering at the successful completion of undergraduate programme. The minimum of 162 credit units must be registered and passed before an undergraduate student is qualified to graduate with B. Eng. (Materials and Metallurgical Engineering). The University generally runs two semesters system (Harmattan and Rain Semester) and the synopsis of the courses are given below

7.1 Students' Work Experience Programme (SWEP)

This is an introduction to practice and skills in general engineering through supervised operation of hand tools and machines for fitting, cutting and fabrication. The SWEP normally takes place at the end of 200 level during the students' vacation. After students have gone through the general aspects of engineering courses, they are expected to have good practical exposure to general engineering processes and equipment. The training is expected to cover the following areas: vehicle/agricultural equipment maintenance, introduction to metal welding, fabrication and casting technology, plumbing works, building and construction machines/equipment, woodworks and applications of electrical and electronics tools.

7.2 Student Industrial Work Experience Scheme (SIWES)

The SIWES is a skills training programme which is designed to bridge the gap existing between theory and practice of engineering and technology. It is aimed at exposing students to machines and equipment, professional working methods and ways of safeguarding the work areas and workers in industries and other organisations. The minimum duration of the programme is 40 weeks. The scheme is a tripartite programme involving the students, University and Industries.

7.3 Academic Facilities

The department has provision for three classrooms namely: lecture room I (LR1) with carrying capacity of 60 seats; lecture room II (LR2) with carrying capacity of 40 seats, both of which are located on the ground floor; and lecture room III (LR3) with capacity of 40 seats is located upstairs. The department has four laboratories for practical purposes namely: materials and mechanical testing; chemical metallurgy and corrosion; extractive metallurgy and mineral processing; and; physical metallurgy. Materials and Metallurgical Engineering students have access to a newly built ultra-modern central research laboratory with range of facilities, applied heat laboratory; corrosion laboratory; central workshop which housed: computer numerical control (CNC); conventional machining tools; welding and fabrication section; and, bench-work section. There are Metrology and Skill-Gill laboratories at block 7 for practical classes. Students also have access to Materials and Metallurgical Engineering foundry which houses melting furnaces, sand and mould preparation laboratory and fabrication machines. The students also enjoy unrestricted access to Nigeria Liquified Natural Gas (NLNG) equipment and laboratories. All these facilities are available to staff and students for teaching and learning respectively.

7.4 Scholarship and Awards

The university awards scholarship packages to scholars who earned, maintained and led the class with CGPA of not less than 4.00 in their respective levels. Also available is the work study program for diligent students with financial hardship. Information concerning these opportunities can be obtained from the level advisers, academic office, students' affairs unit and faculty officer.

7.5 Level Advisers

Every student in the department is assigned a level adviser. Student liaises with his/her level adviser who provides professional guidance throughout the students' stay in the Department. This guidance relates to academic programmes among others. Each student's adviser must be consulted and must sign the necessary forms each session as may be required. Advisable consultation time for registration purposes is 9.00 a.m. - 3.00 p.m.

8 Curriculum

At the commencement of each session, students are required to register for specific courses. Courses taught at different levels are designed to systematically build up the students' knowledge on Materials and Metallurgical Engineering. Courses are identified by Codes, Course title, Credit units, Course status, Lecture hour and Practical hour. The number of credits attached to a course signifies the weight and time allotment to teaching the course. Each credit unit course is assigned 15 hours of lectures or 45 hours of practical hours. Course codes are determined by level, specialisation, semester and changes when the course content is altered. Any change in course structure is subject to approval by the University senate. The course status may be categorised as Compulsory (C), Required (R), Elective (E) or Innovative (I).

Compulsory Course	One that must be registered and passed. Obtained score will count towards graduation and students cannot graduate without passing it.
Required Course	One that must be taken but not necessarily passed. However, whether passed or not, the score obtained will count towards graduation.
Optional Course	One which the student freely registered but not necessarily passed. In any case, the score obtained in an appropriate number of the courses will count towards graduation.
Concurrent Course	One which must be taken along with another stipulated one within the same session.
Prerequisite Course	One which must be taken and passed before another stipulated course can be registered for.
Pass	Satisfactorily completing a course by scoring not less than 50% in the overall assessment of that course. This is necessary in order to obtain or earn the credit allotted to the course.

These are the 3-letter codes for the identification of courses offered in the various programmes in the Engineering and Technology discipline as well as courses offered in other disciplines covered in the CCMAS for the Nigerian University System. They are in three categories dictated by the sources of courses involved:

Category A: Course codes for courses offered in programmes outside the Engineering and Technology Discipline

Category B: Course codes for the general and foundation courses offered by all students registered in the various programmes in the Engineering and Technology Discipline.

Category C: Course codes for courses offered by the various programmes in the Engineering and Technology Discipline.

The Programme offering the Courses	**Course Code**
Chemistry Programme in the Science Discipline	CHM
Mathematics Programme in the Science Discipline	MTH
Physics Programme in the Science Discipline	PHY
General Studies courses offered at the University Level for students registered for GSTs in all the disciplines in the university.	GST
Entrepreneurship courses offered at the University Level for students registered for ENTs in all the disciplines in the university.	ENT
Foundation courses for all the programmes in the Engineering and Technology Discipline	GET
Materials and Metallurgical Engineering	MME

8.1 Course Synopsis

8.1.1 100 Level Courses

Course	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II (Electricity and Magnetism)	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 104	General Physics IV (Vibration Waves and Optics	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
STA 112	Probability I	3	C	45	-
MME 102	Introduction to Materials and Metallurgical Engineering	2	C	30	-
Total		34			

8.1.2 200 Level Courses

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 203	Engineering Graphics and Solid Modelling II	2	C	15	45

GET 204	Student Workshop Practice	2	C	15	45
GET 205	Fundamental of Fluid Mechanic	3	C	45	
GET 206	Fundamentals of Thermodynamics	3	C	45	
UIL-GET 207	Applied Mechanics	3	C	45	
GET 208	Strength of Materials	3	C	45	
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
UIL- MME 201	Fundamental of Engineering Safety Materials	2	I	15	45
UIL- MME 202	Introduction to Thermodynamics of Materials	2	C	30	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		42			

8.1.3 300 Level Courses

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	E	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy System and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
UIL-GET 311	Engineering Economics	3	C	45	-
MME 301	Thermodynamics of Materials	2	C	30	-
MME 304	Chemistry of Materials	2	C	30	-

MME 305	Engineering Materials: Structure and properties	2	C	30	-
MME 312	Physical Metallurgy I	2	C	30	-
UIL-MME 302	Heat and Mass Transfer	3	C	45	-
UIL-MME 303	Mineral processing	3	C	45	-
UIL-MME 306	Mechanical Working of Metals	2	C	30	-
UIL-MME 308	Fracture Mechanics	3	C	45	-
UIL-MME 317	Materials Laboratory I	1	C	-	45
UIL-MME 318	Materials Laboratory II	1	C	-	45
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		50			

8.1.4 400 Level Courses

Course Code	Course Title	Units	Status	LH	PH
GET 402	Engineering Project I	2	C		90
GET 404	Engineering Valuation and Costing	2	C	30	
MME 401	Synthesis, Processing and Manufacturing of Materials	2	C	30	-
MME 405	Corrosion Science and Engineering	2	C	30	-
MME 407	Mechanical Behaviour of Materials	2	C	30	-
MME 413	Chemical Metallurgy	2	C	30	-
UIL-MME 403	Non-ferrous Extractive Metallurgy	2	C	30	-
UIL-MME 409	Fuels, Furnaces and Refractory	2	C	30	-
UIL-MME 411	Manufacturing Processes	3	C	45	-
UIL-MME 415	Introduction to Materials computation and Modelling	2	I	30	-
UIL-MME 417	Materials Laboratory III	1	C	-	45
UIL-MME 421	Experimental Techniques	3	C	45	-
*GET 499	SIWES III: Students Work Experience Scheme	4	C	12 Weeks	
Total		29			

SIWES courses and Engineering valuation*

Course Code	Course Title	Units	Status	LH	PH
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	4	C	12 weeks	
GET 404	Engineering Valuation	2	C	6 weeks	
	Total	13*			

* All credited in the 2nd Semester of 400-Level

8.1.5 500 Level Courses

Course Code	Course Title	Unit	Statu	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MME 501	Analytical Methods for Materials	2	C	30	-
MME 504	Solidification and Foundry Technology	2	C	30	90
MME 505	Nanoscience and Nanotechnology	2	C	30	-
MME 507	Composite Materials	3	E	45	-
MME 510	Project	6	C	-	270
MME 514	Engineering Materials Laboratory	1	C	-	45
UIL-MME 502	Polymers	2	E	30	-
UIL-MME 503	Iron and Steel Making	3	C	45	-
UIL-MME 509	Principle of Materials Selection	2	C	30	-
UIL-MME 511	Material Failure Analysis	2	C	30	-
UIL-MME 512	Biomaterials	2	E	30	-
UIL-MME 513	Student Seminar	2	C	30	-
UIL-MME 514	Ceramics	2	E	30	-
UIL-MME 515	Powder Metallurgy	2	C	30	-
UIL-MME 516	Introduction to Laser Technology and Additive Manufacturing	2	I	30	-
UIL-MME 518	Surface Engineering and Coatings Technologies	2	I	30	-
Total		42			

8.2 Course Contents and Learning Outcomes

8.2.1 100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing [paragraphing, punctuation and expression], post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self- reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using Le Chatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;

7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)
(2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) **(2 Units C: LH 30)**

Learning Outcomes

On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;

7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 103: General Physics III (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoulli's equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
6. conduct measurements of some physical quantities;
7. make observations of events, collect and tabulate data;
8. identify and evaluate some common experimental errors;
9. plot and analyse graphs; and
10. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) **(2 Units C: LH 30)**

Course Contents

(Pre-requisite –MTH 101)

Learning Outcomes

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

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Twodimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 102: General Physics II (Electricity and Magnetism) **(2 Units C: LH 30)**

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;

4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 104 General Physics IV **(2 Unit C: LH 30)**

Learning Outcomes

On completion, the students should be able to:
1. describe and quantitatively analyse the behaviour of vibrating systems and wave energy;
2. explain the propagation and properties of waves in sound and light;
3. identify and apply the wave equations; and
4. explain geometrical optics and principles of optical instruments.

Course Contents

Simple harmonic motion (SHM): energy in a vibrating system, Damped SHM, Q values and power response curves, forced SHM, resonance and transients, coupled SHM. Normal modes. Waves: types and properties of waves as applied to sound; Transverse and Longitudinal waves; Superposition, interference, diffraction, dispersion, polarisation. Waves at interfaces, Energy and power of waves, the 1-D wave equation, 2-D and 3-D wave equations, wave energy and power, phase and group velocities, echo, beats, the doppler effect, propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light; reflection, refraction, and internal reflection, dispersion, scattering of light, reflection and refraction at plane and spherical surfaces, thin lenses and optical instruments, wave nature of light; Huygens's principle, interference and diffraction.

STA 112 Probability I **(3 Units C: PH 45)**

Learning Outcomes

On completion, the students should be able to:
At the end of the course students should be able to
1. explain the differences between permutation and combination;
2. explain the concept of random variables and relate it to probability and distribution functions;
3. describe the basic distribution functions; and
4. explain the concept of exploratory data analysis.

Course Contents

Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

MME 102: Introduction to Materials and Metallurgical Engineering (2 Units C: LH 30)

Learning Outcomes

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

1. solve materials and metallurgical engineering problems using mathematics, science and technology;
2. design components, systems, and processes for materials and metallurgical engineering based on engineering, economy, energy, environment and sustainability;
3. formulate decisions based on data analysis, information, experiments, and practical experience;
4. identify, analyze and formulate alternative solutions for materials and metallurgical engineering;
5. apply modern tools for engineering design and analysis;
6. plan, complete and evaluate tasks within existing constraints as required;
7. work in inter-disciplinary and inter-cultural teams nationally and internationally;
8. be responsible to society and comply with professional ethics in solving problems in materials and metallurgical engineering; and
9. communicate effectively, both orally and writing.

Course Contents

Historical development of Materials and Metallurgical Engineering. Differentiation between materials and metallurgical engineering. Role of materials and metal products in human civilization: Stone age, copper age, iron age, nuclear age, ICT age; imagine the world without materials and metals. Study Periodic Table; classification of metals; Materials and Metallurgical Engineering: definition and classification: Process (Extractive) metallurgical engineering. Get acquainted with terms like roasting calcination, agglomeration, smelting, smelters contract, refining and furnaces. Physical metallurgical engineering: structure - property -application relationship. Mechanical metallurgical engineering: Stress - strain relationship and application. Study of properties and applications of materials of construction or manufacture: ceramics, metals, polymers, and composites. Materials and Metallurgical engineering: ferrous, non- ferrous and other materials industries as basis for industrialisation and national economic development. Nigerian materials and metallurgical industry; professional bodies such as Nigerian Society of Engineers, Nigerian Metallurgical Society (NMS), Materials Science and Technology Society (MSN).

8.2.2 200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

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

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;

7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character moulding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;

3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modelling II (3 Units C: LH 30; PH 45)
Learning Outcomes
Students should:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.
Course Contents
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modelling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modelling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modelling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)
Learning Outcomes
At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;

5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (callipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press- tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various pipe fittings, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system, surrounding, closed and open system, control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;

4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics - heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 207: Applied Mechanics **(3 Units C: LH 45)**

Learning Outcomes

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

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

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

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

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

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

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

UIL-MME 201: Fundamentals of Engineering Safety Materials (2 Units I: LH 15; PH 45)

Senate-approved relevance

Materials and Metallurgical engineering deals with different classes of materials including hazardous, flammable, and chemically potent substances which requires risk assessment, hazard prevention and safety of lives and properties. This will allow graduates of Materials and Metallurgical engineering to learn and identify safety regulations regarding the use and safe handling of potentially hazardous materials in laboratories and workshops in line with the vision and mission of the University of Ilorin.

Overview

Accidents are inevitable in laboratories and workshops. However, understanding of safety rules and regulations on materials handling will help prevent or mitigate the severity of such occurrences.

Manufacturing processes including casting, welding, rolling, and extrusion require operations at high temperatures. Hence, prevention of fire hazards requires the use of appropriate equipment such as apron, eye/face shield, helmet, and safety boots to ensure prevention of lives.

Objectives:

1. Understand safety principles in materials selection
2. Identify potential hazards in materials applications
3. Develop safety protocols for materials handling and processing
4. Analyze materials safety data sheets
5. Conduct risk assessments and hazard analysis
6. Design safe materials storage and disposal systems
7. Implement safety measures for materials transportation
8. Develop emergency response plans for materials-related incidents
9. Understand regulatory requirements for materials safety
10. Promote safety culture in materials engineering

Learning Outcomes:

1. Knowledge of safety standards and regulations
2. Ability to conduct risk assessments and hazard analysis
3. Understanding of materials safety data sheets
4. Skills in designing safe materials storage and disposal systems
5. Ability to implement safety measures for materials transportation
6. Knowledge of emergency response planning for materials-related incidents
7. Understanding of regulatory requirements for materials safety
8. Ability to promote safety culture in materials engineering
9. Familiarity with safety protocols for materials handling and processing
10. Ability to analyze and mitigate materials-related hazards

Course Contents

Safety principles and regulations. Safety equipment and fire-resistant materials. Hazard identification and risk assessment. Materials safety data sheets and handling procedures. Safety measures for materials transportation and storage. Emergency response planning and regulatory requirements. Promoting safety culture in electrical, fire, sound, optical, and chemical operations.

UIL-MME 202: Introduction to Thermodynamics of Materials (2 Units C: LH 30)

Senate-approved relevance

Material science and engineering deals with some fundamental physical principles upon which all practical applications must be built and an engineer must thoroughly understand them. These fundamental principles will never cease to be applicable in the practical, real world! They are useful for building new processes and refurbishing old ones. This will allow graduate of Materials and Metallurgical engineering to learn and apply various critical concepts to real problem especially solving diverse community problems wherever they find themselves which is a core principle in the vision and mission of the University of Ilorin.

Overview

This is an introductory course to the study of thermodynamics of materials as they relate to general phenomena in materials science and engineering with the prediction of their properties and applications. We shall deal with the laws of thermodynamics and their applications to equilibrium and the properties of materials.

The course will teach you how to develop relations pertaining to multiphase equilibria as determined by treatment of solution thermodynamics and the development of graphical illustrations that are essential for the interpretation of phase diagrams. Treatment shall include electrochemical equilibria and surface thermodynamics. Some features of statistical thermodynamics shall be introduced to familiarize you with macroscopic equilibrium from microscopic level.

Objectives

The objectives of the course are to:

1. Define basic terminologies in thermodynamics of materials;
2. Clarify between classical and statistical thermodynamics;
3. Outline the importance of energy conversion to our existence;
4. Explain why change in state properties drives process/reaction;
5. Describe relationship among heat, internal energy and work;
6. State the influence of entropy in process direction;
7. Predict the direction of processes using standard properties;
8. Describe how equilibrium state can be used in various basic material science and engineering processes;
9. Interpret phase diagram; and
10. Apply the concept of statistical thermodynamics to equilibrium phenomena.

Learning outcomes

On completion of the course, students should be able to:

1. Define at least five (5) important terminologies in thermodynamics of materials;
2. list two (2) differences between classical and statistical thermodynamics;
3. list four (4) importance of energy conversion to our existence;
4. explain how changes in material properties is used to drive process/reaction;
5. describe two (2) of heat, internal energy and work as means of interaction between system and the surrounding;
6. explain one (1) method of how entropy is used to determine process direction;
7. describe how Gibb’s free energy is used to predict the direction of processes;

8. develop one (1) equilibrium state of new processes in basic material science and engineering processes;
9. interpret two (2) phase diagram; and
10. determine one (1) equilibrium phenomena using statistical thermodynamics.

Course contents

Introduction. Definition of terms. Thermodynamic laws and relationships. Thermodynamic equilibrium. Strategy for deriving thermodynamic relationships. Behaviour of pure substances and perfect gas. Ideal gas cycles. Physical and chemical equilibria. Thermodynamics and properties of materials. Phase Diagrams and Thermodynamic Components. The Gibbs Free Energy G. Fundamentals of general phenomena in materials science and engineering. Chemical reactions, magnetism, polarizability and elasticity. Statistical thermodynamics. The Concept of Microstate. Partition function. Macroscopic equilibrium phenomena. Phase Equilibrium in a One-Component System
(Minimum Academic Standards)

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: Each programme to indicate additional details of programme-specific activities for their students.

8.2.3 300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;

4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, Zango Kartaf, chieftaincy and land disputes. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peacekeeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue, arbitration, negotiation, collaboration). The roles of international organizations in conflict resolution (a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post- conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units E: LH 45)

Learning Outcomes

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

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills (steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports (competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

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

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;

3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation and percentiles. Probability. Binomial, poisson hyper-geometric and normal distributions. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

UIL-GET 311: Engineering Economics (3 Units C: LH 45)

Senate Approved Relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course provides engineering graduates with the requisite knowledge of the relevant principles of engineering economics so that they can be better managers, in addition to their technical competence.

Course Overview

This course introduces students to the fundamental principles and basic concepts of engineering economics as they relate to potential investment opportunities and their profitability by considering the time value of money. The peculiarity of the engineering economy with respect to various economic concepts are highlighted in the course.

Engineering economics as a course will equip students with overview knowledge of the relevant principles and basic concepts of engineering economics, engineering economic decisions, interest formulae and economic equivalence, and standard cash flows; among others. Also, it will equip students with the ability to apply the fundamentals and principles of economic evaluation and comparison of alternatives.

Objectives

The objectives of this course are to:

1. identify and describe the nature and types of engineering economic decisions;
2. differentiate between engineering economic decisions and design decisions;
3. identify and briefly explain the fundamental principles of engineering economics;
4. explain the meaning of economic equivalence and why its required in economic analysis;
5. explain the concept of interest operation;
6. identify and explain the types of interest formulae used to facilitate their calculations of economic equivalence;
7. identify, analyse and discuss the economic analysis of various types of interest formulae used to facilitate their calculations of economic equivalence;
8. explain the term depreciation;
9. Identify and describe the depreciation methods;
10. outline and discuss the effects of depreciation on net income calculation; and
11. evaluate the potential investment opportunities and their profitability by considering the time value of money and compare mutually exclusive investment opportunities.

Learning Outcomes

On completion of the course, students should be able to:

1. outline the nature engineering economic decisions and describe at least four types of engineering economic decisions;
2. differentiate between engineering economic decisions and design decisions;
3. describe the fundamental principles of engineering economics and briefly explain at least three fundamental principles of engineering economics;
4. explain the meaning of economic equivalence and why its required in economic analysis;
5. explain the concept of interest operation;
6. explain the two types of interest formulae used to facilitate their calculations of economic equivalence;
7. implement the economic analysis of various types of interest formulae used to facilitate their calculations of economic equivalence;
8. define the term depreciation;
9. analyze the depreciation methods and describe at least two depreciation methods;
10. appraise the effects of depreciation on net income calculation; and
11. evaluate the potential investment opportunities and their profitability by considering the time value of money and compare mutually exclusive investment opportunities.

Course Contents

Definition, nature and scope of Engineering Economics. Basic Concepts of Engineering Economy. The Decision-Making Process. Engineering Economic Decisions. Engineering Economic Decisions versus Engineering Design Decisions. Role of Engineers in decision making. Break- even analysis. Time-value of money. Cash flow diagram. Economic Equivalence. Simple interest. Compound interest. Compound interest formulas and factors (P/F, F/A, A/P, P/A, F/A, A/F, A/G, G/A). Evaluation of a single proposal using PW, FW, AW, IRR and payback period analyses. Decision making among alternative proposals with equal and unequal service lives using PW, FW, AW, IRR and payback period analyses. Life-cycle costing. Depreciation – definition, purpose of, methods (straight-line, sum-of the-years-digits, declining balance). The trade-off between Risk and Reward. Effect of tax and inflation in economic analysis.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)
Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three software in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble- shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.
Examples of projects should include the following:
a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in SolidWorks; and d. technical report writing.

MME 301: Thermodynamics of Materials (2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. explain the laws of thermodynamics and their applications to equilibrium and the properties of materials;
2. discuss how thermodynamics affects materials microstructure, defect concentration, atomic ordering etc;
3. analyse equilibrium conditions between solid-liquid, gas-liquid and gas-solid phases in one-component systems;
4. calculate equilibrium conditions between solid-liquid, gas-condensed phases via the Clapeyron equation;
5. explain how the properties of materials are affected by thermo processes;
6. discuss how to develop graphical constructions that are essential for the interpretation of phase diagrams;
7. explain how to apply thermodynamic data to predict stable phases in high temperature systems;
8. explain the construction and use of partial pressure diagram, Eh-pH diagrams, T-C diagrams in metallurgical systems; and
9. discuss slag formation equation and desulphurization process metallurgical system.

Course Contents
Thermochemistry applied to typical metallurgical reactions, graphical representations of equilibria, binary and ternary phase diagrams, heterogeneous equilibrium, behaviour of solutions, standard states, and electrochemical thermodynamics. Application of thermodynamic data to predict stable phases in aqueous and high-temperature systems. Construction and use of partial pressure diagrams, Eh-pH diagrams, temperature-composition diagrams in related mineral and metallurgical systems. Activities and equilibria in slag-metal and gas-metal systems.

MME 304: Chemistry of Materials (2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. explain the chemistry behind the following materials: metals, ceramics, and polymers;
2. describe historic and economic impacts of materials manufacture and use;
3. discuss the application of chemistry principles to Materials Engineering using flowsheet;

4. explain the use of chemistry in reactor design; and
5. discuss the applications of advanced materials in fields such as electronics, aviation, or art.

Course Contents

Basic Inorganic Chemistry of Materials. Topics will include chemical properties, structure and bonding of solids, energy, enthalpy, entropy, thermochemistry, kinetics and rate processes. Application of chemistry principles to Materials Engineering through flowsheeting, reactor design, materials/metals processing and the environment.

MME 305: Engineering Materials: Structure and Properties (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify the following engineering materials: metals, ceramics, polymers, and composites -- their structures and properties;
2. explain the structure-property relationships for engineering materials;
3. discuss the manufacture, processing and applications of engineering materials.

Course Contents

Basic structure of ceramics, alloys, composites, metals, and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal, and chemical properties.

MME 312: Physical Metallurgy I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify and explain various metallurgical reactions e.g. eutectic, peritectic, monotectic, eutectoid etc;
2. draw iron–carbon/carbide and iron-graphite equilibrium phase diagrams;
3. describe the Fe-C/ Fe_3C to classify steel and cast irons according to composition and structures;
4. identify room temperature solidification structures of steel and cast irons;
5. describe the cast structures of steels and cast irons;
6. describe the effect of cooling on structure of steels;
7. discuss the applications of steels and cast irons;
8. explain the heat treatment processes/structures of as-cast and worked steels and cast irons;
9. explain the alloying of metals – ferrous and non-ferrous metals;
10. explain the hardening and tempering processes for steels, cast irons and non-ferrous metals; and
11. explain the different types of high alloy steels, heat treatment and applications.

Course Contents

Introduction to metals and metal alloy systems. The metallic bond and structure of metals. Solidification of pure metals, effect of variables on structure solidification as a nucleation and growth process. Solidification of non-crystalline materials. Preparation of materials to reveal structure, use of microscope, annealing of metals, grain growth, surface energy and shapes of crystals. Deformation, slip, twinning, effect of microstructure, viscous flow. Annealing of deformed metals. Effect of variables. Binary equilibria - alloying, solid solutions. Equilibrium of phase diagrams, complete solubility, Cu/Ni type, Lever rule. Effect of cooling changes in solid, heterogeneous equilibria, Claudius - Chaperon on vapour pressure, phase rule, definitions and

proof. Introducing activity and potential P-T diagrams, condensed systems. Peritectics, more complex equilibrium diagrams with maxima, minima compounds, etc. Iron - iron carbide diagram, hysteresis, allotropy.
Applications-- cast steel, wrought steels, effect of cooling on structure of steels. Martensite. Quenching, T.T.T. curves, hardenability. Bainite, alloying. Tempering properties and structure. Surface hardening. High alloy steels, cast irons, stability Fe_3C, Iron-graphite equilibrium. Copper, copper -- zinc alloys as an example of different strengthening processes.

UIL-MME 302: Heat and Mass Transfer (3 Units C: LH 45)
Senate-approved relevance
A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in this course provide an opportunity to identify, formulate, and solve engineering problems. The course also promotes the use of techniques, skills, and modern engineering tools necessary for engineering practice which is a core principle in the vision and mission of the University of Ilorin.
Overview
The course introduces the governing theories, laws and applications of heat and mass transfer. The knowledge required to solve problems for the design, assessment, and analysis of heat and mass transfer processes will be provided.

The course will focus on analysing and solving problems associated with heat and mass transfer systems for industrial and real-life applications in the metallurgical and materials process industries using analytical approaches and numerical methods.
Objectives
The objectives of the course are to:
1. teach the basic modes of heat and mass transfer;
2. explain the mechanism of heat and mass transfer;
3. explain basic heat and mass equations;
4. teach overall energy balances in fluid flow;
5. introduce mass transfer between multiple phases;
6. understand the mechanism of heat transfer under steady and transient conditions;
7. apply principles of heat and mass transfer to predict transfer coefficients;
8. develop methodologies for solving a wide variety of practical engineering problems;
9. explain simple heat exchanger analysis and design; and
10. provide useful information concerning the performance and design of particular systems and processes

Learning outcomes
At the end of this course, students should be able to:
1. understand the principle of heat by diffusion under steady or unsteady conditions;
2. write three (3) basic heat and mass transfer equations;
3. discuss overall energy balances in fluid flow;
4. discuss the three (3) mechanisms of heat and mass transfer;
5. apply dimensional analysis to heat flow;
6. apply heat and flow analysis to two (2) metallurgical processes e.g. casting, and reheating of slabs and ingots;

7. identify one (1) combined modes of heat transfer;
8. perform one (1) simple heat exchanger analysis and design;
9. demonstrate understanding of the two (2) different types of interface reactions;
10. explain Fick's and Fourier's laws;
11. identify one (1) similarity in conduction and mass transfer in stationary systems;
12. demonstrate an understanding of heat and mass transfer modes and models;
13. explain mass transfer between multiple phases; and
14. obtain two (2) numerical solutions for conduction and radiation heat transfer problems.

Course contents
Fluid Flow. Viscosity and Viscous flow. The differential equations of fluid motion. Turbulent flow. Overall energy balances in fluid flow. Heat transfer. Basic heat transfer equation. Mechanisms of heat transfer. steady and unsteady state heat transfer (conduction, convection and radiation). Application of dimensional analysis to heat flow. Application of heat and flow analysis in metallurgical processes e.g. casting. Thermal resistance. Application of heat and flow analysis in reheating of slabs and ingots. Diffusion and Mass transfer. Diffusivity and steady-state diffusion; Basic equation of mass transfer. Mass transfer coefficient and models. mass transfer between multiple phases. simultaneous heat and mass transfer coupled with transport phenomena in metallurgical processes. Use of finite element method of estimating heat distribution in a slab.

UIL-MME 303: Mineral Processing **(3 Units C: LH 45)**
Senate-approved relevance
Nigeria is blessed with several ores that needed to be processed to obtain valuable minerals and elements. This course will provide the students with appropriate knowledge that can assist Nigeria in diversifying the economy and foreign earnings through mineral extraction and processing. Producing graduates that can help in nation building is a core principle in the vision and mission of the University of Ilorin
Overview
Mineral processing is the first process most ores undergo after mining. The course will provide the students with information and understanding about minerals which are available in Nigeria and how their properties relate to communition and mineral separation methods.
This course covers the application of process engineering to mineral processing operations relative to ore identification and preparation, blending, size reduction (communition) separation and concentration, sorting and floatation.
Objectives
The objectives of the course are to:
1. provide information about several minerals and ores;
2. describe available minerals and ores in Nigeria;
3. introduce the theoretical aspect of common minerals processing techniques;
4. explain the scope, objects and limitations of mineral dressing;
5. explain the theory and practice of crushing and grinding;
6. describe typical equipment used in mineral processing, their field of application and limitations;
7. explain froth flotation and physicochemical principles;
8. describe gravity concentration methods;
9. explain the theory and practice of thickening, filtration and drying; and
10. provide an overview of the procedure and principle of mineral processing of specific raw materials.

Learning outcomes

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

1. categorize five (5) minerals and ores;
2. identify five (5) available minerals and ores in Nigeria;
3. explain two (2) theoretical aspect of common minerals processing techniques;
4. describe two (2) objectives and limitations of mineral dressing
5. grasp the importance of mineral processing technology as a value-addition chain in mineral resource development;
6. explain two (2) gravity concentration methods;
7. explain two (2) froth flotation and physicochemical principles;
8. carry out two (2) mineralogical characterizations of ferrous, base and precious/noble metals;
9. explain the two (2) basic principles involved in physical and physico-chemical processing of minerals; and
10. design one (1) process flow sheet for ores of ferrous, base and precious metals.

Course contents

Origin and formation of mineral deposits. Principal ores of common metals. Discussion of the mineral wealth of Nigeria, their location and type. Scope, objects 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. Flotation machines and flotation of simple ores. Electrostatic and electromagnetic methods of concentration. Dewatering and Drying. Theory and practice of thickening. Filtration and Drying. Coal/Washing. Coal/shale separation, coal flotation & Cleaning. Flowsheets. Simplified flowsheets for the beneficiation of simple ores of copper, tin, lead, zinc, iron, gold, and other ores of local importance.
(Minimum Academic Standards)

UIL-MME 306: Mechanical Working of Metals (2 Units C: LH 30)

Senate-approved relevance

A good understanding and use of mechanical properties are very important and beneficial to the manufacturing industry. Producing graduate that has the skill to strengthen materials for requisite engineering application and for nation’s technological development is a core principle in the vision and mission of the University of Ilorin. This course will also allow engineers to predict failures, behaviors and tendencies of metals during the forming processes.

Overview

In material design for high tech application, the need to understand the stress strain relationship is one of the requisite knowledge areas that is required to develop materials that can withstand hash working environments.
This course is to present the students with the knowledge of stress relationship with strain in materials and the method of strengthening materials through materials deformation using hot and cold working as well as annealing effect on materials properties.

Objectives

The objectives of the course are to:

1. highlight properties of metals;
2. describe the relationship between stress and strain;
3. explain stress-strain curve;
4. describe cold working and its effect on materials properties.;
5. explain hot working;
6. interpret strain curve;
7. explain dislocation;
8. explain strain hardening;
9. describe mechanism of deformation; and
10. explain twining.

Learning outcomes

At the end of this course, the student should be able to:

1. demonstrate stress-strain relationship using diagrams;
2. explain two (2) concepts of deformation and strengthening;
3. discuss three (3) effects of cold-working, hot-working and annealing on material properties;
4. list five (5) differences between hot and cold working;
5. describe three (3) implications of stress strain curve;
6. interpret strain curve;
7. state two (2) types of dislocation modes;
8. describe strain hardening;
9. explain one (1) mechanism of deformation; and
10. state one (1) importance of twining.

Course contents

Properties of metals. Stress-strain diagrams for ductile and brittle metals. Stress-strain relations. principal stresses, strains and directions. The Mohr circle. Elastic and plastic deformations. Elastic constants and plastic yield criteria. Basic concepts of dislocations. Dislocation, density and dislocation motion. Conservative and non-conservative motion. Dislocation motion and plastic deformation. Mechanism of deformation. Slip, twining, grain boundary sliding, directional diffusion. Creep. Theories of creep and stress rupture. Concepts of cyclic loading and fatigue. Strengthening mechanism in metals and alloys. Solid solutions, precipitation and dispersion hardening. Grain size strengthening. Strain hardening, martensite hardening, etc. Composite materials and fibre strengthening, hardness and strength considerations in deformation processing. effects of cold working. Hot working. Annealing.
(Minimum Academic Standards)

UIL-MME 308: Fracture Mechanics (3 Units C: LH 45)

Senate-approved relevance

All engineering components and structures contain geometrical discontinuities. The ultimate goal in the field of applied solid mechanics is to be able to design structures or components that are capable of safely withstanding static or dynamic service loads for a certain period. This course will enable Materials and Metallurgical Engineering students to understand the reasons for mechanical failure, which could help them understand design mechanisms to mitigate against it in terms of design philosophy and damage tolerance design methodology. Producing graduate with tis skill is is a core principle in the vision and mission of the University of Ilorin

Overview

Fracture mechanics is a field of solid mechanics that deals with the mechanical behaviour of cracked bodies. It is a set of theories that described the behaviour of solids or structures with geometrical discontinuity at the scale of the structure. This course focused on the essential concepts and analytical methods of fracture mechanics, aiming at painting a broad picture of the theoretical background to fracture mechanics.

The course covers the mechanics of brittle and ductile materials fracture; linear elastic fracture mechanics; elastic-plastic fracture; fracture testing; and numerical methods. It offers students a basic understanding of fracture mechanics as applied to real engineering problems.

Objectives

The objectives of the course are to:

1. describe the structure of solids;
2. explain the strength of solids;
3. explain fundamental backgrounds of fracture mechanics and its use for the understanding of modes of fracture;
4. describe mechanics of fracture of brittle and ductile materials describe shear, cleavage, defects in solids and concept of elastic cracks;
5. explain the theory of elasticity;
6. describe the process of crack initiation, propagation;
7. calculate strength intensity factor;
8. determine critical crack size;
9. describe different approaches used for determining fracture toughness of materials; and
10. list the application of fracture mechanics in materials selection for various engineering applications.

Learning outcomes

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

1. explain three (3) structures of solids;
2. identify three (3) factors affecting the strength of solids;
3. state two (2) differences between fracture and failure, and explain the different modes of fracture;
4. describe the theory of elasticity;
5. list three (3) importance of stress intensity factor;
6. explain one (1) importance of critical crack size;
7. explain the linear-elastic fracture mechanics concepts
8. list three (3) relationships between stress intensity factor and fracture energy;
9. explain two (2) elastic-plastic fracture mechanics and understand the meaning of the J contour integral and R-curve;
10. describe two (2) probabilistic aspects of fracture mechanics as it relates to brittle materials.

Course contents

Structure of solids. Strength of solids. Shear. Cleavage. Defects in solids. Concept of elastic cracks. Theory of elasticity. Crack initiation and propagation. Stress intensity factor. Fracture of solids. Griffth-Orowan's and Irwin's theories. Elastic and plastic fracture. Stress concentration and design consideration. Fracture mechanics for ductile materials. Plastic zone correction. Crack-opening displacement. J-contour integral. R-curve. Fatigue crack growth. Probabilistic aspect of fracture mechanics.

(Minimum Academic Standards)

UIL-MME 317: Material Laboratory I **(1 unit C: PH 45)**

Senate-approved relevance

Hands-on experience is an important part of engineering education. The laboratory skills that will be developed in this course including mechanical testing and characterization, optical microscopy, etc., will complement theoretical knowledge acquired in the classroom based on introductory materials science principles. In addition, students will develop professional skills regarding working safely and effectively in a team-based laboratory setting, which is a core principle in the vision and mission of the University of Ilorin

Overview

This is the first of three required laboratory courses in the undergraduate Materials Science and Engineering program at the University of Ilorin. This course will focus on applying introductory materials science principles, in tandem with those from prior physics and chemistry courses, to study the properties of metals. Students will apply many of the concepts that are taught in MME 102 the concurrent course, MME 305.

Hands-on laboratory skills that will be developed include mechanical testing and characterization and sample preparation for microstructural examination using optical microscopy. This course will introduce the students to the use of laboratory equipment during their final-year research projects.

Objectives

The objectives of the course are to:

1. develop professional skills on how to work safely and effectively in a team-based laboratory setting;
2. develop hands-on skills in materials characterization involving destructive and non-destructive methods;
3. explain principle and technique of optical metallography;
4. describe specimen preparation of microstructural examination;
5. explain the principles of mass spectrometry for composition analysis;
6. explain qualitative and quantitative microscopy;
7. describe methods of tensile test;
8. explain compression and flexural test;
9. describe different hardness testing methods; and
10. explain non-destructive testing methods.

Learning outcomes

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

1. list five (5) laboratory safety rules;
2. measure and record experimental data, analyse and discuss experimental results and prepare formal laboratory reports;
3. explain two (2) destructive testing and non-destructive testing
4. use three (3) different laboratory equipment such as optical microscope, grinding and polishing machine, cutting machine, universal mechanical testing machine, etc.;
5. prepare two (2) metallic samples for microstructural examination and interpret microstructural images;
6. state five (5) different mechanical properties;
7. perform tensile testing on two (2) different solid materials;
8. perform compression and flexural testing on two (2) solid materials;
9. perform hardness testing on two (2) solid materials; and

10. explain three (3) methods that can be used to determine the chemical compositions of metallic materials.

Course contents

Principle and technique of optical metallography. Specimen preparation methods. Etching. Compositional analysis methods. Mass spectrometry. Qualitative and quantitative microscopy. Mechanical testing- tensile, compression, flexural and hardness. Non-destructive testing- liquid penetrant, visual inspection, etc. Principles of mechanical testing equipment. Operational principle of optical microscope. Analysis of microstructural images. Interpretation of microstructural images. Collection of mechanical testing results. Analysis of mechanical test results. Interpretation of mechanical tests results. plotting of graphs. Use of relevant software- excel, OriginPro; ImageJ; Gatan.
(Minimum Academic Standards)

UIL-MME 318: Material Laboratory II **(1 unit C: PH 45)**

Senate-approved relevance

Materials engineers are trained to convert minerals/ores to useful engineering materials. This requires the students to understand the principles and applications of processes like mineral identification, sieve analysis, ore dressing and beneficiation, and some extractive processes. Students with comprehensive skills in this course will be able to explore the nature of several minerals our country is blessed with which is a core principle in the vision and mission of the University of Ilorin.

Overview

Metals form a foundation for our modern standard of living. We use large quantities of metals to build transportation vehicles that range from bicycles and cars to ships and airplanes. We rely on metals for structural support for buildings, bridges, and highways. We need metals to build computers and electronic devices. Metals generally originate in the earth’s crust as metal oxides, sulfides, and other minerals.
The procedures used for processing minerals containing metallic elements to metals of the required purity for specific applications are generally referred to as extractive metallurgy. To understand how a specific process may lead to the extraction of metals with the required composition, it is necessary to take into account not only the feasibility of the process but also theoretical considerations regarding the principles controlling the rate and extent of the associated chemical reactions. Therefore, special attention is given to the search for and development of new, often unconventional methods of producing and processing metals, or combinations of these metals.The knowledge that the students will acquire from the course will be useful to explore new ways to beneficiate metals from ores, especially those available in Nigeria.

Objectives

The objectives of the course are to:
1. describe minerals using their chemical and physical features;
2. explain froth floation as an important step in mineral beneficiation process;
3. perform simple extraction processes;
4. explain mechanical testing of materials;
5. list the importance of value addition to solid minerals for techno-economic advancement in any nation;
6. describe technical-economic conditions for winning mineral resources;
7. identify various minerals using their physical features such as colour and structure;
8. identify suitable chemicals for leaching of various metals;
9. explain the beneficiation route for several minerals and ores; and
10. Explain how to select extractive process.

Learning outcomes

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

1. identify three (3) minerals using their physical features, chemical composition and microstructure;
2. describe two (2) comminution operations and use a sieve shaker to perform sieve analysis;
3. explain two (2) ways of using sieve shaker for particle sizing;
4. determine particle size distributions of two (2) different powder samples;
5. describe two (2) types of crushers for communition operation;
6. calculate work index;
7. identify five (5) chemicals for leaching;
8. explain two (2) principles of leaching process;
9. explain how to use froth floatation machine for the beneficiation of at least three (3) ores; and
10. analyze three (3) reasons for the selection of various extractive processes based on raw material properties.

Course contents

Mineral identification (chemical/physical). Minerals and ores classification. Sieve analysis. Particle size analysis. Beneficiation. Froth floatation. Principles of leaching operation. Factors affecting leaching process. Simple experiments on extraction processes. Mechanical testing of materials. Impact, fatigue, torsion, and creep. Microstructural examination of minerals and ores. Technical-economic conditions for winning mineral resources. Suitable chemicals for leaching operation. Beneficiation route for several minerals and ores. Principles of froth floatation equipment. Use of sieve shaker. Use of crushers and ball mills. Work index calculation. Data analysis.
(Minimum Academic Standards)

8.2.4 400 Level

GET 402 Engineering Project I (2 Units C: PH 90)

Learning Outcomes

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

1. Complete the design phase of a complex engineering problem sourced from industry or community during the SIWES III programme.
2. Demonstrate the connection between engineering product-making and the theoretical courses they have learned following the applicable industry best practices.

Course Contents

In the second semester of the 400-level students, preferably in groups, work from the university on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 404 Engineering Valuation and Appraisal (2 Units C: LH 30)

Learning Outcomes

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

1. Identify at least three (3) objectives of engineering valuation work, valuer's primary duty and responsibility and valuation terminologies.

2. Describe at least four (4) Valuer's obligation to his or her client, to other valuers, and to the society.
3. Demonstrate with example the engineering valuation methods, valuation standards, and practices.
4. Prepare engineering valuation and appraisal reports and review
5. Discuss expert witnessing and ethics in valuation.
6. Determine price, cost, value, depreciation and obsolescence in real property, personal property, personal property, machinery and equipment, oil, gas, mines, and quarries valuation.

GET 499: Students Industrial Work Experience III (4 Units C: 12 weeks)
Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MME 401: Synthesis, Processing, and Manufacturing of Materials
(2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. explain the synthesis of materials such as principal alloys, ceramics and polymers;
2. differentiate between synthesis and processing;
3. discuss the processing of engineering materials – metals, ceramics and polymers;
4. explain how changes in materials properties enhance the performance of the material;

5. discuss the common manufacturing and processing methods for metals, ceramics, and polymers;
6. describe five casting techniques; and
7. explain the addition and condensation polymerisation mechanisms.

Course Contents

Detailed study of principal alloy, ceramic, and polymer systems. Evaluation of the effects or processing on selected physical and mechanical material properties. Overview of design fundamentals and examination of selected material/design case studies for manufacturing.

MME 405: Corrosion Science and Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the basic concept of corrosion and socio-economic implication;
2. describe the fundamental causes of corrosion problem and failures;
3. explain the thermodynamics and kinetics of electrochemical reactions in corrosion of metals and alloys;
4. describe the various forms of corrosion (from uniform to localised to stress corrosion phenomena);
5. use Pourbaix and Evans diagrams as tools to predict corrosion;
6. discuss corrosion rate measurements using weight loss method and other methods; and
7. discuss the protection systems used to combat corrosion, including inhibitors, coatings and cathodic protection.

Course Contents

The course is aimed at investigating the underlying fundamental causes of corrosion problems and failures. Emphasis is placed on the electrochemical reactions occurring and the tools and knowledge necessary for predicting corrosion, measuring corrosion rates, and combining these with prevention and materials selection.

MME 407: Mechanical Behaviour of Materials (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the mechanisms for mechanical behaviour of materials;
2. explain the similarities and differences in mechanical response within and between the material classes; and
3. discuss stress, strain, tensors, elasticity, dislocations, strengthening mechanisms, high temperature deformation, fracture, and fatigue.

Course Contents

Flow and fracture of solids; uniaxial stress-strain as a reference behaviour; theories of terminal stability under impact; monotonic, sustained (creep), and repeated (fatigue) loadings of solids under various states of stress.

MME 413: Chemical Metallurgy (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the quantitative thermodynamics, fluid flow, heat and mass transfer and its application to process metallurgy;

2. explain the fundamental chemical principles and demonstrates the application of these principles to process metallurgy;
4. explain the fundamental chemical principles involved in metallurgical reactions; and
5. discuss the applications of the chemical principles to the extraction and refining of metals, metal melting and recycling, and metallic corrosion.

Course Contents

Application of thermodynamics, fluid flow, and heat and mass transfer to the design and operation of chemical metallurgical processes; roasting, agglomerating, oxidation and reduction reactions, smelting, converting, and refining.

UIL-MME 403: Non-ferrous Extractive Metallurgy (3 Units C: LH 45)

Senate-approved relevance

Non-ferrous extractive metallurgy course will help students to learn about beneficiation methods, principles of extraction and general methods of extraction of nonferrous metals from ores. The course content will prepare students for careers in Engineering where they have to manage the processes of mineral dressing, metal extraction and refining of non-ferrous metals. The knowledge acquired on this subject will be useful for effective management in metal industries in line with vision and mission of University of Ilorin. It will also provide a firm foundation for the pursuit of graduate studies in Metallurgical Engineering.

Overview

In nature, metals generally occur either in free form or in combined form. Non-ferrous extractive metallurgy is one of the two branches of extractive metallurgy, which pertains to the processes of reducing valuable, non-iron metals from ores or raw materials. The course begins with a general overview of metal classifications and introduces fundamental principles of metal extraction. Various methods for the beneficiation, extraction and refining of nonferrous metals will be covered. Basic engineering principles will be used to explain metal production from ores by high or low-temperature processes.
Topics to be learnt in this course include drying, calcining, roasting, sintering, agglomeration, smelting, converting, and refining will be taught under pyrometallurgy. The hydrometallurgy aspect will emphasise low-temperature procedures for extraction of low-grade ores, which cannot be beneficiated economically but have high chemical specificity. The dissociation or decomposition of a compound in solution will be highlighted as the basis for electrometallurgy viz a viz electrowinning, electrorefining and electrode position.

Objectives

The objectives of the course are to:

1. differentiate metals using the periodic table;
2. describe the process of raw material preparation such as blending, roasting, agglomeration;
3. explain the general methods of Pyrometallurgy (calcination, roasting and smelting);
4. explain the general methods of Hydrometallurgy (leaching, solvent extraction, ion exchange, precipitation);
5. explain the general methods of electrometallurgy (electrolysis and electro-refining);
6. explain methods of refining based on basic approaches, preparation of pure compounds, and purification of crude metal produced in bulk);
7. outline the application of carbon, silicon, hydrogen and other reductants in metallic production;
8. describe limitations and factors influencing the choice of a refining process;
9. explain the design and operations of extraction equipment and plants; and
10. list the factors governing the choice of extraction process route.

Learning outcomes
At the end of this course, students should be able to:
1. outline five (5) merits and demerits of various extractive procedures
2. explain two (2) pyrometallurgical processes in extractive metallurgy;
3. explain three (3) hydrometallurgical processes in extractive metallurgy;
4. describe two (2) electrometallurgical processes in extractive metallurgy;
5. describe three (3) chemical reactions involved in the extraction of specific metals by reduction.
6. state two (2) theories and applications of Ellingham diagram in pyrometallurgy
7. state two (2) theories and applications of Pourbaix diagram in hydrometallurgy and electrometallurgy;
8. develop process flow sheets for extraction of at least five (5) non-ferrous metals;
9. identify two (2) techno-economic and environmental challenges in non-ferrous metal extraction industry; and
10. describe three (3) possible problems and challenges encountered in mineral processing plants.

Course contents
General classification of metals. Periodic Table. Industrial classification into Heavy, Light, Minor, Noble, Refractory, Rare-earth, Disseminated and Radioactive metals. Raw material preparation – blending, roasting, agglomeration. Factors governing the choice of extraction process route. Assessment of the application of carbon, silicon, hydrogen and other reductants in metallic production. Condensation of metal vapour. Simple blast furnace and reverberatory processes. Chemical Reaction Processes. Chemical reactions involved in the extraction of specific metals by reduction. Hydrometallurgical, 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 is made to aluminium, Copper, Zinc, Lead, Tin, Nickel, Gold, Magnesium. Refining Plants. A study of the design and operations of extraction equipment and plants. Problems encountered in various plants, e. g. environmental pollution.
(Minimum Academic Standards)

UIL-MME 409: Fuels, Furnace and Refractories **(2 units C: LH 30)**
Senate-approved relevance
Furnaces are crucial to technological development of a nation. It is an important tool for material processing. This course is an important course in the department designed to enable students have fundamental knowledge in fuels, furnaces and refractories as applied to materials and metallurgical processes. Training of quality Materials and Metallurgical engineers requires them to know types, production and uses of fuels, furnaces and refractories. This course facilitates learning to solve societal problem as entailed in the University of Ilorin’s vision and mission statements.

Overview
The course is structured on the background that students have basic knowledge of engineering materials, materials deformation, and, heat and mass transfer. These are courses that must have been registered and passed prior to offering fuels, furnaces and refractories.
Fuels, Furnaces and Refractories is an important course in the department designed to enable students have fundamental knowledge in fuels, furnaces and refractories as applied to materials and metallurgical processes. Students will be able to identify various energy sources and how to enhance their potentials. Students will recognize the importance of furnaces and refractories in technological development.

Objectives
The objectives of this course include:
1. explain the basic metallurgical fuels and their sources;
2. describe how to choose effectively from fuels and other energy resources for specific processes;
3. outline the basic stoichiometry and calculations regarding fuels and their utilization;
4. discuss economic aspect of fuel utilization;
5. explain inherent refractory minerals properties;
6. describe primary refractory materials, mineralogy, manufacture, service characteristics and their applications;
7. outline various furnaces and reactors;
8. describe the criteria used in classifying furnaces;
9. discuss he design requirements of furnaces;
10. explain some application of furnaces in extractive metallurgy and heat treatment operation;

Learning outcomes
On successful completion of this course, students should be able to:
1. identify ten various fuels and energy sources;
2. describe and explain three (3) fuel classification and their properties;
3. describe eight refractory materials and their properties;
4. highlight five (5) importance of refractories materials;
5. state two (2) differences between furnaces and other high-temperature reactors;
6. analyse three (3) effective utilization of fuels, refractories, and furnaces;
7. enumerate five (5) furnace designs;
8. discuss five (5) selection criteria of suitable refractories for the various materials and metallurgical operations;
9. discuss five (5) selection criteria for fuels for the various materials and metallurgical operations; and
10. explain how to be self-reliance and contribute to the technological development of Nigeria.

Course contents
Fuels. Classifications and properties of fuels. Comparative study of solid, liquid and gaseous fuel and factors governing their choice. Fossil fuels analysis. Coal and coke. Manufacture of metallurgical coke. Choice, preparation and blending of coal. Types of coke ovens and recovery of by-products. Numerical calculations on combustion and fuel efficiency. Furnaces. Furnace as a system involving heat generation, utilization, and losses. Classifications of metallurgical furnaces and reactors. Construction and operation of melting, reheating and kiln type of furnaces. Sources of heat loss in furnaces. Prevention of heat loss- insulation, recuperation, regeneration, waste heat boilers, furnace atmosphere and control. Fuel economy and thermal efficiency of furnaces. Natural, induced and balance draft. Calculation of natural draft. Regulation of primary, secondary and excess air in furnaces. Refractories. Types, Properties, applications and manufacture of refractories. Important refractory materials such as alumina, silica, magnesite, graphite and silica carbide.
(Minimum Academic Standards)

UIL-MME 411: Manufacturing Processes (3 Units C: LH 45)
Senate-approved relevance
It is important for materials and metallurgical engineer understand manufacturing processes and be able to relate the different manufacturing processes with the developed material properties. This will help in

material development for specific manufacturing process since the manufacturing processes often alter the material properties. This course will give the required knowledge about different manufacturing processes and their effect on the materials properties. This knowledge will help to tailor material properties for the manufacturing process so as to achieve the final desired product properties. Additive manufacturing technology is an advanced manufacturing technology that is important for not only product manufacturing but also for material development. This is an advanced skill required in today's graduate to be competitive in the material world which is a core principle in the vision and mission of the University of Ilorin

Overview

This course presents the various traditional and advanced manufacturing processes and their effect on the resulting product properties.

The knowledge of various welding technologies is important for materials and metallurgical engineers for novel materials development. Rapid prototyping and additive manufacturing technology are advanced manufacturing technology and are presented in detail.

Objectives

The objectives of this course are to:

1. explain different traditional and advanced manufacturing processes;
2. define metallurgical engineering joining processes;
3. describe effect of manufacturing on properties of material;
4. describe rapid prototyping and additive manufacturing technology;
5. list the three (3) main classes of metallurgical engineering joining processes: welding, brazing and soldering;
6. explain the concept of heat affected zone (HAZ);
7. describe theoretical knowledge and practical skills involved in welding, brazing and soldering;
8. explain the scope and limitations of welding and brazing;
9. explain influence of manufacturing processes on developed product properties; and
10. list advanced manufacturing processes.

Learning outcomes

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

1. list four (4) differences between traditional and advanced manufacturing processes;
2. list five (5) joining processes;
3. explain three (3) main metallurgical engineering joining processes: welding, brazing and soldering;
4. describe three (3) features of heat affected zone (HAZ);
5. exemplify three (3) theoretical knowledge and practical skills involved in welding, brazing and soldering;
6. explain three (3) limitations of welding and brazing;
7. explain three (3) influences of manufacturing processes on developed product properties;
8. list at least three (3) advanced manufacturing processes;
9. explain rapid prototyping; and
10. describe additive manufacturing processes.

Course contents

Introduction and definition of terms. Casting. Drawing. Extrusion. Forging. Machining. Rolling. Welding. Types of welding processes – gas, arc, resistance, flash, friction and electro-welding. Introduction to explosive welding, Plasma welding and electro-beam welding. Weld rods and fluxes protective atmosphere. Weld defect. Weldability of metals and alloys. The effect of welding processes and mechanical properties of weldments. Heat Affected Zone (HAZ). Soldering: processes. Soldering alloys and application of soldering techniques. Effect of manufacturing processes on materials properties. Powder metallurgy. Blending, briquetting, and sintering processes and secondary operations. Advantages and limitations of powder metallurgy. Rapid prototyping. 3D printing/additive manufacturing processes. (Minimum Academic Standards)

UIL-MME415: Introduction to Materials Computation and Modelling (2 Units I: LH 30)
Senate-approved relevance
Modeling of materials property is a skill that is required for materials and metallurgical engineers. It is important to develop manpower with this skill in Nigeria. Materials modelling enables the prediction of material properties without actually carrying out the experiment. This is cheaper than to carry out the actual experiment that may be difficult to perform or even prohibitive to perform. This skill is required for this digital age and for graduate of materials and metallurgical engineering to be competitive among their pairs is a core principle in the vision and mission of the University of Ilorin.
Overview
This course presents the importance of modelling materials properties. It explains the use of software to model and simulate materials behaviour. It explains the use of software such as MATLAB and ABACUS in design and materials development.
This is a cost-effective method of designing new materials without actually performing the experiment. It saves time and material properties can be simulated under different working condition to gain an insight into how the material will behave in real world.
Objectives
The objectives of this course are to:
1. explain the importance of material computation and modelling;
2. describe importance of geometric models to additive manufacturing;
3. explain particle and continuum methods;
4. explain quantum mechanical methods;
5. demonstrate discretization of bulk material for simulation;
6. various design tools of Design software and their applications;
7. describe the use of AutoCAD and Solidwork for creating two dimensional (2D) and three dimensional (3D) models;
8. demonstrate the use of MATLAB to predict materials behaviour;
9. demonstrate the use of ABACUS to predict materials behaviour; and
10. demonstrate the use of Design Expert for analysis and simulation.

Learning outcomes
At the end of this course, students should be able to:
1. explain two (2) purposes of materials computation and modelling to Materials Engineering Practices;
2. analyze and reformulate three (3) mathematical equations and simple models into a form which is suitable for numerical solutions in a computer;
3. define and highlight two (2) types of geometric models;
4. explain three (3) importance of geometric models to additive manufacturing;
5. describe two (2) methods of discretization of bulk materials for simulation purposes;
6. identify three (3) design tools of Design software and their applications;
7. explore one (1) of AutoCAD or Solidwork for creating 2D and 3D models;

8. explore one (1) of Design Expert or MATLAB for analysis and simulation;
9. simulate to predict behaviour of materials using ABACUS or STAAD Pro.; and
10. describe 2D transient and steady-state heat equation.

Course contents
Introduction to materials computation and modelling. Particle and Continuum Methods. Quantum Mechanical Methods. Basic molecular dynamics. Property calculation. Geometric models (2 and 3 dimensional models), detailing of the 2D model. Importance of the geometric model to additive manufacturing. Creation of geometric models using design software like AutoCAD or Solidwork. Continuum solution, time and space discretization, forward. Backward and central finite difference methods. 2D transient and steady-state heat equation. Software application-MATLAB. Finite element analysis. Stiffness matrix formulation and assembly procedures. 2D truss problems. Application of dimensional analysis-Pi-theorem in materials modelling. Introduction of ABAQUS software. Use of ABAQUS software to solve failure problems involving beam, plate and composites materials. Analysis and simulation using Design Expert.
(Minimum Academic Standards)

UIL-MME 417 Material Laboratory III **(1 unit C: PH 45)**
Senate-approved relevance
This course provides students with the knowledge and necessary skills to perform metal casting operation, which is important for any nation's technological development. The practicals will enable them to gain expertise and confidence in foundry activities, ceramic production and glass making. More so, the students will learn about corrosion measurements, which are relevant in several industries like oil and gas, automobile and building. This knowledge will prepare the students for several positions that will be them successful professionals in their chosen careers in line the vision and mission statement of the University of Ilorin.
Overview
Foundry technology involves molding, melting, and casting of parts. The course will give a basic overview of all stages in casting operation taking into account the choice of specific technology used, i.e. pattern equipment and the type of mould (permanent- non-permanent). The students will undergo practical training to produce simple engineering components.
The students will also be introduced to the various types of welding methods and equipment set-up used. They will learn about personal protection and safety while operating welding equipment. Several ceramic processes understanding on how to work with clay and the tools required to produce ceramic outcomes will be exposed to the students. The course will provide training on a wide range of corrosion testing and monitoring techniques from conventional weight loss coupons, electrical resistance (ER) and linear polarization resistance (LPR) to advanced electrochemical impedance spectroscopy (EIS) for routine applications such as rapid screening of corrosion inhibitors, materials selection, failure analysis and corrosion rate measurement.
Objectives
The objectives of the course are to:
1. explain workshop safety rules;
2. explain basic facts and concepts in foundry and
3. identify the importance and relevance of sand tests;
4. discuss foundry technology in academic and industrial settings;
5. discuss castings defects and remedies;
6. explain different processes used in foundry industries and their applications;

7. develop and apply the skill and knowledge of foundry principles and technology;
8. enumerate the basic set-up configurations of various welding equipment;
9. explain the concepts of ceramics and glass production; and
10. describe defects in ceramics and glass.

Learning outcomes
At the end of this course, students should be able to:
1. list eight (8) workshop safety rules;
2. identify two (2) gating system components like sprue, runner and ingate;
3. list two (2) functions of gating system in casting operation;
4. interpret drawings and prepare moulds for casting five (5) simple engineering components;
5. determine four (4) properties of green sand such as permeability, shatter index, green strength that is used in mould making;
6. operate two (2) melting furnaces such as rotary furnace, bale out furnace and tilting furnace;
7. identify five (5) casting defects and discuss their possible causes and remedy;
8. implement heat treatment of four (4) metallic materials to optimize strength and ductility;
9. describe the basic set-up configurations of three (3) welding equipment; and
10. Explain how to join two (2) metallic parts using welding process;

Course Contents
Foundry practice. Pattern making and allowances. Sand analysis. Mould making. Core making. Melting. Casting. Finishing operations. Casting defect and remedies. Heat treatment process. Effect of heat treatment on phase transformation and microstructure of materials. Welding. Corrosion measurements. Ceramics and glass production. Ceramic and glass defects and remedies. Materials Characterization. Workshop safety requirements.
(Minimum Academic Standards)

UIL-MME 421 Experimental Techniques (3 units C: LH 45)
Senate-approved relevance
Experimental technique is important for materials and metallurgical engineer to be able to carry out proper experimental analysis on materials for understanding the structure and properties of materials. Adequate knowledge and skill in the use of various experimental equipment and their construction as well as their principle of operation is needed in materials development. The engineers trained in this manner will use the knowledge acquired to explore materials for specific applications in line with the University of Ilorin vision and mission.

Overview
This course presents the principle of microscopy, x-ray diffraction and neutron diffraction. Production of X-ray and electrons are comprehensively explained. Important material analytical instruments are also explored.
How the experiment should be designed using design of experiment is also analysed for proper analysis and results interpretation. Techniques of surface examination will be discussed. Analysis of stress in materials will also be elucidated. Design of experiments and interpretation of results will also be introduced.

Objectives
The objectives of the course are to:
1. explain the principle of microscopy;

2. describe how X-ray is produced;
3. explain Bragg's Law; reciprocal lattice; diffraction methods, including powder, Laue and rotating crystal techniques;
4. describe materials analytical instruments;
5. discuss principle of thermal analysis;
6. describe how electron beam is generated;
7. explain the principle of optical miscroscopy;
8. describe principle of fluorescent analysis;
9. discuss how atomic absorption spectroscopy is carried out; and
10. discuss experimental stress analysis.

Learning outcome

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

1. describe three (3) principles of microscopy;
2. explain two (2) types of X-ray generation;
3. describe Bragg's Law; reciprocal lattice; diffraction methods, including powder, Laue and rotating crystal techniques;
4. discuss five (5) analytical instruments;
5. describe three (3) principles of thermal analysis;
6. describe two (2) methods of electron beam generation;
7. highlight five (5) basic steps required in optical miscroscopy;
8. describe three (3) basic principles of fluorescent analysis;
9. discuss when atomic absorption spectroscopy is required; and
10. discuss three (3) modes of experimental stress analysis.

Course content

Principles and techniques of optical microscopy, electron microscopy, and scanning-probe microscopy. X-ray diffraction and neutron diffraction. Production and choice of X-rays and electrons with matter. Bragg's Law. reciprocal lattice. diffraction methods including powder, Laue and rotating crystal techniques. Fluorescent analysis. applications of diffraction methods in metallurgy and materials. Materials Analytical Instruments. Principles and applications of X-ray spectrometry. Atomic absorption spectroscopy. Pyrometry. Dilatometry. Thermogravimetry (TG). Differential thermal analysis (DTA). Thermomechanical analysis (TMA). Technique of surface examination [touch, microscopy (optical and electron), surface profilometry (contact and optical)]. Experimental Stress Analysis. Statistical design of experiments and interpretations of results.
(Minimum Academic Standards)

8.2.5 500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

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

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case
- financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MME 501: Analytical Methods for Materials (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. describe the external morphology of crystals and law of constant angle;
2. explain representation by directions of ace normal;
3. discuss Crystal Chemistry - ionic, covalent, metallic and Van der Wall's bonded crystals;
4. explain the physics behind X rays, it's production, properties and applications in radiology;
6. explain the principles of diffraction, atomic Scattering, Bragg's equation and missing reflections;
7. explain the principle of electron and neutron diffraction method; and
8. discuss how spectroscopy and spectrometric analysis can be used to study materials.

Course Contents

Crystallography, physics of X-rays, diffraction by crystalline materials, applications of X-ray, electron and neutron diffraction, and spectrometric analysis of materials.

MME 504: Solidification and Foundry Technology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. select appropriate casting method for particular component;
2. explain the production of various engineering components;
3. identify properties of cast products; and
4. discuss areas of application of cast component.

Course Contents

Processes of freezing: nucleation and growth of solid phase; Plannar and dendritic growth freezing of alloys; constitutional super-cooling. Solidification of two-phase alloy; structure of cast alloy; effect of cast structure on properties; segregation in ingots. Casting techniques and finishing operations; defects in casting.

MME 505: Nanoscience and Nanotechnology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify and control individual atoms and molecules;
2. make materials at the nanoscale deliberately;
3. explain enhanced properties of nanomaterials such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts; and
4. apply nanoscale materials particles to create changes in the composition of the materials.

Course Contents

Fundamental concepts in nanoscience and nanotechnology. Review of quantum mechanics. Nanosystems. Molecular dynamics. Scanning probe microscopy. Nanomaterials. Production and characterization of nanoparticles. Design of nanostructured systems. Nanomechanics of materials, Applications of nanosystems in the industry. Carbon nanofibres, Nanocomposites. Fabrication methods. Computational nanotechnology.

MME 507: Composite Materials **(3 Units E: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. produce advanced engineering materials;
2. describe the production, characteristic and applications of hybrid composites;
3. discuss the mode of failure in composites; and
2. discuss the application of composites in various engineering fields and other areas.

Course Contents

Fundamental aspects of modern composite materials; types of composite materials viz: fibre, reinforced, particulate dispersion strengthened and laminar types, Metal matrix composites, Ceramic matrix composites, polymer matrix composites, and hybrid composites. Methods of fabricating composites; solid state and liquid state fabricating techniques; characteristics and properties of composites; measurement and testing of properties of composites; application of composites in engineering design; failure modes of composites.

MME 510: Final Year Project **(6 Units C: PH 270)**

Learning Outcomes

The student(s) will develop a technology and/or system to solve a known and significant materials and metallurgical engineering problem and design, and if possible/practicable, build/produce/ manufacture some relevant new materials/device(s) representing the solution using the skills acquired in the programme.

Course Contents

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the engineering degree.

MME 514: Engineering Materials Laboratory **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. discuss the various laboratory procedure and methods for engineering materials;
2. discuss principles and different methods of hardness measurement;
3. discuss the correlations among different types of hardness measurement and correlations of hardness with tensile strength;
4. use various types of hardness testers;
5. use a computer-controlled universal testing machine (UTM) to perform standard tensile test and test procedure;
6. observe the tensile behaviour of metal and polymer materials,
7. explain material properties from stress-strain curves obtained from tensile tests and methods for toughness measurement with impact tests;
8. discuss the procedure for specimen preparation for macro and microscopic examination, compound optical microscopes and metallography.
9. describe the heat treatment principles and methods; and
10. examine surface characteristics of engineering materials.

Course Contents

Materials testing and evaluation, laboratory procedures and techniques, metallography, heat treatment, phase diagrams, hardenability, and mechanical testing.

UIL-MME 502: Polymers **(2 units E: LH 30)**

Senate-approved relevance

Graduate of Materials and metallurgical engineering are expected to know the basic types of engineering materials and how to manipulate them for improvement of human life. Graduates trained under this program will be able to apply knowledge acquired to solve problems in infrastructures, medicine and reduction in environmental pollution which is a core principle in the vision and mission of the University of Ilorin.

Overview

This course is aimed at developing knowledgeable engineers in polymer science and engineering specialized for career in the industry, teaching, and research. The course will expose students to fascinating properties of in polymer science and technology so as to enable them fulfil the needs and expectations of providing scientific and industrial solution in polymer science and engineering.

Student will learn the structures of polymer, the mechanism of deformation of polymer and characterization method for polymers.

Objectives

The objectives of the course are to:

1. develop knowledgeable engineers in polymer science and engineering;
2. explain polymer structures;
3. differentiate between thermoset and thermoplastic;
4. describe basic features and behaviours of elastomers;
5. explain mechanism of polymers deformation;
6. explain polymer crystallinity;
7. explain polymer synthesis and various types of polymerization reactions;
8. describe various polymer characterization methods;
9. explain Flory Huggin's theory; and
10. describe the scope of polymers in engineering applications.

Learning outcomes

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

1. explain two (2) polymer and their structures and configurations;
2. explain two (2) different thermomechanical properties of polymers;
3. discuss two (2) polymer crystallization process;
4. list three (3) differences between thermoplastic and thermosetting resins;
5. discuss six (6) methods of polymer characterization;
6. explain two (2) types of polymerization reactions;
7. State two (2) differences between enthalpic and entropic contributions to polymer crystallization
8. apply Flory Huggin's theory;
9. calculate the solubility of one (1) polymer in a given solvent, as well as the mutual miscibility of various polymer types; and
10. process polymers from their basic units, mers.

Course contents

Introduction to polymers. Polymer structures- hydrocarbons molecules, molecular shape, molecular structure, molecular configurations. Polymer crystallinity and polymer crystals. Mechanical and thermomechanical characteristics. Stress-strain behaviour. Deformations of semi-crystalline polymer. Crystallisation. Chain-growth polymerization. Free radical polymerization, reactions, mechanisms, kinetics. Ionic polymerization. Stereochemistry, coordination polymerization. Ring-opening polymerization and copolymerization. Polymer conformations. Copolymerization. Melting and glass transition phenomena. Thermoplastic and thermosetting polymers. Viscoelasticity deformation and elastomers. Fracture of polymers. Polymer solubility/miscibility and phase diagrams. Flory Huggin's theory. Step-growth polymerization, condensation reactions. Polymer characterization methods. Mechanical properties of polymers and processing. Stimuli responsive polymers and gels.
(Minimum Academic Standards)

UIL-MME 503: Iron and Steel Making **(3 units C: LH 45)**

Senate-approved relevance

Nature has blessed Nigeria with abundant iron ore and coals which are important ingredients in making steels for infrastructural development. This course will enable metallurgical engineers and scientist utilize these raw materials for the development of the nation which is a core principle in the vision and mission of the University of Ilorin.

Overview

Iron and steel are the bedrocks of technological development of a country. This is a compulsory course designed for Bachelor of Engineering (B. Eng.) training in Materials and metallurgical engineering.
This course will enable students learn basic processes needed to convert iron ore to wrought iron or steel. It exposes students to how to manoeuvre different means of improving metals.

Objectives

The objectives of this course are to:

1. discuss iron ores distribution across the globe;
2. ensure theoretical background evaluation and beneficiation of iron ore;
3. describe furnaces importance to iron and steel making;
4. describe blast furnace and discuss its working principles as it relates to iron production
5. explain steelmaking process;
6. explain the chemistry of steelmaking process;
7. discuss steelmaking in induction furnaces;
8. discuss gases and non-metallic inclusions in steels
9. explain de-oxidation process of steels by Mn, Si, Ti, AI, Si-Ca and Si-Mn; and
10. explain the principles Bessemer and LD Converters.

Learning outcomes

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

1. describe three (3) ore distribution evaluations and beneficiations;
2. explain one (1) steelmaking process;
3. illustrate two (2) chemical reactions in steelmaking process;
4. discuss three (3) critical importance of iron and steel making in national economic development;
5. describe iron and steel making via the two (2) major routes (blast furnace and direct reduction);
6. highlight three (3) basic design principles of the blast furnace and direct reduction method of iron and steel production, their operations and their thermochemistry;

7. explain two (2) different secondary steel making processes and manufacturing of alloy steel such as ferro alloy and super alloys;
8. describe three (3) operations in a blast furnace;
9. highlight three (3) chemical changes in a blast furnace;
10. explain steelmaking in induction furnaces; and
11. describe Bessemer and LD Converters.

Courses content

Ores. Ore 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-C and 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 advantage and disadvantages. Manganese, Silicon, phosphorus sulphur reduction and desulphurization in the blast furnace. Pig Iron and slag formation. Properties of slag. Methods of blast furnace intensification. Blast Furnace Operation: Blast furnace operations irregularities (The peripheral furnace run, channelling, change hanging, cold and hot run of the furnace, etc). Blast Furnace Equipment: Ladles, Topedoes, Anzitiary equipment e.g. for cleaning and utizations of blast furnace gases, etc. Alternative Methods of Iron Making: Pellet production (Green ball formation its composition, binder and machine etc), sintering (flored and unilored}, direct iron reduction and coke production. High Manganese; pig iron production its uses. Blast Furnace Design and Operation: General design principle; Blast furnace profile; refractories instrument, Blast furnace assay calculation and thermal balance. Physical Chemistry in Steel Making: Thermodynamics oxidations reactions e.g. Carbon, sulphur, phosphorus, manganese e.t.c. De-oxidation of steels by Mn, Si, Ti, AI, Si-Ca, Si-Mn etc. recipitation de-oxidation. Diffusion de-oxidation. De-oxidation using vaccum, and synthetic slags. Gases and non-metallic inclusions in steels. Steelmaking 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). Modifications of the processes. Oxygen Process-Developments of LD Converters. Construction of LD converter (Linings& 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 & Acid). Steelmaking in Induction furnaces. Production of steel from sponge Iron. Special Treatments: Iron gas (especially Argon) injection. Injection of powdered materials.
(Minimum Academic Standards)

UIL-MME 509: Principle of Materials Selection (2 units C: LH 30)

Senate-approved relevance

Materials selection is a very important procedure in the engineering profession. This course is an important course in the department designed to enable students to have a fundamental knowledge of predefined tools applied in the selection of materials in several applications. Training of quality Materials and Metallurgical engineers requires them to know how to apply these tools to systematically eliminate unsuitable materials and identify best candidates for a particular application using different indices. Producing graduate with this type of skill is a core principle in the vision and mission of the University of Ilorin.

Overview

This course will expose students to spectra of engineering materials and describe their area of applications. Student will be able to use some important numerical tools such as Ashby plots, cost issues (life cycle assessment, net present value) and performance index for material selection.

Students will gain knowledge about how material development evolves over time and areas of application of different types of engineering materials.

Objectives

The objectives of the course are to:

1. describe the evolution of engineering materials;
2. discuss engineering materials classifications
3. identify the concept of materials indices;
4. define the principle of materials selection;
5. identify metallurgical, mechanical, electrical, and environmental factors considerations in materials selection;
6. explain application areas of various class of engineering materials;
7. describe materials procurement and cost;
8. discuss discounted cash flow;
9. identify and enumerate materials disposal and environmental impact assessment; and
10. explain life cycle assessment.

Learning outcomes

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

1. discuss evolution of engineering materials;
2. describe three (3) classifications of engineering materials;
3. explain the concept of material selection;
4. discuss four (4) important factors for considerations in materials selection;
5. list five (5) application areas of various class of engineering materials;
6. describe three (3) procedures for materials procurement;
7. list two (2) cost analysis approaches in material procurement;
8. explain discounted cash flow;
9. list three (3) merits of discounted cash flow;
10. list three (3) demerits of discounted cash flow;
11. highlight three (3) principles of material selection and its economics; and
12. explain the life cycle assessment of materials.

Course contents

Materials Selection: Evolution of engineering materials. Concepts of materials indices. Materials and shape selection. process selection. Principle of Materials Selection- metallurgical, mechanical and environmental factors. Metals and alloys for heavy, medium and light casting. Lightweight structural alloys of aluminium, magnesium and titanium. Structural steels (carbon, low carbon and ultra-high strength steel). Tool steels (carbon, low alloys and high speed tool steels. Bearing metal. Materials for electrical conductor, contact, and resistance. Magnetic materials. Corrosion and heat resistant alloys. Alloys for low and high temperature applications. Alloys for forming operation. Engineering Economics-introduction. Time value of money, single payment discounting value, multi-payment discounting, non-uniform cash flows, effective interest rates, evaluating alternatives, MARR, PW, AW, IRR, uncertainty. Comparing alternatives. Dealing with changing prices. Life Cycle Assessment- introduction. Cost of

materials usage. An overview of life cycle assessment. Analysis goal and scope. Inventory methods. impact assessment.
(Minimum Academic Standards)

UIL-MME 511: Material Failure Analysis (3 units C: LH 45)

Senate-approved relevance

Engineers should be able to detect and prevent failure in engineering materials since the consequence is usually huge. Hence graduates that take this course will be able to solve society problems by providing adequate professional services to support the infrastructures around the globe. This important skill of having graduate that can predict and prevent failure of engineering structures which is required worldwide is a core principle in the vision and mission of the University of Ilorin.

Overview

Failure, though not wanted, but usually occur in materials in service. This course will enable engineering students learn causes and possible prevention measures.
Analysis of failures that occur in engineering materials are crucial to provide necessary information for improvement in designs, areas of applications and most importantly prevention measures against such catastrophic occurrences.

Objectives

The objectives of the course are to:

1. identify modes of failure;
2. describe failure types based on fracture surfaces;
3. demonstrate how to prevent material failure theoretically and experimentally;
4. learn techniques used in failure predictions;
5. state the importance of failure analysis;
6. describe the essence of fractography;
7. relate failure analysis to design;
8. match failure analysis to materials selection;
9. identify legal implications in failure analysis; and
10. translate failure analysis in selected cases to real life applications.

Learning outcomes

On completion of the course, students should be able to:

1. identify three (3) failure modes;
2. vividly illustrate the two (2) types of failures;
3. state three (3) differences between brittle and ductile failures;
4. state three (3) techniques employed in prediction, monitoring and analysing failure types;
5. list five (5) advantages of failure analysis;
6. explain two (2) importance of fractography;
7. correlate failure analysis to design;
8. describe three (3) ways how materials selection could influence material failure;
9. recognize legal implications in failure analysis; and
10. describe three (3) cases of failure analysis in real life scenario.

Course contents

Importance of failure analysis. Procedures and methods of failure analysis. Mode of failure. Types of failure. Causes of failure. Stages of failure. Root cause analysis. Failure due to excessive elastic deformation. Failure due to excessive plastic deformation. Failure due to loss of dimension. . Fatigue.

Theoretical and experimental techniques in failure prediction. Monitoring and analytical techniques for failure analysis such as scanning electron microscopy and optical microscopy. Fractography. Relationship of failure analysis to design and material selection. Legal issues involved in failure analysis. Selected case studies.
(Minimum Academic Standards)

UIL-MME 512: Biomaterials **(2 units E: LH 30)**

Senate-approved relevance

Biomaterials are materials that are used in transplant in the biomedical industries. Development of biomaterials is important for everlasting organ and tissues replacement. Developing competence in design and development of biomaterials is needed to prevent patient that need organ transplant from frequent visit to the theatre room for failed transplant replacement. This is a core principle in the vision and mission of the University of Ilorin.

Overview

This course will give students a strong material science and engineering base to biomaterials engineering. The principles of materials science for biomedical application. Characterization of biomaterials.
Development of biomaterials is an area that the world over is interested in because of the aging body parts of human body that needs replacement at some point in human life to improve quality of life.

Objectives

The objectives of the course are to:
1. characterize biomaterials;
2. describe structure-property of metal, ceramic and polymers for biomaterials application;
3. explain material characteristics in simulated body fluid;
4. describe development of biomaterials;
5. apply metals to body tissues such as bone and teeth;
6. use ceramics for bone and teeth tissues;
7. apply polymers to some soft tissues such as cartilage, ligament; skin; muscle and vasculature;
8. relate how different materials can behave in different body fluids;
9. classify behaviour of materials in simulated body fluids; and
10. demonstrate application of composite materials in biomedical applications.

Learning outcomes

On completion of the course, students should be able to:
1. explain three (3) characterization methods of biomaterials;
2. explain three (3) structure-property of metal, ceramic and polymers for biomaterials application;
3. characterize biomaterial;
4. develop biomaterials;
5. enumerate two (2) metals that could replace body tissues such as bone and teeth;
6. explain three (3) areas of application of ceramics for bone and teeth tissues;
7. Highlight three (3) reasons for using polymers in soft tissues replacement;
8. describe how three (3) different materials can behave in different body fluids;
9. list three (3) behaviours of materials in simulated body fluids; and
10. identify two (2) application of composite materials in biomedical applications.

Course contents

Characteristics and properties of biomaterials. Characterization of biomaterials. Types of biomaterials. Development and characteristics of metallic biomaterials. Development and characteristics of ceramic biomaterials. Development and characteristics of polymeric biomaterials. Development and characteristics of composite biomaterials. Forms in which biomaterials are used. The structure-property relationships of metals, ceramics, polymers and composites biomaterials. Structure-property relationships of biomaterials with properties close to soft tissues such as cartilage, ligament, skin, muscle and vasculature. Structure-property relationships of biomaterials with properties close to hard tissues bone and teeth. Biomaterials sterilization methods. Behaviour of materials in the physiological environment. Material characterization in simulated body fluid. Degradation of biomaterials. Biomaterial-Receptor and Receptor-Biomaterial Interactions. Behaviour of the biomaterial in the in vivo condition. Applications and requirements of biomaterials.
(Minimum Academic Standards)

UIL-MME 513: Student Seminar **(2 Units C: PH 90)**

Senate-approved relevance

Student seminar is expected to expose students to solving real-life problems through a structured report of previous efforts related to a selected/assigned topic. This will develop students' competence in problem-solving and a match between theories and social responsibilities. Students trained using this model will show professionalism as entrenched in the mission and vision of the University.

Overview

This course will enable students dig into previous works to solve future problems. Students will be taken through literature review to develop a cognitive problem statement sufficient to address an approved topic in Materials and Metallurgical Engineering.

A well-organized methodological approach to solving the problem through research objectives will be described and each student is expected to make presentation on the topic.

Objectives

The objectives of the course are to:

1. introduce students to a comprehensive literature survey;
2. identify the cogent footprint of a research paper;
3. summarize scientific research work;
4. describe the research gap from reviewed works;
5. formulate the problem from the literature review;
6. state precisely specific aim of scientific research;
7. outline the objectives required to achieve an aim;
8. justify reason(s) for the research work;
9. appraise and develop a well-structured literature review; and
10. formulate a methodology that suitably addresses the defined problem.

Learning outcomes

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

1. recognize three (3) relevant scientific works related to a topic;
2. outline three (3) reasons for a particular published paper;
3. state three (3) differences between reputable and predatory/unreliable journals;
4. identify three (3) research gaps in a reviewed topic;
5. write three (3) cognitive problem statements;

6. describe aim and list at least four (4) objectives of a topic;
7. identify three (3) methodologies in published journals;
8. prepare a detailed research method to solve a problem;
9. use two (2) software e.g. Microsoft Word and PowerPoint in report writing and presentation; and
10. justify the scope of a research work.

Course contents
Communication and presentation skill. Original individual student project related to a prescribed Materials and Metallurgical Engineering problem. Comprehensive concepts in literature search approaches. Literature review and research gap. Project proposal writing. Materials and methods. Identification, definition, and formulation of Engineering problem. Theoretical investigations. Modelling. Simulation. Design of experiments. Material analysis and design. Statistical analysis of results. Drawing inferences from observations and results. Discussion of results. Bill of engineering measurement and evaluation (BEME). Reference styles and management.
(Minimum Academic Standards)

UIL-MME 514: Ceramics **(2 Units C: LH 30)**
Senate-approved relevance
This course will equip students with basic principles and working knowledge of ceramic materials processing. The course will equip the undergraduate students of Materials and Metallurgical Engineering with knowledge on how to produce vital engineering materials for many advanced and traditional technologies which is a core principle in the vision and mission of the University of Ilorin: electronic and optical assemblies, aerospace parts, biomedical components, nuclear components, high temperature, corrosion resistant assemblies, fuel cells, and electronic packaging.
Overview
The course focused on the science and technology of creating objects from inorganic, non-metallic materials. It provides an overview of the structure, properties, manufacturing and design of ceramics.
This course will introduce the major types of ceramics and their areas of applications and discuss possible defects. Glass manufacturing, shaping and heat treatment as well as mechanical properties will also be covered.
Objectives
The objectives of the course are to:
1. describe various types of ceramics;
2. explain the structure of ceramics;
3. explain the properties of ceramic products;
4. relate the structure and properties of ceramic;
5. explain the various types of clays and their structures.
6. explain the science of preparation and production of ceramics;
7. discuss defects in ceramics;
8. understand ceramic materials applications in structural, biological and electrical components;
9. discuss general properties of glass;
10. describe glass manufacturing process; and
11. glass heat treatments.

Learning outcomes
At the end of this course, the students should be able to:
1. develop a working knowledge of design concepts related to ceramic materials production;

2. list three (3) differences between traditional and advanced ceramics;
3. describe three (3) common ceramic crystal structures;
4. list three (3) ceramic processing techniques, including sintering theory and grain growth;
5. develop a working knowledge of design concepts related to glass production;
6. list two (2) types of glass and glass-ceramic composite materials;
7. discuss three (3) ceramic materials applications in structural, biological and electrical components;
8. describe three (3) structures of clay minerals such as kaolin, montorillonite, illite etc;
9. discuss three (3) processes involved in the manufacture of clay products; and
10. list five (5) advantages of ceramic materials.

Course contents

Introduction. General definition of ceramics. classes of ceramics. Traditional ceramics in the group of domestic and art wares. Pottery. Engineering or industrial ceramics e.g. bricks, tiles, abrasives, dielectric insulators semiconductor, glass, etc. Review of structure of atoms. molecules and bonding in ceramics. Clays. Formation and types of clays. Structures of clay minerals such as kaolin, montorillonite, illite etc. Clay-water system. cation exchange. reaction on firing. Properties of fried clay products. Manufacture of Clay Products: Sizing, mixing, moulding and slip casting processes, firing, finishing and testing. Silica- Nature and occurrences, types and structures of silica inversion and conversion of silica. Effects of impurities and fluxers 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. Abrasives structure and application of ceramics abrasives insulating, magnetic and dielectric materials etc. Macro and microstructures of ceramics. Discussion on defects in ceramics. 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, photosensitive and high refractive index glasses. Advanced ceramics and applications.
(Minimum Academic Standards)

UIL-MME 515: Powder Metallurgy **(2 Units E: LH 30)**

Senate-approved relevance

Powder metallurgy is an important manufacturing technology using powder to make products. The knowledge of this powder metallurgy is important in the development of powder materials for the required applications. Competence in powder metallurgy is required for technological advancement. Ability to develop powder materials with novel material properties is an important research interest and can help to propel our graduate in the world research community which is a core principle in the vision and mission of the University of Ilorin.

Overview

This course will provide learner with the required knowledge in powder formulation and development. The principle of powder metallurgy, powder compaction and sintering. Particle size analysis, and powder consolidation. Characterization of sintered part.

The knowledge of this course is important in some engineering component development such as porous part or filters.

Objectives

The objectives of the course are to:

1. introduce powder metallurgy to students;
2. describe the principle of powder metallurgy;

3. describe approaches to productions of metal powders to students;
4. explain different manufacturing processes for powder;
5. describe particle size analysis;
6. explain powder consolidation and sintering;
7. create a platform for students to learn techniques for particle size determination;
8. explain modes of operations of machines/equipment for producing metal powders and their size determinations;
9. explain properties of binders and lubricants used in compactions of particles to students;
10. give guides to students to interpret particle morphology;
11. introduce consolidation processes to students; and
12. guide students in relating properties of sintered materials to industrial applications.

Learning outcomes
At the end of the course, students should be able to:
1. explain the principle of Powder Metallurgy;
2. list three (3) different manufacturing methods to produce metal powders;
3. explain three (3) techniques for particle size determination morphology: size, shape, characterization;
4. describe three (3) the requirements/properties of lubricants and binders;
5. describe three (3) consolidation/shaping processes including conventional press and sinter, metal injection moulding, metal additive manufacturing, hot isostatic pressing, roll-forming, powder extrusion;
6. describe two (2) post-sintering operations and interpret materials properties;
7. identify three (3) machines/equipment for metal powder synthesis and size determinations;
8. explain particle morphology;
9. list three (3) sintering furnaces and atmospheres;
10. interpret microstructures in relation to necking and sintering processes;
11. interpret three (3) materials properties; and
12. recognize management issues including safety, health, cost, efficiency, markets, and applications.

Courses content
Introduction to powder metallurgy. Powder properties. Diffusion processes in powder metallurgy. Forming of metal powder. Particle size analysis. Powder characterization. Powder compaction. Green strength. Hot pressing. sintering kinetics. Engineering components processing. Application of powder metallurgy. Advantages and limitations of powder metallurgy. Processing and properties of bearing and friction materials. Cemented carbides. Porous metals, electrical and magnetic materials. Areas of application of Powder Metallurgy.
(Minimum Academic Standards)

UIL-MME 516: Introduction to Laser Technology and Additive Manufacturing (2 Units I: LH 30)
Senate-approved relevance
Laser technologies and additive manufacturing is an important course in Materials and Metallurgical Engineering programme and plays a vital role in exploring innovative manufacturing technologies which will enhance the versatility of graduate from the Department of Materials and Metallurgical Engineering, University of Ilorin, Nigeria. This course will be useful in aerospace, defense, automotive, biomedical, tools and moulding for rapid prototyping, artistic and architectural designs

Overview

Laser and additive manufacturing provides limitless design flexibility, rapid prototyping, and reduced material waste. Combining laser and additive manufacturing technologies enables synergy between these two cutting-edge fields. This unlocks new possibilities for innovative product design, rapid prototyping, and efficient production. This synergy will potentially transform various industries and revolutionize the way we create complex products.

Objectives

1. Understand laser technology principles and applications
2. Learn additive manufacturing techniques and processes
3. Develop skills in designing and producing components using additive manufacturing
4. Analyze laser-based additive manufacturing techniques
5. Understand applications and case studies
6. Develop skills in laser technology and additive manufacturing
7. Understand future directions and emerging trends
8. Learn about laser-based manufacturing techniques
9. Understand additive manufacturing materials and processes
10. Apply laser technology and additive manufacturing principles

Learning Outcomes

1. Knowledge of laser technology principles and applications
2. Ability to design and produce components using additive manufacturing
3. Understanding of laser-based additive manufacturing techniques
4. Skills in analyzing and interpreting additive manufacturing processes
5. Ability to implement laser technology and additive manufacturing principles
6. Familiarity with laser-based manufacturing techniques
7. Ability to analyze and mitigate laser technology and additive manufacturing challenges
8. Knowledge of additive manufacturing materials and processes
9. Understanding of future directions and emerging trends
10. Ability to apply laser technology and additive manufacturing principles

Contents

Laser fundamentals: laser principles and operation, types of lasers (e.g., solid-state, gas, semiconductor), and laser characteristics (e.g., wavelength, power, beam quality). Laser materials processing: laser cutting and welding, laser surface treatment and modification, and laser material removal and machining. Laser applications: industrial applications (e.g., manufacturing, material processing), medical applications (e.g., surgery, diagnostics), and military and defense applications. Laser safety and control: laser safety protocols and regulations, laser control systems and instrumentation, and laser beam delivery and optics. Additive manufacturing techniques and processes. Designing and producing components using additive manufacturing. Laser-based additive manufacturing techniques. Applications and case studies. Future directions and emerging trends.

(Minimum Academic Standards)

UIL-MME 518: Surface Engineering and Coatings Technologies (2 Units I: LH 15, PH 45)
Senate-approved relevance
Surface Engineering and Coatings Technologies is an important course in Materials and Metallurgical Engineering programme which plays a crucial role in enhancing the properties of materials for aesthetics and improved service performance. Relevant coating technologies commonly practice in recent times include flame retardant coating, thermal barrier coating, intumescent coating, corrosion protection, tribological coating, electroplating and electroless plating, surface modification including laser, anodising, plasma etc, smart coating and nanocoating. These technologies are applied in various industries such as aerospace, automative, and energy industries to mention but few. The relevance of surface engineering and coating technologies are quite significant on enhanced materials properties, improved safety of sensitive equipment and facilities, preventive and corrective maintenance, increased life span and regulatory compliance such as in food, medical, and energy industries.

Overview

Introduction to surface engineering and coatings technologies will expose students to a range of surface modification and coating coating techniques for target purposes. The course will cover different techniques for applications in flame retardant coatings; thermal barrier coatings; intumescent coatings; corrosion protection; tribological coatings; electroplating and electroless plating; surface modification; nanocoatings; and smart coatings. The areas of application of surface engineering and coating technologies include aerospace, automotive, energy including nuclear, oil and gas, construction, electronics, textiles, and medical industries.

Objectives

1. Understand surface engineering principles and techniques

2. Apply coatings technologies for material performance enhancement

3. Develop surface treatment protocols for specific applications

4. Analyze surface properties and characteristics

5. Design surface engineering processes for materials modification

6. Understand surface engineering equipment and instrumentation

7. Develop skills in surface characterization and analysis

8. Understand corrosion protection techniques

9. apply the theoretical knowledge of surface engineering and coating in practical cases.

Learning Outcomes

1. Knowledge of surface engineering methods and coatings technologies
2. Ability to select and apply surface treatments for material enhancement
3. Understanding of surface characterization techniques
4. Skills in designing surface engineering processes for materials modification
5. Familiarity with surface engineering equipment and instrumentation
6. Ability to analyze and interpret surface properties and characteristics
7. Knowledge of coatings technologies for corrosion protection
8. Understanding of surface engineering applications in biomedical fields
9. Ability to develop surface treatment protocols for specific applications

Course Contents

Introduction: Surface Engineering fundamentals; coatings technologies overview; surface properties and characterization; surface modification techniques (cleaning, etching, etc.). **Coatings Technologies:** Paints and coatings formulation; coating methods (spraying, dipping, etc.); coating types (polymer, ceramic, metal); coating properties (mechanical, thermal, electrical). **Surface Engineering Techniques:** Electroplating and electroless plating; vacuum deposition (PVD, CVD); thermal spraying (plasma, HVOF); surface treatment (nitriding, carburizing). **Advanced Topics:** Nanocoatings and nanostructured surfaces; smart coatings and self-healing materials; tribological coatings and surface engineering; corrosion protection and surface engineering. **Applications and Case Studies:** Aerospace and automotive applications; energy and industrial applications; medical and biomedical applications; case studies and project-based learning.

Laboratory and Project Work: Surface characterization and analysis; coatings deposition and testing; surface engineering project design and, implementation; and mini group project.

(Minimum Academic Standards)

9 Student Membership of Engineering Organizations/Society

The Nigerian Society of Engineers (NSE) including Association of Professional Women Engineers of Nigeria (APWEN); Materials Science and Technology Society of Nigeria (www.msn-ng.org); Nigerian Metallurgical Society (www.nigerianmetsociety.org) and National Society of Black Engineers (NSBE), London (www.nsbe.org) are organisations that provide students the opportunity to begin their professional careers by joining as student members. They also provide awareness for students on recent developments in the field of Materials and Metallurgical engineering through publications and activities of the society, as well as promote fellowship and interaction with other engineering organisations. Registered student's associations in the University are NUESA, Materials and Metallurgical Engineering Students Association

10 Minimum Academic Standards

10.1 List of Laboratories/Workshops/Equipment /Instruments/Tools

10.1.1 Foundry Laboratory

1. Melting furnaces (Crucible, Electric arc, Rotary)
2. Oil fired crucible furnace
3. Sand moulding equipment
4. Sand testing equipment
5. Crucibles of various sizes
6. Moulding sands
7. Sand blasting machines
8. Pattern making machine
9. other foundry accessories
10. Scale balance
11. Digital weighing balance
12. Scraps yard

10.1.2 Heat Treatment Laboratory

1. Heat treatment furnaces (1000, 1200, 1800, 2000 °C)
2. Ovens (200, 300, 600 °C)
3. Salt bath furnace and accessories
4. Thermocouples of various temperatures
5. Pyrometer
6. Quenching bath (Oil & water)
7. Jominy end quench apparatus

10.1.3 Machining Workshop

1. Lathe machine (Standard)
2. Drilling machine
3. Boring machine
4. Power cutting machine
5. Bench vices
6. Files of different sizes
7. Cooling lubricants

10.1.4 Metallography Laboratory

1. Thin sectioning machine and the discs
2. Hot/Cold mounting machines and accessories
3. Automatic grinding/polishing machines and accessories
4. Hot/cold sample mounting materials
5. Optical microscopes (x1000) with inbuild camera
6. Image analyser
7. Scanning Electron microscope (SEM) with EDS
8. X-ray Differential machines, AAS

9. Etchants
10. Desiccators
11. Air drier
12. Metal Analyser
13. Fume cupboard

10.1.5 Minimum of 10 Desktop Computers

Minimum of 15 Laptop Computers (1TB HDD,500GB Memory, Webcam, Internet ready)

10.1.6 Materials Testing Laboratory

1. Universal tensile test machine
2. Hardness tester machine (BHN, Vickers & Rockwell)
3. Impact energy testing machine
4. Fatigue/creep testing machine

10.1.7 Corrosion Testing Laboratory

1. Potentiometer equipment and the kits
2. Digital weighing balance scale

10.1.8 Welding and Fabrication Workshop

1. Arc welding machine
2. Gas welding machine
3. Oxygen gas and accessories
4. Acetylene gas and accessories
5. Electrodes of different types
6. Electrode holders
7. Other welding accessories (hand gloves, eye goggles, boots)

10.2 Staffing

10.2.1 Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

10.2.2 Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

10.2.3 Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

10.2.4 Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

10.2.5 Minimum Number of Staff

1. There should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. Each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. There should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

10.2.6 Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

10.2.7 Library

Subject to the general standards specified by NUC, the central and/or faculty/departmental libraries should have:
1. Physical holdings of current books in the relevant fundamental science and engineering subject areas;
2. Physical holdings of current books in the core mechanical engineering subject areas;
3. Physical holdings of current journals in the core materials and Metallurgical engineering subject areas;
4. E-subscription of current books in the relevant fundamental science and engineering subject areas;
5. E-subscription of current books in the core mechanical engineering subject areas; and
6. E-subscription of current journals in the core mechanical engineering subject areas.

10.3 Classrooms, Laboratory, Workshops, Clinics and Offices

The NUC recommends the following physical space requirements:

10.3.1 Office Facilities

Academic	**Area (m^2)**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

REGULATIONS

EXAMINATION CODE OF CONDUCT, OFFENCES AND PENALTY

Candidates shall:

a. Not use or consult books, papers, instruments or other materials or aids during the examination except permitted or provided by the University;
b. Not introduce or attempt to introduce into the examination venue, hand bags, books, notes, mobile phones, instruments or aids that are not permitted;
c. Not enter the examination venue with any inscriptions on any part of the body e.g. palm, arm, thigh, etc. and/or any material if such inscriptions bear relevance to the examination;
d. Not pass or attempt to pass any information from one person to another during an examination;
e. Not act in collaboration with any other candidate(s) or person(s) or copy or attempt to copy from another candidate or engage in any similar activity;
f. Not disturb or distract other candidate(s) during examination;
g. Not be allowed to leave the examination venue until after 75% of the time allocated for that particular paper has expired;
h. Not use other people to sit for the University examination on their behalf;
i. Not smoke in the examination hall;
j. Not be in possession of incriminating material(s) either used or unused during the examination or involved in any other serious examination misconduct including impersonation before, during or after the examination; and
k. Be orderly and abide by rules or guidelines at the centre in the case of CBT examinations.

Any candidate found guilty of these offences; the penalty is EXPULSION.

APPENDIX

Appendix I: List of Reviewers (NUC 70%)

1. Prof. S. B. Hassan
2. Prof. J. A. Ajayi
3. Mr. B. Osemeke
4. Mr. M. Zamuna

Appendix II: Senate Committee on 30% Delivery for UNILORIN CCMAS

1. Prof. O. A. Omotesho - Chairman
2. Prof. G. T. Arosanyin - Director, Academic Planning Unit
3. Prof. M. O. Yusuf
4. Prof. L. A. Yahaya
5. Prof. A. C. Tella
6. Prof. A. A. Baba
7. Prof. A. A. Adeoye
8. Prof. Omenogo V. Mejabi
9. Prof. O. A. Lasode
10. Prof. M. S. Ajao
11. Prof. G. B. Adesiji
12. Ebunoluwa O. Osagbemi
13. Taiwo K. Afolayan
14. A. G. Dauda
15. I. Dauda
16. Omobukola G. Omotoye - Secretary
17. A. A. Lawal - Co-Secretary

Appendix III: Members of the Programme Working Group

1. Prof. J. K. Odusote
2. Prof. Y. L. Shuaib-Babata
3. Prof. I. I. Ahmed
4. Prof. Rasheedat M. Mahamood
5. Dr. J. A. Adebisi
6. Dr. Y. O. Busari
7. I. N. Aremu
8. T. Yahaya
9. I. O. Ambali
10. K. S. Ajao
11. J. O. Adegbola