

STATE UNIVERSITY OF MEDICAL AND APPLIED SCIENCES

IGBO-ENO, ENUGU STATE

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

DEPARTMENT OF BIOMEDICAL ENGINEERING



STUDENTS' HANDBOOK UNDERGRADUATE DEGREE PROGRAMME

2024

FOREWORD

This handbook contains useful guidelines necessary to earn B.Eng Degree in Biomedical Engineering of the **State University of Medical and Applied Sciences, Igbo-eno, Enugu.**

This handbook is meant to give students of the department details structure of the programme and various procedures to follow in order not to run against any of the University regulations.

Students are also to familiarize themselves with each semester's workload in order to maximize their potentials.

I sincerely welcome you to the Department of Biomedical Engineering and wish you the best in your stay at the State University of Medical and Applied Sciences, Igbo-eno, Enugu.

Engr. Dr. Onyeabo, U. A.

B.Eng, M.Eng, PhD

Ag. Head of Department

Table of Contents

FOREWORD-----	2
Philosophy of SUMAS-----	5
Vision-----	7
Mission-----	7
Goal and Objectives of the University-----	7
PRINCIPAL OFFICERS OF THE UNIVERSITY-----	8
VICE CHANCELLOR-----	9
REGISTRAR-----	9
UNIVERSITY LIBRARIAN-----	9
BURSAR-----	9
List of Academic Staff-----	9
List of Laboratory Staff-----	10
Historical Background of Biomedical Engineering -----	10
Overview-----	11
Philosophy of B.Engr. Biomedical Engineering-----	11
Objectives-----	11
Rational / Justification-----	12
Departmental Focus -----	12
Job Opportunities-----	13
Employability Skills-----	14
21st Century Skills-----	15
Unique Features of the Programme-----	15
The Programme Educational Objectives -----	16
Programme Outcomes -----	16
Admission and Graduation Requirements-----	19
Admission Requirements-----	19
Graduation Requirements-----	20
Duration of the Programme-----	21

Classification of Degree-----	21
-------------------------------	----

Duration of the Programme-----	22
--------------------------------	----

Student Industrial Experience (SIWES)-----	23
--	----

Students' Work Experience Programme (SWEP)-----	23
---	----

Global Course Structure-----	23
------------------------------	----

100 Level-----	23
----------------	----

200 Level-----	24
----------------	----

300 Level-----	24
----------------	----

400 Level-----	25
----------------	----

500 Level-----	26
----------------	----

Course Contents and Learning Outcomes

100 Level-----	29
----------------	----

200 Level-----	42
----------------	----

300 Level-----	58
----------------	----

400 Level-----	72
----------------	----

500Level-----	81
---------------	----

Minimum Academic Standards-----	89
---------------------------------	----

Staffing-----	93
---------------	----

Academic Support Personal-----	93
--------------------------------	----

Technical Support Personal-----	94
---------------------------------	----

Library-----	94
--------------	----

Appendix-----	95
---------------	----

Philosophy of SUMAS

The University is fully committed to efficient time management skills which are critical for students and lecturers alike in teaching and learning processes. Allocating realistic amount of time means effective learning for student and effective teaching for lecturers. How an institution defines time expectations for student, lectures, administrations, and other professional staff can establish the basis for high performances for all. Time on task will be a principle that applies to all person within, and all components of, an institution. The university will therefore consider student time on task (learning), lecturer time on task (teaching), and institutional time on task (devoted to teaching and learning). Student typically will have heavy course-hour requirement, and the University will expect a tremendous amount of work outside class in preparation for each hour. For lecturers, the University will ensure that individual teachers themselves commit sufficient time to the institutional task. Teachers are powerful role model for their student. The simple matter of starting and ending class on time can send important messages about how professors and profession view and use time. Corresponding efforts may be required to ensure the students are timely in their own class attendance. Lecturers will be expected to prepare conscientiously for class and employ teaching methods appropriate for the subject matters and objective of their courses. The objectives and requirement of their courses, including applicable attendance and grading rules, will be clearly stated.

The university is fully committed to devoting adequate resources to teaching. The University will actively compete for funds that are appropriated to support teaching enhancement and improvement, multidisciplinary teaching and collaborative teacher-student efforts. Private donors may be quite interested in programme to enhance teaching. While donors have traditionally supported teaching through such gifts as endowed chairs, in recent years private funds have been successfully raised for other teachings initiatives. The university will develop a principles and practice programme, in which practicing professionals team-teach upper-level courses with full time lecturers. Students will learn from both the practitioners and the professors and members of the teaching-team learn from each other. The university will seek a donor to endow the

programme, as well as donors to support lecturer-practitioner teams in individual principles-and-practice courses.

Not only will the University focus on ways in which individual students and teachers can become more focused on appropriate tasks; the lecturers should also consider the institutional structure in which teaching, and learning occur. Lecturers will consider the impact of the University's curriculum on their efforts to make the most of efficient use of student and staff time. The University will, furthermore, make efficient use of student time by careful curriculum planning. Moreover, the University will review its curricula regularly in with global best practices and to consider the needs of the stakeholders in our rapidly changing society.

Core Values

As operating ethos, the following values are prioritized to underlie the University's mission. These values serve as the foundation for commitment of the University as a tertiary institution focusing on health sciences, technology, and legal studies to provide a more equitable and inclusive atmosphere for education, practice and research while envisioning both personal enhancement and social progress.

Respect: Vicissitude of ideas leads to gaining a trenchant perspective; thus, the university will respect diverse scientific approaches of its community members.

Communication: Inpursuit of sustaining its leadership role, the university will exhort scholars to exchange ideas, and create an effective communicative environment. To serve its global vision, the university will also attempt to excel its international relations and communicate its scholarly views worldwide.

Diversity: The University will endeavor to be home to people from different walks of life. Diversity fosters a productive academic atmosphere, promoting the university's mission and enriches a greater creative environment. Being hospitable to diverse backgrounds will strengthen understanding of each other.

Teamwork: Every department and division of the university will be called for synergy to boost both the university resourcefulness and scientific progress.

Unity: Although the university is deemed a platform for the plethora of options, a home to diverse people and a forum to exchange divergent ideas, it is viewed holistically and as an entity which attempts to become united with others across the globe.

Excellence: In teaching, research, and public service, excellence will be observed to utilize the available to create new ones and to ensure quality delivery.

Innovation: Consistently seeking noble approaches to healthcare systems, engineering, technology, and research will be among the focal values to positively impact practice and experience the university.

Compassion: Compassion will be one of the university's true hallmarks reflected in the university's humanitarian attitude in sympathizing with those suffering, standing with them in their suffering and endeavoring to alleviate their pains.

Service: Commitment to the well-being of the national community and any other person the university encounters, will compel the university to provide the people with state-of-the-art service.

Respect for the national environment: The university recognizes human impact on environment and ramifications that they shall consequently incur. The university, therefore, understands its responsibilities towards nature and values ecological solutions and interdisciplinary practices to ameliorate environmental degradation or diminish the negative results of the activities the university may cause.

Integrity: honesty and truth will pervade the university words and deeds and serve as the basis for every decision the university will make.

Vision

The vision of State University of Medical and Applied Sciences is “to be a leading university of excellence in medical and applied sciences”. The University will accelerate progress as an international leader in medical and applied sciences. It will empower its students to fulfill their academic and professional passions in a university that is welcoming and inclusive for all students, lecturers, and professional staff. The University will create innovative connections among medical, health, natural and applied sciences, and engineering. It will strengthen support for dynamic set of lecturers dedicated to teaching, mentoring, research, clinical care, engineering services and technology

Mission

The mission of the University is to provide a learning environment in which staff and student can discover, examine critically, preserve, and transmit the knowledge, wisdom and values that will help ensure the survival of this and future generations and improve the quality of life for all. The University will seek to help student to develop an understanding and appreciation for complex cultural and physical worlds in which they live and to realize their highest potential of intellectual, physical, and human development.

Goal and Objectives of the University

The state university of medical and applied sciences shall be firmly committed to offering students of widely varied ages, backgrounds, interests and needs, a broad range of educational opportunities and experiences.

The objectives of the university shall be, to:

(a) Provide a wide range of quality learning opportunities for undergraduates and postgraduate students without distinction of race, creed, sex, religion, or political convictions that will enhance their best intellectual, social, and personal development.

(b) provide academic, professional, and vocational training of high quality in a way as to enrich and improve state, national and international human resource capabilities and assist its graduates to contribute to the common good of the society.

(c) foster academic research which contributes to human knowledge and the vitality of the institution.

(d) Encourage thoughtful and responsible staff and students' participation in local, state, national and international affairs.

(e) Maintain the highest academic standards in respect of university degrees and other awards and preserve and protect their reputation and integrity.

PRINCIPAL OFFICERS OF THE UNIVERSITY

VICE CHANCELLOR

Prof. James Chukwuma Ogbonna

B.Sc. (Jos); M.Eng. (Yamanashi); Ph.D. (Tsukubai)

REGISTRAR

Mr. Anselm U. Onah

B.A. Ed. (Hons); FCAI; FIIA; MANUPA

UNIVERSITY LIBRARIAN

Dr. Monica E. Eze

CLN; FNLA; FCAI

BURSAR

Dr. Ozoadibe Elvis Emeka

B. Sc., MBA' M.Sc.; Ph.D.; FCA; ACTI; MILRM

List Of Academic Staff

S/n	Name	Designation	Highest Qualifications	Status	Specialization
1	Onyeabo Uzoamaka Agatha	Lecturer I	Ph.d (Chemical Engineering)	Full Time	1. Kinetics (Chemical Reaction) 2. Thermodynamics, Biotechnology
2	Felix Uzochukwu Asoiro	Professor	Ph.d (Food and Bioprocess Engineering)	Sabbatical	1. Bioprocessing Engineering; 2. Bioengineering 3. Biomaterials And Tissue Engineering; 4. Biotechnology 5. Genetic Engineering; 6. Renewable And New Energy Engineering
3	Prof. Mishark Nnamdi Nnabuchi	Professor	B.Sc., M.Sc., Ph.D.	Full Time	Solar Energy Devices, Photovoltaic and Modelling, Nano Materials-Synthesis
4	Prof. Pius Oziri Ukoha	Professor	B.Sc., M.Sc., Ph.D.	Visiting	Intelligent Systems and Computational Intelligence, Autonomous Systems, Computer Network Systems, Optimization
5	Dr. Frank Ekene Ozioko	Associate Professor	B.Sc., M.Sc., Ph.D.	Visiting	
6	Eugene Chijindu Ukaegb	Senior Lecturer	B.Sc., M.Sc., Ph.D.	Full Time	Computing and Statistics, Data Science and Programming
7	Dr. Ogbebor Clara Ekwe	Senior Lecturer	B.Sc., M.Sc., Ph.D.	Full Time	
8	Onyekwere Ojike	Senior Lecturer	Ph.d (Food And Bioprocess Engineering)	Visiting	Bioprocessing Engineering, And Biomaterials.
9	Dr. Tochukwu Chijindu Asogwa	Senior Lecturer	B.Sc., M.Sc., Ph.D.	Visiting	Computer Programming, Artificial Intelligence, Microprocessor and Embedded Systems
10	Eneh Afam Samuel	Lecturer I	Ph.d (Biomedical Engineering)	Visiting	Bioinformatics Bioinstrumentation

11	Oghorodi Akpobo Marvellous	Lecturer II	M.Sc (Biomedical Engineering)	Full Time	1. Biomaterials & Tissue Engineering 2. Neuroengineering 3. Regenerative Medicine, 4. Nanomedicine, 5. Drug Delivery, 6. Neuropharmacology
12	Edehri Oghenefejir o Omonigho	Lecturer II	M.Sc (Biomedical Engineering)	Full Time	1. Biomechanics 2. Biomedical Instrumentation

LIST OF NON-ACADEMIC STAFF

S/N	Name	Qualification	Post
1.	Ugwuagbo Linda Ebere	Biomedical Technology (b.Tech)	Technologist li
2.	Asadu Cynthia Kasiemobi	Dental Therapy (National Diploma)	Senior Laboratory Technician
3	Agumba David Chukwuka	B.Eng. Electrical & Electronics Engineering	Technologist li
4	Onah Appolonia Chinasa.	HND Chemical Engineering	Technologist li
5	Eze Victoria Ifeoma	NCE Social Studies/ Igbo	Executive Officer
6	Eneomenwu Obinna Steven	B.Sc Criminology and Security Studies	Administrative Officer

Historical Background of SUMAS Biomedical engineering

The Department was established in the year 2022 to provide academic training for prospective Engineers who will integrate the emerging principles of modern biology with other basic sciences and engineering to offer solutions for health-related challenges and improve healthcare delivery in Nigeria and beyond. First coordinator, of the department is Engr. Okozor Nkeiruka.P

The Department admitted ten(10) students into her B.Eng. programme (100 Level) during 2022/2023 academic session, and twenty three (23) students during the 2023/2024 academic session. Candidate for admission into 100 Level of the B.Eng. degree in Biomedical Engineering must possess a minimum of five credits in Secondary School Certificate Examination (SSCE) or its equivalent, which must include English Language, Mathematics, Physics, Chemistry and Biology.

Candidate for **Direct Entry admission into 200 Level** of the B.Eng. degree in Biomedical Engineering must possess at least five credits in SSCE or its equivalent, which must include English Language, Mathematics, Physics, Chemistry and Biology. They must also possess GCE “A” Level or its equivalent in Physics, Mathematics and Biology/Chemistry not below grade “C” or OND with a minimum of upper credit in Biomedical engineering or Electrical engineering or Chemical engineering or Mechanical engineering.

Candidate for **Direct Entry admission into 300 Level** of the B.Eng. degree in Biomedical Engineering must possess at least five credits in SSCE or its equivalent, which must include English Language, Mathematics, Physics, Chemistry and Biology. They must also possess HND with a minimum of upper credit in Biomedical engineering or Electrical engineering or Chemical engineering or Mechanical engineering.

Every candidate must take **UTME subjects: English Language, Mathematics, Physics and Chemistry** like for other engineering discipline.

Remedial students of the University who passed remedial exams may be absorbed into 100 Level.

The Department operates an academic programme which leads to a **B.Eng.** degree at a duration of five academic sessions for students who gained admission through UTME; and four academic sessions for post A-level, OND with upper credit and three academic sessions for HND with upper credit direct entry.

The five-year programme is broken into nine semesters of residence and one industrial attachment. Each semester is usually fifteen teaching weeks long and instruction is by courses

quantified into course credits. Lectures, tutorials, practical sessions and projects are organized during each semester and every student in the programme is expected to participate fully since the grading system reflects each aspect.

The Industrial Training aspect of the degree programme is divided into four parts. The first part is the Student Work Experience (SWEP) Program is held at the end of the 200-level just after the end of-session break in the Faculty's Workshops or any other designated center approved by the department. During this programme, students are exposed to workshop practice and have a "hands-on" experience of practical engineering. This serves as a channel for integrating entrepreneurial development and skill into our programme in-house.

Overview Biomedical Engineering

Biomedical Engineering applies physical science principles and engineering designs, concepts and problem-solving techniques to biology and medicine to improve healthcare. In biomedical engineering, many aspects of electrical engineering, mechanical engineering, chemical engineering, materials science and engineering, chemistry, mathematics and, computer science and engineering are integrated with human biology to improve human health. Biomedical engineering started as an interdisciplinary field and has grown into a multispecialty profession. A wide range of specialties and sub-specialties currently exists in biomedical engineering. The major sub-specialties include:

1. Bioengineering
2. Biomedical informatics
3. Bio-process engineering
4. Biotechnology
5. Clinical engineering
6. Dental engineering

7. Medical engineering
8. Neural and regeneration engineering
9. Pharmaceutical engineering
10. Rehabilitation engineering
11. Biomedical Instrumentation
12. Biomaterials and Tissue Engineering

PHILOSOPHY of Biomedical Engineering

The programme is hinged on academic training for prospective Engineers who will integrate the emerging principles of engineering design to the design and development of medical devices and bio- therapeutics that address health-related challenges and healthcare delivery. There is broad engineering background in general engineering disciplines in the first two years and in core Biomedical Engineering Courses in the last three years of the programme.

OBJECTIVE

1. To cultivate engineering professionals equipped with a robust understanding of mathematics, the physical sciences, biology, physiology, anatomy, materials science, and engineering, enabling them to address complex challenges at the crossroads of medicine and engineering.
2. To offer students a comprehensive and well-rounded foundation that prepares them to thrive as professional biomedical engineers in diverse fields.
3. To furnish students with the essential knowledge and skills required for advanced studies in specialized areas integrating medicine and engineering.

4. To empower biomedical engineering graduates with entrepreneurial skills, fostering opportunities for income generation and enhancing their capacity for innovation.
5. To contribute to national growth through research and consultancy, addressing pressing needs in engineering, medicine, pharmacy, and other biomedical-related sectors.
6. To prepare students for successful industrial careers in biomedical engineering or related fields through practical industrial training and real-world applications.

RATIONALE/JUSTIFICATION

Healthcare in Nigeria, and Africa as a whole, faces unique challenges compared to developed nations. As a developing country, Nigeria relies heavily on the importation of medical technologies, many of which are not well-suited to the tropical environment. The growing population of Nigeria faces healthcare challenges influenced by economic, social, and environmental factors that are often overlooked by the global medical industry.

The urgent need to apply engineering principles to design and develop medical devices and biomaterials that address these health-related challenges has highlighted the importance of training professionals in biomedical engineering who can adapt such principles to local contexts. Some of the key challenges faced by Nigeria include a shortage of skilled personnel, the high cost of importing medical devices and equipment, and the lack of adequate consideration for the specific needs of end-users. Addressing these issues requires a focus on developing localized, sustainable solutions in biomedical engineering that are both affordable and effective in improving healthcare outcomes.

This programme is compatible with SUMAS's mission to improve the quality of life for all through innovation in medical and applied sciences. Graduates of the programme will help fill the human skills gap in engineering, medical establishments and other areas of human endeavour. In the long run, the Biomedical Engineering programme will help to improve the healthcare delivery system in Nigeria and thereby reduce the need for dependence on foreign medical equipment, devices, and expertise.

DEPARTMENTAL FOCUS

The Biomedical Engineering undergraduate programme focuses the attention on three major areas which include:

- i. Biomedical Instrumentation
- ii. Biomaterials and Tissue Engineering
- iii. Clinical Engineering

JOB OPPORTUNITIES

Biomedical engineering is an interdisciplinary field focused on applying engineering principles to solve biological and medical challenges. It incorporates concepts from nearly all engineering disciplines to address healthcare-related problems.

The career opportunities for biomedical engineering graduates are vast, as they play a critical role in improving quality of life. Employment prospects exist in both academic settings and the healthcare industry. Biomedical engineers contribute to fields such as:

- **Bioinformatics:** Developing computer tools for collecting and analyzing medical and biological data.
- **Bio-Microelectromechanical Systems (Bio-MEMS):** Creating devices like micro-robots for internal surgeries or drug-delivery systems implanted in the body.
- **Biomaterials:** Engineering materials for medical devices or implants that interact with living tissue, such as infection-resistant coatings for artificial joints.
- **Biomechanics:** Applying mechanics to biology to study motion, material deformation, and fluid flow, such as in artificial heart development.
- **Biotechnology:** Using living organisms to create or modify products, improve species, or develop microorganisms, from traditional animal breeding to yeast in bread-making.
- **Clinical Engineering:** Applying engineering and managerial skills to improve patient care and manage healthcare technology, particularly in hospitals.
- **Genomics:** Mapping and analyzing genomes to improve disease diagnosis, treatment, and detection.

- **Micro and Nanotechnology:** Creating microscopic tools like sensors that assist surgeons in identifying and removing unhealthy tissue, or diagnosing heart attacks through nanotechnology.
- **Nuclear Medicine:** Using radiopharmaceuticals to detect disease through biological changes in tissue, rather than anatomical changes, as with X-rays or CT scans.
- **Telemedicine:** Utilizing telecommunications to provide remote clinical healthcare, expanding access to medical services across distances.

Through these areas, biomedical engineers drive innovation and contribute to advancements in healthcare technologies and patient care.

Employability Skills

Biomedical engineers find employment across diverse sectors, depending on their area of specialization. Graduates of biomedical engineering with a bachelor's degree have multiple career paths available:

- **Clinical Sector:** Biomedical engineers are employed in general, specialist, and teaching hospitals, as well as federal medical centers. Their role involves managing, designing, and maintaining medical equipment, particularly in areas like orthopedics, psychiatry, and general medicine. They also train healthcare personnel on the use of medical devices. Engineers with a focus on biomedical informatics work in hospital records departments, ensuring smooth digital operations.
- **Advanced Clinical Training:** Some biomedical engineers pursue further qualifications such as medical degrees (MDs). This allows them to combine clinical expertise with technical knowledge to directly interact with patient care. These professionals may also design custom medical devices to address specific healthcare challenges or assist in clinical research.
- **Research and Development:** Biomedical engineers participate in or lead research projects alongside medical professionals, physiologists, and nurses. They manage laboratory equipment in research institutions and may serve as technical advisors in biomedical

companies. Opportunities also exist in government health research facilities, biotechnology firms, and ministries focused on health and science.

- **Academic Sector:** Universities, polytechnics, and schools of health technology across Nigeria offer programs in biomedical engineering, ranging from certificates to doctoral degrees. Graduates can pursue careers as academic and technical staff in these institutions.
- **Design and Innovation:** Biomedical engineers are involved in developing new or improved biomedical products, whether for performance testing, proprietary designs, or customized medical devices. They can also work in the sales and marketing of biomedical equipment or develop medical software applications in bio-IT industries. Opportunities in bioengineering and tissue engineering exist in sectors like pharmaceuticals, biotechnology, and food industries.
- **Government and Regulatory Bodies:** Biomedical engineers can work as product testing and safety officers in agencies such as NAFDAC and NSO, ensuring medical devices meet safety standards. They may also play a role in certifying professionals and institutions, similar to the work done by COREN (Council for the Regulation of Engineering in Nigeria). Additionally, they can be employed by ministries overseeing health and science policy implementation.
- **Entrepreneurship:** With the growing emphasis on entrepreneurship within university curricula, biomedical engineers are equipped to become entrepreneurs. They may start by offering repair and maintenance services for medical equipment in hospitals, drawing on relationships built during internships or NYSC service. This career path requires technical proficiency, as well as entrepreneurial skills and confidence.

21st Century Skills

Biomedical engineering graduates are expected to develop key skills for the modern workforce:

- **Creativity and Innovation:** The ability to generate new solutions and approaches to problems.
- **Critical Thinking and Problem-Solving:** Applying advanced thinking to address emerging challenges.

- **Communication:** Effectively conveying ideas across various formats and contexts for different purposes.
- **Collaboration:** Working in teams to develop, share, and implement ideas.
- **Information Literacy:** Accessing, evaluating, and synthesizing information from interdisciplinary sources.
- **Technology Proficiency:** Identifying and effectively using appropriate technology tools in an ethical and efficient manner.
- **Career and Life Skills:** Becoming self-directed learners who can adapt to changes, manage responsibilities, lead teams, and achieve goals.
- **Personal and Social Responsibility:** Developing cultural competence to work with individuals from diverse backgrounds.

Unique Features of the Programme

Biomedical engineering stands out for several reasons:

- It plays a crucial role in improving healthcare delivery.
- It integrates modern biological principles into engineering design processes.
- It is a multidisciplinary field blending science and technology to advance the healthcare industry.
- It emphasizes problem-solving and technical expertise, particularly in medicine and healthcare, aimed at helping others.
- Its hybrid nature has led to ground breaking innovations that enhance healthcare and human well-being.

The Programme Educational Objectives (PEOs)

The Biomedical Engineering Department established the following educational objectives of the programme in support of the vision and mission of the University. Graduates are expected to be able to attain the following objectives within 5 years following graduation:

PEO1: Apply biomedical engineering knowledge and skills to analyse, design, and solve complex healthcare and engineering problems to world-class standards.

PEO2: Conduct innovative research and develop creative biomedical technologies that advance healthcare delivery and contribute to medical and clinical progress.

PEO3: Address Nigeria's healthcare, technological, and socioeconomic needs through safe, sustainable, and culturally sensitive biomedical engineering solutions.

PEO4: Demonstrate professional integrity, ethical practice, and effective leadership within multidisciplinary biomedical, clinical, and engineering environments.

PEO5: Apply entrepreneurial thinking and commit to lifelong learning, adapting to evolving biomedical technologies and contributing to industry and national development.

PROGRAMME OUTCOMES (POs)

The department adopted the COREN's Twelve (12) Programme Outcomes (POs) which are identical to Washington accord are presented in Table 3.1

Table 3.1: Programme Outcomes

PO1	Engineering Knowledge: apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of developmental and complex engineering problems
PO2	Problem Analysis: identify, formulate, research literature and analyze developmental and complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
PO2.1	Demonstrate ability to solve problems by concepts through the integration of mathematics, science and engineering.
PO2.2	Demonstrate skill in identifying vital information from resources in solving problems.
PO2.3	Demonstrate skill and appropriate technique and ingenuity in solving developmental or engineering problems.
PO3	Design/Development of Solutions: proffer solutions for developmental or complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations
PO3.1	Demonstrate understanding of the impact of engineering decisions and solutions to societal issues.

PO3.2	Demonstrate understanding of solutions to cultural diversity based on our local context in Nigeria.
PO3.3	Demonstrate knowledge of the implications of engineering designs and solutions to the public health and safety of all.
PO4	Investigation: conduct investigation into developmental or complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO4.1	Demonstrate ability to appropriately set-up and conduct experiment to understand and extract underlining and fundamental principles.
PO4.2	Demonstrate ability to apply statistical tools in designing and analyzing experiments.
PO4.3	Demonstrate skill in applying the appropriate research method in solving engineering problems.
PO5	Modern Tool Usage: create, select and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modeling and optimization to developmental and complex engineering activities, with an understanding of the limitations
PO5.1	Demonstrate an understanding of the inherent limitations of software (application) tools, and analytical and numerical techniques.
PO5.2	Demonstrate ability to identify and apply appropriate techniques in investigating and solving problems of engineering relevance.
PO5.3	Demonstrate capability and proficiency in using modern and ICT tools to solve engineering problems.
PO6	The Engineer and Society: apply reasoning informed by contextual knowledge including Humanities and Social Sciences to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice
PO6.1	Demonstrate awareness of legal implications of professional engineering practice.
PO6.2	Demonstrate understanding of the required contribution of engineers to the society.
PO7	Environment and Sustainability: understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
PO7.1	Demonstrate an understanding of the impact of engineering solutions on the society and

	environment.
PO7.2	Demonstrate ability to recognize and evaluate the ethical dilemmas that may arise in the workplace.
PO8	Ethics: apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice, including adherence to the COREN Engineers Code of Conducts
PO8.1	Demonstrate knowledge and understanding of the COREN Engineers Code of Conduct.
PO8.2	Demonstrate ability to apply professional responsibilities and norms of engineering practice.
PO8.3	Demonstrate understanding and appreciation of diversity.
PO9	Individual and Team Work: function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO9.1	Demonstrate knowledge and understanding in completing set goals and plan tasks
PO9.2	Demonstrate understanding in apply, using skills acquired to examine and adopt ideas as a member or team lead
PO9.3	Demonstrate the ability to work with other engineering discipline or multi-disciplinary settings
PO10	Communication: communicate effectively on developmental or complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO10.1	Demonstrate the skills to communicate within the engineering society and outside engineering profession
PO10.2	Demonstrate the ability to make presentations and be able to communicate the society at large
PO10.3	Demonstrate the ability to use appropriate presentation methods for effective communication and follow clear instructions.
PO11	Project Management: demonstrate knowledge and understanding of engineering, management and financial principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments
PO11.1	Demonstrate the ability to conduct, manager and execute projects in multi-disciplinary areas

PO11. 2	Demonstrate the ability to work within the budget when executing a project for proper management
PO11. 3	Demonstrate recognition or the skills needed for project management
PO12	Lifelong Learning: recognize the need for, and have the preparations and ability to engage in independent and lifelong learning in the broadest context of technological and social changes.
PO12. 1	Demonstrate the ability to learn new technology or techniques that will be used for solving life problems and professional development activities
PO12. 2	Demonstrate the ability to apply knowledge acquired from teaching, professional journals and industry publications to improve processes and systems

Admission and Graduation Requirements

Admission Requirements

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)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary

Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programme may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a 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 24 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 four 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 and 13 semesters in the case of Direct Entry students who entered at 200Level and 11 semesters in the case of students who entered at 300Level.

DEGREE OFFERED AND REGULATIONS GOVERNING THE DEGREE PROGRAMMES

Title of the Degree

Courses shall be provided leading to the Bachelor's Degrees to be denoted as: **Bachelor of Engineering (B. Eng.)**

The degree of the Department shall be awarded with Honours.

Instruction shall be by Courses; these courses are quantified into credits.

(a) One credit shall be a series of 15 one-hour lectures or tutorials, or two hours of seminar, or three hours of Laboratory or field work.

(b) A session consists of two Semesters, each of 15 weeks or lectures.

(c) A long vacation period is a 12-week period.

Admission, Withdrawal from Courses

(a) Registration of Courses

Registration for Courses must be during the first two weeks of the semester, there is a penalty of late Registration.

(b) Addition of Courses:

A student may add a course by completing the Add and Drop form before the end of the third week of the semester in which the course is being offered.

(c) Dropping of Courses

A student may drop a course by completing the Add and Drop form before the end of the fifth week of the Semester in which the course is being offered. A student who withdraws from a course without acceptable explanation after half of it has been given, shall be deemed to have failed the course.

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.

Duration of the Programme

A maximum of 6 and 7 year are allowed for a 4 and 5 years degree programme respectively for the award of classified Degree.

To be eligible for a degree, a student admitted for the 4/5-year undergraduate programme must obtain a minimum of 164 credits from courses taken during 200-500 Levels including those obtained in GNS 111, 112, 211, 212, 311 and 312. A candidate admitted in any other level must pass all prescribed courses in order to be eligible for a degree.

CLASSIFICATION OF DEGREES

The degree of Bachelor of Engineering (B. Eng.) in Biomedical Engineering shall be awarded according to the following classification of final Cumulative Grade Point Average (CGPA).

Class of Degree	Range of CGPA
First Class	4.50 – 5.00
Second Class (Upper division)	3.50 – 4.49
Second Class (Lower division)	2.40 – 3.49
Third Class	1.50 – 2.39

STUDENT INDUSTRIAL EXPERIENCE (SIWES)

The SIWES (Student Industrial Work Experience Scheme) is a practical training initiative designed to close the gap between academic theory and real-world application in engineering and technology fields. Its objective is to give students hands-on experience with machinery, equipment, and professional work methods, while also emphasizing workplace safety. The program lasts for a minimum of 40 weeks and is a collaborative effort between students, universities, and industries (the employers), ensuring that all parties benefit from the partnership.

STUDENTS' WORK EXPERIENCE PROGRAMME (SWEP)

This introduces students to fundamental engineering practices and skills through hands-on training in the operation of various tools, such as those used for woodworking, metal cutting, and fabrication. The Student Work Experience Programme (SWEP) typically occurs at the end of the

second year during the students' vacation, following the completion of general engineering courses. It aims to provide students with practical exposure to essential engineering processes and equipment.

The training covers a broad range of topics, including vehicle and agricultural equipment maintenance, basic welding and fabrication techniques, plumbing, machine and equipment building, as well as woodworking. Additionally, it introduces applications of electrical and electronics systems.

Global Course Structure

100 LEVEL

First Semester					
Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GET 101	Engineer in Society	1	C	15	-
MTH 101	Elementary Mathematics I	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 103	General Physics III	2	C	30	-
CHM 101	General Chemistry I	2	C	45	-
CHM 107	General Practical Chemistry I	1	C	-	45
BIO 101	General Biology I	2	C	45	-
BIO 107	General Practical Biology I	1	C	-	45
SUMAS-COS 101	Introductory to Computer Application	2	C	30	-
SUMAS-GET 109	Environmental awareness and protection	2	C	30	-
TOTAL		20			

Second Semester

COURSE CODE	COURSE TITLE	Units	Status	LH	PH
--------------------	---------------------	--------------	---------------	-----------	-----------

GST 112	Nigerian Peoples and Culture	2	C	30	-
MTH 102	Elementary Mathematics II: Calculus	2	C	30	-
PHY 108	General Practical Physics II	1	C	-	45
CHM 102	General Chemistry II	2	C	30	-
CHM 108	General Practical Chemistry II	1	C	-	45
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
BME 102	Introduction to Biomedical engineering	2	C	30	-
SUMAS-GET 108	Occupational Safety	2	C	30	-
SUMAS-PHY 104	General Physic IV (Vibration, Waves and Optics	2	C	30	-
SUMAS-GET 106	Applied Mechanics	3	C	30	45
TOTAL		19			

200 LEVEL

First Semester					
Course Code	Course Title	Units	Status	LH	PH
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 209	Engineering Mathematics I	3	C	30	-
GET 211	Computer and Software Engineering	3	C	30	45
BME 215	Human Genetic I	2	C	30	-
BME 211	Human Anatomy I	2	C	30	-
BME 213	Human Physiology I	2	C	30	-
SUMAS-MEE 243	Measurement and Instrumentation	3	C	30	45
TOTAL		20			

DURING THE LONG VACATION AT THE END 200 LEVEL

*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
TOTAL		3			

Second Semester

COURSE CODE	COURSE TITLE	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 203	Engineering Graphics and Solid Modeling II	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
BME 214	General Biochemistry I	2	C	30	-
SUMAS- GET 210	Engineering Mathematics II	3	C	45	-
SUMAS-GET 214	Engineering Economics	2	C	30	-
SUMAS-BME 212	Human Biomechanics	2	C	30	-
TOTAL		19			

300 LEVEL

First Semester					
Course Code	Course Title	Units	Status	LH	PH
GET 305	Engineering Statistics and Data Analysis	3	C	45	-
GET 307	Introduction to Artificial Intelligence,	3	C	45	-

	Machine Language and Convergent Technologies				
BME 351	Biomaterials Engineering	2	C	30	-
SUMAS-BME311	Design Thinking and Innovation	2	C	15	45
SUMAS-BME 317	Biomedical Radiation Technology	2	C	15	-
SUMAS-BME 371	Biomedical Engineering Laboratory I - Cell and Biomaterials Laboratory	2	C	15	45
SUMAS-BME 303	Statistics for Healthcare Professionals	2	C	15	-
SUMAS-BME 313	Biomedical Instrumentation 1	2	C	30	
TOTAL		16			

DURING THE LONG VACATION AT THE END 300 LEVEL - TO BE REGISTERED UNDER FIRST SEMESTER COURSES

*GET 399	SIWES I: Students Work Experience Scheme	4	C	12 Weeks
----------	--	---	---	----------

Second Semester					
Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
BME 332	Biomedical Electronics	2	C	30	-
BME 316	General Pharmacology	2	C	30	-
SUMAS-BME 381	Biomedical Engineering	2	C	45	

	Laboratory II				
SUMAS-CHE 312	Waste Processing Technology	1	C	15	-
SUMAS-BME302	Introduction to Bionics	2	C	15	45
SUMAS-BME 314	Biomedical Instrumentation II	2	C	15	45
Total:		19			

400 LEVEL

First Semester					
Course Code	Course Title	Units	Status	LH	PH
BME 401	Biomedical Systems Analysis	2	C	30	-
BME 435	Biomedical Informatics	2	C	30	-
BME 453	Human Biotechnology	2	C	30	-
BME 461	Clinical Engineering	2	C	30	-
BME 481	Rehabilitation Engineering	2	E	30	-
SUMAS-BME421	Health Management Information systems	2	C	15	45
SUMAS-BME 413	Biomedical Equipment Design	2	C	15	45
SUMAS-BME 441	Medical Imaging, I	2	C	15	45
Total:		16			

Second Semester

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 and costing	2	C	6 weeks	
GET 402	Engineering Project I	2	C		90
TOTAL		15			

500 LEVEL

First Semester					
Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
BME 521	Biomedical Engineering Design	3	C	45	-
BME 523	Biomedical Image Systems	3	C	45	-
SUMAS-BME541	Biomedical Signals and Systems	2	E	15	45
SUMAS-BME501	Biomaterial Host Interactions in Regenerative Medicine	2	C	15	45
SUMAS-BME 532	Stem Cell Engineering	2	C	15	45
TOTAL		15			

Second Semester					
Course Code	Course Title	Units	Status	LH	PH

GET 502	Engineering Law	2	C	30	-
BME 522	Equipment Reliability and Safety Technology	3	C	45	-
BME 526	Computer-Aided Design of Biomedical Systems	3	C	45	-
BME 524	Biomedical Signal Processing	3	E	45	-
SUMAS-BME522	Cardiovascular Mechanics	2	C	15	45
SUMAS-BME 594	Biomedical Engineering Project II	6	C		
TOTAL		19			

****Biomedical Instrumentation**

****Biomaterials and Tissue Engineering**

****Clinical Engineering**

***NOTE:**

C – Compulsory, E – Electives; R – Required Course; LH – Lecture hours; PH – Practical hours

GST General Studies courses offered at the University

ENT Entrepreneurship courses offered at the University

GET Foundation courses for all the programmes in the Engineering

BME Core Courses for Biomedical Engineering Programmes

CHM Courses are courses domiciled in the Department of Chemistry

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, generalization 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:

analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;

1. identify and list the major linguistic groups in Nigeria;
2. explain the gradual evolution of Nigeria as a political entity;
3. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
4. enumerate the challenges of the Nigerian state regarding nation building;
5. analyse the role of the judiciary in upholding fundamental human rights
6. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
7. 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.

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 LeChatelier’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.

New

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.

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 107: General Practical Physics I (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; and
5. 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.

BIO 101: General Biology (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. explain the characteristics of living and non-living things;
2. outline the taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates;
3. describe the scientific methods to biology concepts;
4. explain the cell concepts, structure, organisation, functions, and chemical and physical characteristics; and
5. state the elements of biological chemistry, and of ecology and types of herb.

Course Contents

Characteristics of living and non-living things. Scientific methods to biology concepts. Taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates. Morphology and life cycles of phyla and plant kingdoms. Cell concepts, structure, organization, functions, and chemical and physical characteristics. Cells, tissues and organ systems, and organisms. Elements of biological

chemistry – cellular metabolism - aspects of organic, inorganic and physical chemistry relevant to biology. Elements of ecology and types of habitats

BIO 107: General Practical Biology (1 Unit C: PH 45)

Learning Outcomes

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

1. conduct experiments on microscopes and microscopy;
2. conduct experiments on food test, enzyme activities, osmosis and diffusion;
3. identify and evaluate external morphology of the herbaceous plant, and cytological techniques;
4. make observations of experiments made; and
5. draw conclusions from experimental and numerical analysis of data.

Course Contents

Experiment on microscopes and microscopy, food test, enzyme activities, osmosis and diffusion, external morphology of the herbaceous plant and cytological techniques.

New

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.

BME 102: Introduction to Biomedical Engineering (2 Units C: LH 30)

Learning Outcomes

Students should, at the conclusion of the course:

1. know how fundamental physics, biological and chemical principles are applied to human body functions;
2. explain the impacts of technology on knowledge of biology, medicine and areas of general chemistry such as electronic configuration, atoms, chemical bonds, metals and non-metals, acids and bases, carbon and covalent bond and, water and its properties
3. know about cells, tissues, organs, and organisms; amino acids, proteins; carbohydrates; fatty acids and lipids; nucleic acids and nucleotides; genes and genetic information transcription and translation;
4. assess forces experienced by bones, joints, and muscles during exercise osteokinematics and arthro-kinematics; and
5. apply fundamental principles in physics, biology, and chemistry to human body functions.

Course Contents

Bio- and Medical Engineering: impacts of technology on biology and medicine. Biomedical engineering: definition, history, and components. Biomedical engineering, health technology, and human system: man, as a living machine; human system and instrumentation research, development, education, training, certification, and practice of biomedical engineering and health technology; problems and prospects of biomedical engineering and health technology in Nigeria and Africa.

SUMAS-PHY 104 General Physics IV [2 Units, C: LH 30]

Senate-Approved Relevance

Graduates who are highly skilled in physics is in accord with the vision of SUMAS to become a leader in the discovery, dissemination, and application of new knowledge in areas of sciences for the development of self and society. Relevance is seen in graduates of Biomedical Engineering from SUMAS having sufficient science, engineering and programming knowledge that will

enable the graduates to adapt to working in any engineering outfit, making graduates of the institution renowned and world-class.

Overview

The study of vibrations, waves, and optics is vital to the training of Biomedical Engineering graduates because their applications are used in solving Biomedical Engineering related problems. This highlights the importance of preparing students in Biomedical Engineering with the knowledge and skills on how to apply the basic concepts of vibrations, waves and optics in the solution of industrial problems.

Therefore; this course will expose students on the basic concepts and analysis of vibration systems, wave energy, and optics.

Objectives

The objectives of the course are to:

1. describe and quantitatively analyze the behavior of vibrating systems and wave energy;
2. describe the propagation and properties of waves in sound and light;
3. identify and apply the wave equations;
4. describe geometrical optics and principles of optical instruments; and
5. describe Doppler effect

Learning Outcomes

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

1. describe and quantitatively analyze the behavior of vibrating systems and wave energy;
2. describe the propagation and state at least three (3) properties of waves in sound and light;
3. identify and apply the wave equations to solving three (3) problems;
4. describe at least two (2) geometrical optics and principles of optical instruments; and
5. describe Doppler effect.

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. Types and properties of waves as applied to sound. Transverse and Longitudinal waves. Superposition. Interference. Diffraction. Dispersion. Polarization. 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. Nature and propagation of light. Reflection. Refraction, and internal reflection. Dispersion. Scattering of light. Reflection and refraction at plane. Spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Huygens's principle. Interference and diffraction.

Minimum Academic Standards

As described in CCMAS.

SUMAS-GET 109: Environmental Awareness and Protection [2 Units; C; LH:30]

Senate – Approved Relevance

The world class training of students who are highly knowledgeable in a wide range of environmental challenges and opportunities in Enugu State and are adequately exposed to environmental management systems, legal framework and socio-cultural issues pertaining to utilization of natural resources are in tandem with SUMAS' mission statement of "protection of future generation and improving the quality of life". Graduates from SUMAS are therefore expected not only to become environmental protection ambassadors in their various areas of profession but to be highly aware of issues concerning our environment with relevance to sustainable economic development.

Overview

Environmental awareness and protection are cardinal in every economy for the achievement of Sustainable Development Goals (SDGs). This involves proper management of the micro and macro environment. Proponents of environmental management therefore call for a systems approach where every profession must contribute positively towards the protection of the environment. This is in accordance with Agenda 21's slogan of "Think globally, while acting locally".

The purpose of this course is therefore to ensure that graduates of SUMAS are in tune with world best practices of environmental protection and acquire skills in environmental surveillance, monitoring, planning and management for the wellbeing of the present and future generations.

Objectives

The objectives of the course are to:

1. define the term "Our Environment"
2. illustrate the various environmental systems
3. provide a comprehensive description of urban environmental problems and their solutions
4. identify rural environmental problems and their solutions
5. determine the legal framework for environmental protection in Nigeria
6. describe the meaning of sustainable development and sustainable development goals (SDGs)
7. present the interplay between population, poverty and environment
8. examine the concepts of renewable and non-renewable resources
9. describe pollution and its various control measures
10. explore issues and challenges of waste management including generation, collection, transportation and disposal
11. show the relationship between resource depletion and environmental protection

12. describe environmental protection regulations and standards
13. explain the concept of climate change
14. explain environmental degradation

Learning Outcomes

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

1. give at least four definitions of the term “our environment”;
2. illustrate the various environmental systems;
3. provide at least five urban environmental problems and their solutions;
4. identify at least five rural environmental problems and their solutions;
5. discuss the legal framework for environmental protection in Nigeria;
6. describe the meaning of sustainable development and sustainable development goals (SDGs);
7. illustrate the interplay between population, poverty and environment;
8. examine the concept of renewable and non-renewable resources;
9. describe the 3 types of pollution and their various control measures;
10. explore issues and challenges of waste management system including generation, collection, transportation and disposal;
11. show the relationship between resource depletion and environmental protection;
12. describe environmental protection regulation and standards by NESREA;
13. discuss with examples the concept of climate change;
14. explain environmental degradation.

Course Content

Definition and meaning of environment. Environmental education. Man and environment. Environmental systems (eg. ecosystem). Urban environmental problems and mitigating measures. Rural environmental problems and mitigating measures. Renewable and non-renewable resources. Sustainable development and SDGs. Legal framework for environmental protection in Nigeria. Population, poverty and the environment. Environmental toxicology. Pollution control. Waste management. Resource depletion and environmental protection. Climate change. Environmental protection and regulation standards. Land use planning. Landscaping and environmental design. Environmental degradation.

Minimum Academic Standards

As described in CCMAS.

SUMAS- COS 101 Introductory to Computer Application [2 Units, C: LH 30]

Senate-Approved Relevance

The general philosophy therefore is to produce graduates with high academic standard and adequate practical background for self-employment as well as being of immediate value to industry and the community in general.

Introductory computer application(ICA) course is to provide students at State University of Medical and Applied Sciences (SUMAS) with the foundation needed to proficiently use computers for personal and professional purposes. The course will introduce students to the basic functions of a computer, keyboard, mouse, and Internet. Students will also be introduced to software applications commonly used in business, including word processing, spreadsheet, presentation, and database software. Students will be encouraged to utilize online resources, such as Blackboard and Freedom, to augment classroom instruction. The skill and knowledge that will be acquired in ICA will launch SUMAS students up to an academic pedestal that will allow them to compete favourably with their peers anywhere in the world.

Overview

Introduction to Computer Application is a course that provides an overview of basic computer concepts and applications. It covers the essential knowledge and skills needed to use computer systems, software applications, and the Internet. The course typically includes instruction on basic computer hardware components, operating systems, word processing, spreadsheet software, and presentation software.

Students will learn the basics of computer organization, such as input/output devices, memory, storage, and central processing units. They will learn how to create, save, and print documents using word processing software, create and format spreadsheets using spreadsheet software, and create presentations using presentation software.

The course also covers basic computer security and privacy concepts and introduces students to internet browsing and email usage. Additionally, students will learn about digital citizenship, online ethics, and responsible online behavior.

Overall, an introductory computer application course provides students with a fundamental understanding of computer technology, its applications, and its impact on daily life. It is an essential foundation for individuals pursuing further education or careers in fields such as business, education, engineering, science, or technology.

Objectives

The course is aimed at providing the following:

1. Recognize basic computer hardware and software: The first objective of an introductory computer application course is to help students understand the basic components of a computer system, such as the processor, memory, hard drive, and input/output devices, as well as common software applications, such as word processing, spreadsheets, and presentation software.
2. Identify basic computer skills: The course should aim to develop students' basic computer skills, such as using a mouse and keyboard, opening and closing applications, creating and saving files, and managing files and folders.

3. Illustrate the use common productivity software: The course should teach students how to use common productivity software applications, such as Microsoft Office or Google Suite, including word processing, spreadsheets, and presentation software.
4. Recognize the basics of computer networks: Students should learn about the basics of computer networks, such as how data is transmitted over a network, how to connect to a network, and how to troubleshoot basic network issues.
5. Identify basic programming skills: An introductory computer application course can also introduce students to programming concepts, such as basic programming syntax and logic, and provide hands-on experience with simple programming tasks.
6. Identify basic internet and web concepts: Students should also learn about basic internet and web concepts, including how to use a web browser, how to search for information on the internet, and how to create and manage an email account.
7. Identify information literacy: Finally, the course should aim to develop students' information literacy skills, such as how to evaluate the credibility and reliability of online sources, how to properly cite sources, and how to avoid plagiarism.

Learning Outcomes

On completion of this course, the student will be able to learn the followings:

1. Apply Basic computer skills: Students learn fundamental computer skills, including how to use the keyboard and mouse, navigate through the file system, create and save documents, and manage files and folders.
2. Operate Software applications: Introductory computer applications courses expose students to various software applications like word processors, spreadsheets, presentation tools, and database software.
3. Apply Internet skills: Students learn how to search for information online, how to browse the web safely, and how to use email and other forms of online communication.

4. Practice Time management: Computer application courses teach students how to manage their time effectively by prioritizing tasks and setting achievable goals.
5. Demonstrate Analytical skills: Students learn how to analyze data and create reports using spreadsheets, graphs, and charts.
6. Demonstrate Communication skills: Computer application courses help students improve their communication skills by teaching them how to create professional-looking documents, presentations, and other forms of communication.
7. Apply Problem-solving skills: Through hands-on exercises and assignments, students develop problem-solving skills as they learn how to troubleshoot software applications and resolve technical issues.

Course Content

An introductory computer application course is designed to introduce students to fundamental computer skills and concepts, including the use of software applications, hardware components, and basic programming concepts. The following are some common topics covered in an introductory computer application course:

Introduction to computers and computing devices. Operating systems and file management. Word processing software and document formatting. Spreadsheets and data analysis. Presentations and multimedia software. Web browsing and internet navigation. Email and communication software. Social media and online collaboration tools. Cloud computing and data storage. Computer security and data privacy. Basic programming concepts and logic. Algorithms and problem-solving techniques. HTML and web development. Database management and querying. Basic networking and network protocols. Computer hardware components and peripherals. Emerging technologies and trends in computing.

These topics may vary depending on the course and the instructor, but they provide a good overview of the basic concepts and skills covered in an introductory computer application course.

Minimum Academic Standard

As described in CCMAS

SUMAS-GET 106: Introduction to Applied Mechanics [3 Units, C: LH 45]

Senate-Approved Relevance

Training engineers with sound knowledge of mechanics which is the building block of statics, dynamics, and strength of materials is fundamental to the vision of the State University of Medical and Applied Sciences (SUMAS) to produce graduates who are knowledgeable, creative, and innovative. Sustainable development goal 9 aims to develop quality reliable, sustainable, and resilient infrastructure, hence graduates with good knowledge and technical application of applied mechanics, as bridge between theory and practical application to technology would go a long way in the development of sustainable material for sustainable industrialization.

Overview

Applied mechanics investigates the motion of solid materials observed by humans without the assistance of instruments. It is classified into statics and dynamics. While statics deals with forces that acts on a body at rest, dynamics deals with body in motion which is further subdivided into kinetics and kinematics. Different materials react differently when a load is applied, and this provides a very useful information in materials selection and the expected service life of such materials.

This course fortifies the learners with the classical mechanics such as force, mass, and motion and moreover problem solving skills via the application of principles of mechanics to basic engineering problems. It also encompasses the concepts of thermoplasticity, elasticity theory, fracture mechanics, fracture and failure mechanism, fatigue, and computational mechanics. Furthermore, material response and performance are important design consideration for engineers especially mechanical, structural, and civil engineers.

Objectives of the Course

The objectives of the course are to:

- 1) explain the theory, concepts, principles, and equations that govern the motion of solid materials;
- 2) describe the broad categories of applied mechanics;
- 3) develop the capacity to visual and create meaningful mathematical model of a body subjected to force within the context of engineering application;
- 4) differentiate between kinetics and kinematics and explain the concepts of acceleration, velocity, and the response of body due to applied external loads such as force and torque;
- 5) use interpersonal understanding, teamwork and communication skills working on group assignments;
- 6) apply several mechanics formulas derived to solve example problems;
- 7) explain shear forces and bending moments diagrams; and
- 8) explain deflection of beams.

Learning Outcomes

It is expected that at the end of this practical course, the students will be able to:

- 1) define basic concepts in applied mechanics and formulate kinetic and kinematic formula that govern rigid bodies;
- 2) list and explain the two broad categories of applied mechanics as well their sub-classifications;
- 3) identify the actual restraints and equations that govern a given engineering structure within a specified condition;
- 4) identify kinematic and kinetic problems and analyse several loading conditions;
- 5) show competence in understanding and teamwork in the given group assignments;
- 6) Solve several example problems by applying the principles learnt in the course;
- 7) Draw Shear forces and bending moments diagrams; and

8) Determine deflection of beams.

Course Contents

Forces. Moments. Couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area. Centroids. Kinematics of particles in plane motion. Kinematics of rigid bodies in plane motion. Free body diagram. Newton's laws of motion. Kinetic energy and momentum analyses. Hooke's law. Stresses and strain due to loading and temperature changes. Shear forces. Work. Power. Energy. Torsion. Stress circle. Deflection of beams with symmetrical. Deflection of beams with combined loadings. Resultant of coplanar forces. Elastic buckling of columns. Shear forces and bending moments. Bending moment diagrams. Analytical methods for structures.

Minimum Academic Standards

As described in CCMAS

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 assesses 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 molding.

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, susceptance.
New

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 nanomaterial's, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardizing 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. Toughening 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 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 (calipers, 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 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, 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 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 organization – 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.

GET 299: Students Industrial Work Experience I (6 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. (8-10 weeks during the long vacation following 200 level).

BME 211: Human Anatomy I (2 Units C: LH 30)

Learning Outcomes

Upon successful completion, students should be able to:

1. recognize and describe the major structures of the human body;

2. discuss the structural organization and functions of each system of the human body;

3. apply their knowledge of human anatomy to solve questions regarding function and

disease;

4. identify clinical scenarios, the concepts and knowledge of the general terminology, cell

structure and function, histology, and gross anatomy of several organ systems

(integumentary, skeletal, muscular, and nervous);

5. analyse and critically evaluate various sources of information related to these systems to

discern reliable scientific information from outsourced information and pseudoscience;

6. demonstrate how human organ systems are interrelated, to apply a holistic approach to human health; and

7. develop research skills, including critical analysis, interpretation, synthesis, and communication of scientific data.

Course Contents

An overview of cell biology; tissue structures and human histology; basic structure of the human body; body planes and positions; the skeleton; regional anatomy of the upper limb, lower limb, thorax and abdomen.

BME 213: Human Physiology I (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. demonstrate knowledge and understanding of terminology, concepts, and relationships in human anatomy and physiology;
2. utilize a broad foundation of anatomical relationships and physiological principles in analysis, application, and synthesis related to human physiology and pathophysiology;
3. evaluate scientific information to help make decisions concerning personal health, clinical applications, and research in human physiology;
4. describe how physiological parameters are measured in humans and animal preparations
5. achieve thorough insight into homeostatic mechanisms and the functions of the various organs and organ systems in humans;
6. interpret basic physiological data; and
7. apply the basic physiological principles explored to understand how their bodies work and carry that knowledge into their specific professional areas.

Course Contents

Basic concepts in Human physiology; cellular physiology; homeostasis; musculoskeletal system; Cardiovascular System; Respiratory System; Urinary System.

BME 214: General Biochemistry I (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. demonstrate an understanding of fundamental biochemistry principles, including topics specific to chemistry and biochemistry;
2. explain the properties and biological functions of the major biomolecules;
3. locate, critically analyze, interpret and discuss data, hypotheses, results, theories, and explanations found in the primary literature;
4. design, carry out, and record the results of chemical and biochemical experiments using classical techniques, modern instruments, and computers, then analyze those results to draw reasonable, accurate conclusions;
5. communicate biochemical concepts and experimental results through effective written and oral communication; and
6. appreciate the structure and function of the main biochemical molecules (sugars, proteins, lipids, and nucleic acids), metabolic pathways of animal eukaryotic cells, and their regulation.

Course Contents

Review of general chemistry: chemical elements and the periodic table; electronic configuration, electronic orbital, valency of atoms, and types of chemical bonds; metals and non-metals; acids and bases, highlighting Lewis Conception; carbon, sp^3 hybridization, the tetrahedron and covalent bond; functional groups; water and its special properties.

Introduction of the cell and hierarchy of organisation of living things: macromolecules, organelles, cells, tissues; organs, systems and organism. Amino acids, proteins; the peptide bond and polypeptides; proteins as biological catalysts, immune agents and structural molecules.

Carbohydrates; the glycosidic bond; relationship of photosynthesis and tissue respiration; carbohydrate as storage molecule of easily accessible metabolic energy. Fatty acids and lipids: the ester bond of lipids and triglycerides; fat as efficient energy storage molecule.

Nucleic acids and nucleotide: DNA and RNA as polymers of nucleotide; the phosphodiesterase bond; gene and genetic information transcription and translation.

BME 215: Human Genetic I (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. exhibit a sound knowledge of basic genetics principles;
2. recognize important concepts related to human genetic diversity and inheritance;
3. identify the appropriate clinical applications of specific genetic techniques;
4. explain the basic concepts of human genetics as the basis of genetic engineering;
5. apply the simple technique of DNA fingerprinting;
6. discuss how these principles can be applied to fight disease; and
7. demonstrate the application of genetic engineering in fighting diseases.

Course Contents

Human Heredity: haploid and diploid chromosome, DNA, trait, genes, blood group. The Human Genome: Definition of Genome; History of Human Genome Project; Gene Sequencing; Molecular organization and gene content; Genetic Coding Genomic variation in humans. Genetic disorders: Albinism, Cystic Fibrosis, Dwarfism, Sickle Cell Disease, Color Blindness, Hemophilia, Duchenne Muscular dystrophy.

SUMAS-GET 207: Occupational Safety [2 Units, C: LH 30]

Senate-approved relevance

Training of high-quality graduates that are well knowledgeable to work in a protective environment as well as the health and safety of workers in engineering operations in Nigeria in line with SUMAS' mission to address African developmental challenges by producing graduates in metallurgical and materials engineering.

Overview

Environmental and Occupational Safety (EOS) provides a general introduction to the field of occupational safety and health in any kind of working environment. The course includes

introducing concepts, terminology, and methodology in the practice of EOS and identifying resource materials.

Objectives

The objectives of the course are to:

1. Provide information of some of the important international conventions which will be useful during the future endeavours after graduation
2. Be informed of the relevant legislations and of any new regulation concerning the EOS.
3. Health hazards at work and exposure assessment standards
4. Evaluating the working environment (surveys, sampling, risk assessment)
5. Controlling health hazards Selection and Use of Personal Protective Equipment
6. Make realize the importance of natural resources management for the sustenance of the life and the society.
7. Apprise the impact of pollution getting generated through the anthropogenic activities on the environment
8. Provide the concept of Sustainable Development, energy and environmental management
9. Impart knowledge on the new generation waste like e-waste and plastic waste

Learning outcomes

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

1. Recognize, evaluate and recommend controls for a variety of potentially hazardous occupational exposures.
2. Mention basic legislations, regulations and guidelines in EOS
3. Conduct a complete survey in a working environment and identify the potential hazards and stresses for the health of the workers.
4. Propose preventive or mitigation strategies to sustain or improve the health of the workers.
5. List safety precautions that must be observed in an engineering environment

6. Mention some of the importance of natural resources management for the sustenance of the life and the society.
7. Show familiarity on various forms of pollution and its impact on the environment.
8. Describe the elements of Sustainable Development, energy and environmental management
9. Acknowledge on the role of new generation waste like e-waste and plastic waste

Course contents

General principles of evaluating the work environment include sampling methodology, evaluating exposure to health hazards and controlling them, the principles of ventilation, personal protective equipment, and safety signs. hazards at work (exposure to harmful physical, chemical, and biological agents), such as chemicals, noise, and thermal stress. ergonomics and psychological stress are also discussed. a special focus is given to the regulations for chemicals and the management of safety and health at work. risk assessment, prevention, and mitigation strategies. environmental impact assessment and environmental audit in metallurgical and materials engineering. impact of mining on the environment and possible environmental management options in mining and processing of the minerals, sustainable resource management (land, water, and energy), and resilient design under the changing environment, management of plastic waste and e-waste: sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; waste management practices including onsite handling, storage, collection and transfer. e-waste and plastic waste, processing alternatives, e-waste management rules and plastic waste management rules, 2016 and their subsequent amendments

Minimum Academic Standards

As described in CCMAS

SUMAS-MEE 243: Measurement and Instrumentation [3 Units, C: LH 30]

Senate-approved Relevance

Training potential mechatronic engineers in Measurement and Instrumentation as it applies in the multidisciplinary field involving a synergy between mechanical, electronic and computer software engineering. This will develop engineers with adequate knowledge, skill and ability to apply the principles of process measurement, instrumentation and process control. This is in accordance with Sumas' mission to improve the quality of life for all. through mechatronics philosophy and design thinking in developing products, processes and in the delivery of services.

Overview

The general principles of measurement and instrumentation deals with Error analysis, sensors, signal conditioning and data presentation elements, and power supplies. The role of the various elements of a measurement system is to evaluate the given inputs signals to determine the corresponding output. The course will apply common sensors and signal components to determine various instrumentation real system. Real-world case studies such as acoustic emission detection, vibration monitoring, triboelectric sensing, flow measurement and structural health monitoring are provided to illustrate the applications and significance of measurement systems in industry.

Objectives

The objectives of the course are to:

1. understand the basic working principles of electrical and electronic measuring instruments.
2. receive the skills to managing and operating analogue and digital instruments for a particular application.
3. learn the ways of presenting and interpreting results.

4. calculate the uncertainty of the direct and indirect single and multiple measurements.

Learning Outcomes

After successful completion of the course, the student will be able to:

1. analyse the performance characteristics of each instrument;
2. analyse basic metres such as voltmeters and ammeters;
3. explain different types of signal analysers;
4. explain the basic features of oscilloscope and different types of oscilloscopes;
5. apply the complete knowledge of various electronics instruments/transducers to

measure the physical quantities in the field of science, engineering and technology.

Course Contents

Errors in measurements, classification and functional analysis, performance of instruments systems, calibration. Control system components, amplifiers, sensing devices, pumps and controllers, error detectors and output elements, instrumentation methods; measurements and recording of dimensions, time, weight, frequency, temperature, pressure, transducers, bridge and potentiometer methods. Synchros, Hall effects, photovoltaic and moving iron transducers. Instrument transformers, Pulse transformers, energy meters and metering, information storage techniques, electronic instrumentation, digital technique, analog/digital signal processing. Survey of modern instrumentation components. Non-linear computing elements.

Minimum Academic Standard

As described in CCMAS

SUMAS-GET 214: Engineering Economics [2 Units, C: LH 30]

Senate-Approved Relevance

The need for engineering economy is primarily motivated by the fact that everything in engineering must be done economically and optimally, whether it is designing an equipment, selecting between alternatives, operating a plant, marketing a product, or maintaining a plant, all of which involve a decision-making process. The fundamental elements of cash flows of money, time, and interest rates are all involved in the decision-making process. This course introduces the fundamental concepts and terminology required for an engineer to combine these three key elements in order to solve problems and make better decisions. Because engineering economics formulas and techniques are applicable to all types of money matters, they are equally useful in business and for individuals.

Overview

The course deals with the decision of where and how to invest the limited resources motivated by a primary goal of adding value as future, anticipated results of the selected alternative. It involves formulating, estimating, and evaluating the expected economic outcomes of alternatives designed to accomplish a defined purpose, normally an engineering project at the best values of decision metrics. Mathematical techniques simplify the economic evaluation of alternatives.

Course Objective

The main objectives of the course are to:

1. Equip students with grounded skill of economic decision making in engineering considerations.
2. Take students through a taxonomy of engineering costs and valuation.
3. Educate students on the principle of time value of money and cash flows.
4. Introduce the economic methods for evaluating capital projects and mainstream cash flow analysis.
5. Acquaint students with the understanding of Sensitivity and Breakeven analysis.

6. Introduce the required elements of Accounting in Engineering.

Learning Outcome

At the end of the Course, Students will be able to:

1. Take economic and optimal cost decisions in Engineering.
2. Compute fixed and variable costs, recurrent and non-recurrent costs, life-cycle costs, as well as cost estimation models.
3. Compute cash flows; time value of money; simple interest, compound interest, interest formulas, economic analysis with spreadsheets.
4. Undertake economic Sensitivity and Breakeven analysis, compare alternatives and decision analysis as well as uncertainty (Risk) analysis.
5. Monitor and understand Inflation and price change, minimum attractive rate of return and other metrics of engineering economic analysis.

Course Contents

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

Minimum Academic Standard

As described in CCMAS

SUMAS-BME 212: Human Biomechanics (2 Units C: LH 30)

Senate-approved Relevance

Training of high-quality Biomechanics engineers who are up-to-date with skilled in Human Biomechanics in accordance with SUMAS's mission to improve the quality of life for all through quality and safety of medicine. This is achievable by training potential biomedical engineers to have adequate knowledge, skill and ability to obtain and interpret human movement. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to deploy their knowledge in tissues such as bone, ligaments, skeletal muscle, cardiac muscle and cartilages.

Overview

Mechanics is the branch of science that deals with forces and the effects produced by these forces. The application of this science to biological system is referred to biomechanics. Human biomechanics focuses on how forces act on the musculoskeletal system and how the body tissue responds to these forces. Human beings are to produce a variety of postures and movements giving them the ability to move from one place to another, example the locomotive function. This is made possible by our musculoskeletal system that supports body loads and movement of body segments. This function is embedded in the principal of human biomechanics. Biomechanics is considered to be one of the underpinning principles in physiotherapy practice to provide optimal care for movement-related injuries or condition.

Course Objective

The main objectives of the course are to:

1. Equip students with skill on how to provide information for a variety of kinesiology professions to analyse human movement to improve effectiveness.
2. Train students that can design modern orthopaedic devices e.g. advanced walking aids.
3. Educate students on the use of principles of biomechanics in physiotherapists.
4. Acquaint students with the understanding of sports techniques and training systems and develop ways to make them more efficient

5. To enable student propose and analyse new training techniques based on mechanical demand of sport, aimed at resulting in better performance.

Learning Outcomes

Upon successful completion of this course, students should be able to:

1. outline the principles of the study of human movement;
2. describe the range of factors that influence the initiation, production, and control of human movement;
3. define and list the types of forces and describe the relationship between forces and movement, body balance and control;
4. employ the role of biomechanics in the analysis of fitness activities such as strength, power, endurance, flexibility, and cardiovascular training;
5. locate the body's lever systems and their relationship to basic joint movement and classification;
6. demonstrate an understanding of kinetic concepts including inertia, force, torque, and impulse;
7. identify the major factors involved in the angular kinematics of human movement; and
8. apply biomechanics knowledge in tissues such as bone, ligaments, skeletal muscle, cardiac muscle, and cartilages.

Course Contents

Fundamental Principles of mechanics applied to study the physiology of biological systems.

Introduction to the basic concepts of continuum mechanics-tensors, finite deformation kinematics, stress, conservation laws of mass, momentum and energy applied to deformable continua; rigid body kinematics in the context of applications in biomechanics. Application of biomechanics in tissues such as bone, ligaments, skeletal muscle, cardiac muscle and cartilages. Skeletal muscle and mechanism of movement; biomechanical implications of the sliding filament theory; velocity-force curves; lever mechanics; types of muscle fibres.

Minimum Academic Standard

As described in CCMAS

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

Senate Approved Relevance to Vision and Mission

This course will help overcome the problems of trial-by-error approaches currently applied in engineering design which is in line with SUMAS mission of improving the quality of life for all. This course will reduce the reliance on fortuitous discoveries, or accidents in the laboratory thereby saving time and money.

Overview

Today science and engineering still depend on mathematical principles. A mathematical approach seeks to manipulate systems. This often gives rise to fundamentally new materials and systems, which are required to address outstanding needs in numerous fields, from energy to healthcare to electronics. Additionally, with the increased sophistication of technology, trial-by-error approaches are often costly and difficult. This is very crucial to technological development in SUMAS and by training the future workforce to understand these principles, the university and nations will benefit in its technological development.

This course will help SUMAS graduates to be competent and outstanding in solving real world problems with the basic knowledge of differential equations, MATLAB and Cauchy integral theorem.

Objectives

The objectives of the course are to:

1. Deliver a clear understanding of differential equations (ODEs);
2. Illustrate differential equations (ODEs) using examples
3. Identify components and direction displacement, velocity, acceleration, and torsion.
4. Perform differentiation and integration of vector with respect to scalar variable.

6. Outlines various components of velocity and acceleration of a particle.
7. Calculate and understand Cauchy integral theorem

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.

Minimum Academic Standard

As described in CCMAS

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, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). 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 peace keeping. 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, etc). 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; New
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, FirstMover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic bookkeeping, 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 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, structure Fog and 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 researchreports 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, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. 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 Content: 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; trans esterification of edible oil into biodiesel; simulation of geothermal energy; Geiger Mulleror Scintillation Counters' determination of uranium or thorium energy; simple solid or saltstorage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning andConvergent 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.

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 softwares 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 troubleshooting, and wooden

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.

BME 316: General Pharmacology (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. demonstrate an understanding of basic pharmacological principles and mechanism of action and classification of drugs;
2. describe fundamental concepts of drug-receptor interactions;
3. display an understanding of the processes involved in absorption, distribution, metabolism, and excretion of toxicants, including an understanding of the toxicokinetic behavior of toxicants in mammals;
4. identify molecular targets and pathways that are druggable and those for which there are already drugs available;
5. justify the main pharmacodynamic and pharmacokinetic principles and apply them to particular drugs;
6. integrate the principles of pharmacology in the process of drug evaluation (efficacy, safety, and quality); and
7. apply the principles of drug evaluation to specific situations: generics and biosimilar.

Course Contents

General Pharmacology: Historical development of pharmacology; divisions of pharmacology and their applications; definitions of terms and abbreviations: concept and nature of drugs. Pharmacodynamics; pharmacokinetics; classification of drugs and their importance. Drug abuse and control; drug noncompliance or misuse. Toxicology: Introduction to toxicology and its importance; general principles of poison managements.

BME 332: Biomedical Electronics (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. discuss the history of biomedical electronics;
2. describe standard biomedical electronic devices and systems;
3. explain necessary the precautions against hazards involved in electromedical devices;
4. acknowledge biomedical signals and their requirements for detection and processing;
5. identify and understand the required building blocks for a given biomedical system;
6. design circuits and systems for a given biomedical system specification; and
7. perform safety testing and troubleshooting of electromedical equipment.

Course Contents

General overview of biomedical electronics; history of biomedical electronics; biomedical electronics as composing of bioelectronics and medical electronics; intersection areas in biomedical electronics. Introduction to bioelectronics. Introduction to medical electronics. Study of common biomedical electronic equipment and systems such as thermometers, stethoscopes, pulse oximeters, patient monitors, telemetry systems, ambulatory systems. Hazards of electro-medical devices: physiological effects of electricity; tests and safety checks of medical devices; electrical safety testing. Troubleshooting of electro-medical equipment. Design of biomedical circuits. Computer applications in biology and medicine.

BME 334: Biomedical Instrumentation (2 Units E: LH 30)

Learning Outcomes

Students will have demonstrated the ability to:

1. explain the physical and medical principles of biomedical instrumentation;
2. describe different types of electrical medical equipment;

3. analyse and solve problems related to the design of biomedical measurement instruments;
4. describe the underlying physical phenomena, architecture, employed materials, operational modes device/instrumentation;
5. identify and use basic biomedical instrumentation;
6. classify medical instruments based on different principles with application viz - (diagnostic, therapeutic, Imaging, analytical), physiological parameter and biopotential, biological system, in other departments in the hospital;
7. illustrate the different types of medical transducers used in medical instruments for body temperature, blood pressure, and respiration rate; and
8. comprehend the physics of various biomedical transducers, such as electrodes, displacement transducers, thermocouples, thermistors, and flow meters.

Course Contents

Introduction to biomedical instrumentation: basic biomedical instrumentation system. General considerations in the design of biomedical instrumentation systems. Biomedical measurements: errors in measurement. Biological signals: bioelectric signals. Biomedical sensors and transducers-types and forms. Physiological measurements: audiology; cardiac physiology; gastrointestinal tract physiology; neurophysiology; ophthalmic and vision science; respiratory physiology; urodynamic physiology; vascular technology; blood pressure measurement; blood flow measurements; measurement of the respiratory system; ECG measurement systems. Clinical laboratory instrumentation. Electrical safety in instrumentation. Introduction to Biomedical signal processing.

BME 351: Biomaterials Engineering (2 Units E: LH 30)

Learning Outcomes

Students should be able to:

1. comprehend biomaterials and tissue engineering terminology;
2. list different material types used in biomaterials and tissue engineering;
3. demonstrate a broad knowledge of materials science and engineering in biomedical applications;
4. examine physical properties, including degradation and mechanical properties of

- different kinds of biomaterials;
5. analyse biocompatibility and tissue-material interaction for different kinds of biomaterials;
 6. determine the engineering properties of biomaterials;
 7. apply the knowledge of engineering properties in the design of biomaterials for implants, prosthesis, and artificial organs;
 8. explain what the application of biomaterials in biology and medicine means to biocompatibility and tissue-material interactions; and
 9. ascertain what host response is to biomaterials and biomaterials failure.

Course Contents

Introduction to Engineering properties of biomaterials: fatigue of biomaterials applications of materials in medicine-cardiovascular, surgical, dental, ophthalmologic, orthopaedic applications. Bioelectrodes and bio (medical) sensors. Artificial organs: heart, teeth, limbs and kidney. Compatibility of biomaterials: tissue-material interactions; host response to biomaterials; biomaterials failure.

SUMAS-CHE 312: Waste Processing Technology [1 Unit, C: LH 15]

Senate Approval Relevance:

This comes in recognition of the relevance to the vision and mission of the SUMAS' strategic plan to turn out Biomedical Engineers who are adequately skillful to innovate on the waste processing techniques and waste management strategies in our immediate and remote environments, and industrial or municipalities in a fast-transforming world of circular economy.

Training chemical engineering students in waste processing technology is giving them knowledge and skill for self-reliance and in part preparing them for entrepreneurship and lead private and industrial consultancies in the area. This is in line with SUMAS' vision of developing quality manpower using technology to serve society which is in tandem with the global practice of offering functional education. Moreover, SUMAS or the Department of Mechanical Engineering could commercialize or patent innovative processes arising from the teaching of this course.

Overview

This course emphasizes processes based on anaerobic digestion of organic materials/matter in which microorganisms break down biodegradable materials in the absence of oxygen. These processes apply widely; treating wastewater sludge and organic wastes for the fact that it provides volume and mass reduction of input material. This course provides SUMAS Mechanical Engineering graduates with basic understanding about conventional and natural waste water treatment technologies as well as integrated solid waste management. Knowledge about wastewater management can be used to solve the issue of environmental waste problem.

Plasma pyrolysis or plasma gasification, for example, is a waste treatment technology that gasifies matter in an oxygen-starved environment to decompose waste material into its basic molecular structure. The process demands high electrical energy for creating high temperature by an electrical arc gasified.

Objectives

The objectives of the course are to:

1. identify sources of water pollution, priority pollutants and their impacts on water bodies as well as processes of purification and instrumentation.
2. explain protection of environment from pollution and contamination and repair and reduce the damage caused by pollution.
3. describe key biological treatment procedures such as activated sludge and biofilm, N and P removal sludge system, natural and on-site treatment systems
4. capture the waste management hierarchy and the principles of integrated waste management, the impact of wastes on health, environment and the enforcing legislation
5. recognize types of wastes, the compositions, properties and amount of waste, the collection and transportation of the wastes, optimization techniques, recycling stations and transfer stations
6. clarify mechanical processing of wastes, incineration and biological treatment procedures

7. conveniently institute sanitary landfilling process, understand the risks, hazards and nuisances as well as mitigation steps therein including bottom lies and cover materials, collection and treatment of leachate and gas

Learning Outcomes

At the end of the teaching encounter with the students, students should be able to

1. apply the skill of increasing recycling, reducing carbon emissions, and attaining sustainability goals. improve air and water quality as well as reduces greenhouse gas emissions;
2. employ data-driven waste solutions for garbage collection in smart cities;
3. describe simple waste solutions-No litter and less costs;
4. evaluate the subject from the technical, legal and economical points by learning of all terms related to general solid wastemanagement;
5. state the hierarchical structure in solid waste management and a requirement for an integrated solution;
6. examine the technical points that are required to set up a solid waste management system;
7. apply the legal legislation related to solid waste management;
8. evaluate economic analysis of the solid waste management system;
9. make route optimization for a solid waste collection and transport system;
10. plan a recycling program;
11. design a packaging waste separation facility;
12. design an incineration facility;
13. make site selection for a landfill;
14. plan a solid waste management system for decision makers.

Course Content

Sources for water pollution. Priority pollutants and their effect on water bodies. Eutrophication and self-purification processes. Characteristics and composition of wastewater. Pollution load, sewage pumps and pumping stations. Primary purification devices, mechanical treatment.

Screening, sand trap, sedimentation. Biological treatment Activated sludge and biofilm, N and P removal sludge treatment. Natural treatment systems and on-site treatment systems. Waste management hierarchy and principles of integrated waste management. Impact of wastes on health and environment, legislation. Types of wastes, compositions, properties, and amount of waste. Collection and transportation of wastes. Optimization. Recycling stations, transfer stations. Mechanical processing of wastes. incineration and biological treatment. landfilling, risks, hazards, and nuisances. and their mitigation methods. Bottom lines and cover materials. Collection and treatment of leachate and gas.

Minimum Academic Standard

As described in CCMAS

SUMAS-BME 303: Statistics for Healthcare Professionals (2 Units, C:LH=15,PH=45)

Senate-approved Relevance

Training of high-quality biomedical engineers who are abreast with and skilled in medical statistics, in accordance with SUMAS's mission to improve the quality of life for all. through quality and safety of medicine. This is achievable by training potential biomedical engineers to have adequate knowledge, skill and ability to obtain and interpret medical statistics. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to deploy medical statistics in improving the quality and safety of the medicine.

Overview

The field of Statistics for Healthcare Professionals is concerned with collecting, analyzing, interpreting, and presenting data for effective health service delivery and management. Medical statistics enable the determination of important information relating to rates of morbidity and recovery, allocation of resources, activities of medical institutions, and many other aspects. Hence, the need to enhance students' knowledge and skill in obtaining and interpreting medical data, which is very useful for determining the causes of morbidity or death, their prevalence, and, based on

the information received, for the allocation of resources. The objectives of the course, learning outcomes, and contents are provided to address this goal.

Objectives

The objectives of the course are to:

1. Introduce students to statistical techniques used in design and analysis of controlled clinical experiments.
2. Measure disease frequency and association.
3. Provide students with the knowledge of applications of descriptive, inferential, parametric and non-parametric statistics to health.
4. Enhance students' skills in biostatistics; population sampling, structural measurements
5. Introduce students to statistics of health delivery

Learning Outcomes

At the completion of this course students will be able to:

1. Explain statistical techniques used in design and analysis of controlled clinical experiments.
2. Discuss measures disease frequency and association
3. Apply knowledge of descriptive, inferential, parametric and non-parametric statistics to health
4. Demonstrate skills in biostatistics; population sampling and structural measurements
5. Discuss statistics as applied to health delivery generally.

Course content

Topics include measures of disease frequency and association; inferences for dichotomous and grouped case-control data; logistic regression for identification of risk factors; Poisson models for grouped data; Cox model for continuous data; life table analysis; and SAS used in analysis of

data, Statistical techniques used in design and analysis of controlled clinical experiments. Topics include introduction to four phases of clinical trials; randomization, blocking, stratification, balancing, power, and sample-size calculation; data monitoring and interim analyses; baseline covariate adjustment; crossover trials; brief introduction to categorical and event-time data; and SAS used in analysis of data. Applications of descriptive, inferential, parametric and non-parametric statistics to health. Theory of probability, sampling techniques, hypothesis testing. Dealing with errors; construction and interpretation of graphs and data tables. Biostatistics; population sampling, structural measurements. Statistical applications to health and medicine. Drug counting. Statistics of health delivery. Descriptive Statistics, introductory probability, inferential statistics: random variables, discrete and continuous distributions, point and interval estimation, tests of hypotheses, sample size and power, nonparametric methods, correlation and regression, and ANOVA.

Minimum Academic Standards

Basic knowledge of statistics as described in CCMAS

SUMAS -BME 302: Introduction to Bionics (2 Units, Compulsory:LH=15,PH=45)

Senate-approved Relevance

Training of high-quality biomedical engineers who are abreast with the use of electronic/electrical stimulation in promoting positive health outcomes, in accordance with SUMAS's mission to improve the quality of life for all. through quality healthcare. This is achievable by training potential biomedical engineers to have the skill and ability to interphase electrical stimulation in a controlled manner to achieve specific clinical outcomes. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to stimulate and modulate impaired excitable cell systems, muscle, and nerve to return to function by electrical stimulation through development and deployment of biomimetic devices.

Course Overview

The field of bionics or medical bionics is concerned with the development of devices that enable the effective integration of biology and electronics to achieve a targeted functional outcome. Bionics or biomimetics involves integration of human-engineered devices to take advantage of functional mechanisms/structures resident in nature. Medical bionics enables medical experts to explore the possible use of electrical stimulation in promoting positive health outcomes. Hence, the need to enhance biomedical students' knowledge and skill in using biomedical bionics in returning impaired biological cells, nerves and senses back to function. The objectives of the course, learning outcomes, and contents are provided to address this goal.

Course Objectives

The objectives of the course are to:

1. Define bionics and its basic and operational aspects.
2. Introduce students to biomimetic and interphase of biology and electronics
3. Review of the basic principles of electronic and its integration in medical bionics to mimic living system
4. Study electronically operated mechanical systems and other kinds of bionic appliances
5. Design and manufacture of bionic devices.
6. How to maintain bionic devices to ensure safety of health professional and patients
7. Select appropriate bionic devices for the Nigerian health system.
8. Study ethical concerns in bionics.

Learning outcomes

At the completion of this course students will be able to:

1. Define bionics and discuss the basics of its operation
2. Discuss how electronics interfaces with biology to promote health
3. Explain the basic principles of electronic and how it is integrated in medical bionics

3. Classify bionic devices and how they are operated
4. List steps in the design and manufacture of medical bionics
5. Demonstrate how to maintain some medical bionics
6. Advise on selection of appropriate bionic devices for use in Nigerian hospitals
7. Demonstrate adequate knowledge of standards and ethical concerns in deployment of bionics.

CourseContent

Definition of bionics; basic and operational; biomimetic and interphase of biology and electronics. Review of the basic principles of electronic. Interphase of biology and electrons to mimic living system. Electronically operated mechanical systems that function as prostheses. Different kinds of bionic appliance. Bionic (biocompatible materials). Design and manufacture of bionic devices. The safety of bionic devices. The maintenance of bionic appliance. Appropriate bionic devices for the Nigerian health system. Ethical concerns in bionics

Minimum Academic Standards

Well-equipped bionics laboratory with NUC-MAS requirement facilities.

SUMAS-BME 311: Design thinking and innovation (2 Units, C: LH:15,PH:45)

Senate-approved Relevance

Training of high-quality biomedical engineering students to ideate, launch, run, and successfully complete innovative projects in biomedical field, in accordance with SUMAS's mission to improve the quality of life for all through innovation in healthcare. This is achievable by training potential biomedical engineers to have the skill and ability to implement a design thinking approach to innovation. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering using this human-centred and team-based approach to create new products that will significantly and meaningfully impact the health sector.

Course overview

Design thinking is a human-centred approach to innovation. It is an iterative approach to solving problems with cross-functional teams. This course is meant to expose biomedical students to the

design thinking approach and mindset using highly interactive exercises that will wake the innovative and problem-solving abilities within them. The primary aim of the course is to empower students to ideate, launch, run, and successfully complete innovation projects that have a significant and meaningful impact on biomedical field and the health sector in general. This course is anchored in understanding customer's needs, rapid prototyping, and generating creative ideas that will transform the way we develop products, services and processes. The mantra in today's world is design and innovate or die and our biomedical students have to be competitive as well.

Objectives

The objectives of the course are to:

- 1. Introduce students to design thinking and innovation**
- 2. Implement a design thinking approach to innovation**
- 3. Create design thinking teams and conduct design thinking sessions**
- 4. Apply both critical thinking and design thinking in parallel to solve problems**
- 5. Apply some design thinking concepts to daily work**

Learning outcomes

At the completion of this course students will be able to:

1. Define design thinking
2. Describe how to implement a design thinking approach to innovation
3. Explain how to set up design thinking teams and conduct design thinking sessions
4. List stages in design thinking and innovation
5. Apply design thinking to solve a specific problem in medical field

Course Content

This is a project-based design course focusing upon ensuring that products meet the needs of their users. The course introduces observational methods, brainstorming, rapid prototyping, user testing, business models, and the social, marketing and engineering concerns that impinge upon products. Students will do weekly project assignments aimed at illustrating the concepts discussed in class and readings. Students will also work in teams to plan, design and develop a product to the prototype stage. Learning is supported through lectures, discussions, readings, in-

class exercises, and through a series of formal design reviews that encourage reflection on students' process and their insights. Students will spend significant time observing, listening to, Analyzing, storytelling, and otherwise engaging users as they develop and implement meaningful and transformative designs.

Minimum Academic Standards

Well-equipped design thinking innovation laboratory with NUC-MAS requirement facilities.

SUMAS-BME 313: Biomedical Instrumentation I (2 units, C, LH:15, PH:45)

Senate-approved Relevance

Training of high-quality biomedical engineering students *to* design electronic-based medical instrument to measure biological signals, in accordance with SUMAS's mission to improve the quality of life for all. through instrumentation in healthcare. This is achievable by training potential biomedical engineers to have the skill and ability to design, deploy and manage electrical equipment used to diagnose and treat diseases. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering using both analog and digital equipment to acquire, process and store biological signals to aid diagnosis and treatment.

Course overview

Biomedical Instruments assist physicians to diagnose the problem and provide treatment. This course involves acquiring skills in the design a medical instrument using the concepts of electronics and measurement of biological signals with this technique. Biomedical instrumentation helps physicians diagnose the problem and provide treatment. This course focuses on electrical medical equipment used for the treatment of patients; everything from examinations by the general practitioner to advanced hospital treatment. The aim is to understand the fundamental principles for measurement techniques, imaging methods, treatment, and analysis of the most common types of electrical medical equipment used today, and to understand the context in which these are used. An essential part of the course is to describe the medical and physiological need for the equipment, and how these interact

Objectives

The objectives of the course are to:

1. make the students understand the physical and medical principles of biomedical instrumentation
2. Study different types of electrical medical equipment and their shortcomings.
3. Design electronic medical equipment such as transducers as applicable to physiology
4. explore the human body parameter measurements setups

Learning outcomes

At the completion of this course students will be able to:

1. explain the physical and medical principles of biomedical instrumentation
2. Discuss merits and demerits of different medical equipment, as well as sources of error and risks linked to them
3. Measure biomedical and physiological information
4. Discuss the application of electronics in diagnostics and therapeutic area

Course content

Biosensors and transducers – types and forms, measurable biological signals, biological components and physiochemical transducer; Instrumentation system processors – analog and digital signals, signal conversion and data processing; Display and storage systems – data acquisition and recorders.

Minimum Academic Standards

Well-equipped instrumentation laboratory with NUC-MAS requirement facilities

SUMAS-BME 314: Biomedical Instrumentation II (2 units, Compulsory, LH=15, PH=45)

Senate-approved Relevance

Training of high-quality biomedical engineering students to have a deeper understanding of the bio-signals recording equipment, measurement and analysis of bio-signals for diagnosis and treatment, in accordance with SUMAS's mission to improve the quality of life for all through improvement in medical diagnosis and treatment via high-level instrumentation. This is achievable by training potential biomedical engineers to have higher skill and ability to use electrical equipment to measure and obtain reliable bio-signals to assist in diagnosis and treatment. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering using modern digital equipment competently to measure biological signals, set up and manage clinical instrumentation laboratory.

Course overview

Biomedical Instrumentation II course is meant to further expose students to bio-signals recording, transducers for biomedical application, action potentials EMG, EEG, ECG, amplifiers and signal processing, blood flow and pressure measurements, data acquisition and signal conditioning, spectral analysis of data, filtering, and safety aspects of electrical measurements. It aims to enable practical operation of these bio-signal measurement techniques by students.

Objectives

The objectives of the course are to:

1. gain deeper understanding of the bio-signals recording devices
2. expose students to practical operation of bio-signal measuring devices
3. apply basic circuit theory to perform measurement of bio signals
4. acquire and analyze a signal using time and frequency techniques
5. set up of bioinstrumentation laboratory and electrical safety in instrumentation.

Learning outcomes

At the completion of this course students will be able to:

1. explain the principle of blood flow and pressure measurement
2. Discuss the operation of electrocardiogram

3. Discuss with the aid of circuit diagram how to perform any of bio-signal measurement
4. Explain how bio-signals can be acquired and filtered using time and frequency techniques
5. Describe step by step set up of bioinstrumentation lab and state the safety concerns

Course Content

Topics covered include bio-signals recording, transducers for biomedical application, action potentials EMG, EEG, ECG, amplifiers and signal processing, blood flow and pressure measurements, data acquisition and signal conditioning, spectral analysis of data, Filtering, and safety aspects of electrical measurements. Ultimately, students will learn (1) how to apply basic circuit theory to perform measurement of bio signals, (2) be familiar and use common measurement devices, such as multimeter and oscilloscope, (3) be familiar with Op-amps circuits, how to acquire and analyze a signal using time and frequency techniques, and how-to filter a signal to remove noise. Blood pressure measurement; Blood flow measurements; Measurement of the respiratory system; Clinical laboratory instrumentation; Electrical safety in instrumentation.

SUMAS-BME 316: Biomedical Radiation Technology (2 units, Compulsory, LH=15, PH=45)

Senate-approved Relevance

Training of high-quality biomedical engineering students to have a deeper understanding of the use of radiation in medicine and biology for diagnosis, treatment, and research, by SUMAS's mission to improve the quality of life for all through improvement in medical diagnosis and treatment via high-level radiation technology. This is achievable through the training of potential biomedical engineers to have higher skills and ability to use diagnostic imaging tools such as X-rays, CT scans, and PET scans. Further emphasis is on the interactions of radiation with the biological system.

Course Overview

Biomedical Radiation Technology is meant to expose students to an in-depth understanding of the principles, applications, and safety concerns surrounding radiation in biomedical applications. Students will explore the interaction of radiation with biological tissues, the use of radiation in medical diagnostics and therapies, and the technological advancements in imaging and treatment modalities. The course also emphasizes radiation safety and regulatory standards to ensure proper clinical application.

Learning outcomes:

At the completion of this course, students will be able to:

1. Understand the principles of radiation and its interaction with the biological system
2. Have a demonstrable knowledge of diagnostic imaging equipment such as X-ray, CT scans, MRI, PET, Ultrasound, etc.
3. Understand the various types of radiation used in biomedical applications, including ionizing and non-ionizing radiation.
4. Understand the principles of radiation therapies and its use in diagnosing diseases such as cancer.
5. Discuss the safety protocols and regulatory standards governing the use of radiation in medicine
6. Analyze the advancement involved in the use of radiation base technology for medical use.
7. Apply radiation protection techniques in biomedical settings and clinics.

Course Content

Introduction to biomedical radiation technology: history, scope, overview. Fundamentals of atomic and nuclear physics. Types of radiation: Alpha, Beta, Gamma, X-rays. Energy transfer mechanism. Radiation interaction with biological tissue: effect, damage and repair mechanism, and measurements of radiation exposure. X-ray, Fluoroscope, CT, PET, MRI, and Ultrasound: production mechanism, principles, and clinical applications. Nuclear medicine. Introduction to radiotherapy: uses, types, and dose delivery. Techniques in radiotherapy, treatment outcomes and side effects. Radiation safety and protection: PPE, and safety guidelines. Legal and ethical issues

in radiation use. Advancement in biomedical radiation technology: hybrid imaging system, Proton therapy. Clinical application of radiation, use of radiation in cancer, and the role of biomedical engineers. Future trends in biomedical radiation technology.

SUMAS-BME 381: Biomedical Engineering Laboratory I (2 Units C: LH 45)

Laboratory investigations and report submission for selected experiments and prescribed projects drawn from first semester courses.

SUMAS-BME 382: Biomedical Engineering Laboratory II (2 Units C: LH 45) Laboratory investigations and report submission for selected experiments and prescribed projects drawn from second semester courses.

400 LEVEL

BME 401: Biomedical System Analysis (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. demonstrate the knowledge of the mathematical concepts applied in biomedical engineering, including linear relations and functions, systems of inequalities;
2. apply the best mathematical method for addressing a particular bioengineering problem;
3. formulate bioengineering problems in terms of appropriate mathematical modelling methods;
4. analyse biological data using appropriate mathematical methods;
5. evaluate the output of the mathematical modelling methods concerning the underlying biological processes;
6. manipulate experimental data using mathematical methods; and
7. assess the output of the mathematical analysis of a bioengineering problem.

Course Contents

Advanced mathematical concepts: linear relations and functions; systems of equations and inequalities; polar coordinates and complex numbers; exponential and logarithmic functions;

iteration; statistics and data Analysis; limits, derivatives and integrals: applications of differentiation and integration. Mathematical methods and Models: numerical methods; finite differences; solutions of differential equations; role and application of models in biology and medicine. Computer simulations: Development of computer simulation techniques to study physiological system.

BME 435: Biomedical Informatics (2 Units C: LH 30)

Learning Outcomes

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

1. apply knowledge and awareness of the basic principles and concepts of biology, computer science, and mathematics;
2. design, deploy and use the various electronic health information systems;
3. simulate biomedical systems experimentation and design with the aid of computer systems;
4. explore the massive biological data available and their manipulation with the computer systems;
5. utilise existing software effectively to extract information from large databases and to use this information in computer modeling; and
6. develop problem-solving skills, including the ability to develop new algorithms and analysis methods.

Course Contents

Introduction to biomedical informatics; components of biomedical informatics. Bioinformatics: What is bioinformatics; components of bioinformatics; biological data; information complexity; bioinformatics applications? Medical informatics: Management Information Systems in biology and medicine-data acquisition, data storage and retrieval, data processing; components of Health Information Systems; types of Health Information Systems. Computer networking in the hospitals: the concept of computer networking, telemetry; e-Health. Software development in biology and medicine. Computer applications in medical diagnosis and therapy. Computer-aided simulation and experimentation.

BME 453: Human Biotechnology (2 Units E: LH 30)

Learning Outcomes

Students should be able to:

1. apprehend the general principle and practice of biotechnology;
2. explain the structure and function of cell organelles and cellular transport;
3. describe the science of biotechnology and identify its product domains;
4. comprehend the concepts in human genetics and its applications;
5. identify the various natural and laboratory based modifications of DNA;
6. apply human biotechnology in solving human health problems;
7. use molecular biology techniques genetically engineer the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial applications; and
8. explain how scientific methodologies are used to conduct experiments and develop products.

Course Contents

Introduction to Biotechnology: Historical background; types, their examples and applications

Biotechnology and human health: pharmaceuticals, diagnosis, vaccines, gene therapy, organ replacement therapy, nutrition, environmental health, health prevention, etc. Introduction to

Genetic Engineering: history of genetic engineering; cloning; DNA fingerprinting; polymerase chain reaction; summary of DNA fingerprinting; application of GE in fighting diseases. Introduction to Tissue Engineering: basic biological concept— cells, organelles; tissue organisation; tissue dynamics, representative tissue; case studies; barriers to tissue engineering adoptions.

BME 461: Clinical Engineering (2 Units; E: LH 30)

Learning Outcomes

Students should be able to:

1. recognise the need and significance of technical support in hospital environments;
2. learn the basic skills for troubleshooting hospital equipment;
3. appreciate the challenges of technology management and its importance to good healthcare delivery;

4. design and implement the complete process of technology management;
5. conduct an economic analysis of medical technologies during acquisition processes (cost benefit analysis);
6. facilitate a better understanding between biomedical engineers and medical doctors; and
7. acknowledge the role of clinical engineers in the healthcare environment.

Course Contents

Evolution of clinical engineering. The health care environment. Equipment planning. Clinical engineering education. Quality assurance. Equipment replacement project. The role of clinical engineering in hospital organisation and enhancing patient's safety. Healthcare facilities planning; A model clinical engineering department; careers, roles, and responsibilities of clinical engineers.

BME 481: Rehabilitation Engineering (2 Units E: LH 30)

Learning Outcomes

Upon completion of the subject, students should be able to:

1. apprehend the clinical fundamentals of injuries and dysfunctions;
2. recognise and apply fundamental knowledge of engineering in the rehabilitation of clients suffering from selected injury and body dysfunction;
3. use analytical skills to assess and evaluate the needs of the end-user requiring rehabilitation and assistive devices;
4. conduct patient/technology evaluation via the use of modern instrumentation;
5. apply rehabilitation engineering technology to help individuals with disabilities; and
6. appreciate safe working practices in rehabilitation engineering.

Course Contents

Introduction to rehabilitation engineering: technology and disability. Assistive technologies: implants, prostheses, and artificial organs in rehabilitation; Wheelchair and others. Rehabilitation robotics: aids for physically handicapped people. Rehabilitation in Special areas: Rehabilitation in Sports; Physiotherapeutic technologies; Psychiatric devices; orthopaedic devices, etc.

GET 499: Students Industrial Work Experience III (8 Units C: 24 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 engagement and the larger society and creatively devise 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.

SUMAS-BME 421: Health Management Information Systems (2 units, Compulsory, LH=15, PH=45)

Senate-approved Relevance

Training high-quality biomedical engineering students to develop a deeper understanding of the critical role of Health Management Information Systems (HMIS) in enhancing healthcare delivery by SUMAS's mission to improve the quality of life through optimized healthcare data management. This is achieved by equipping future biomedical engineers with advanced skills in the design, implementation, and management of HMIS technologies, which streamline medical diagnosis, treatment planning, and patient care. Mastering tools such as Electronic Health Records (EHR), and healthcare simulation techniques will enable students to drive improvements in healthcare systems and contribute to the efficient management of medical data, ultimately enhancing patient care and healthcare delivery.

Course Overview

Health Management Information Systems is an integrated information system designed to manage healthcare data and information to enhance decision-making processes in health services, and also improve the quality of healthcare delivery. Health Management Information Systems promotes the efficient collection, storage, analysis, and dissemination of health-related data which include patient records, resource allocation, and hospital management data. This course will provide students with an understanding of how technology and data management systems are integrated into healthcare to improve patient outcomes. Students will explore Health Management Information Systems such as Electronic Health Records (HER), and telemedicine, gaining practical skills in the design, implementation, and evaluation of health information systems to improve healthcare delivery.

Objective

The objective of the course is to:

1. Introduce students to the fundamental concepts and the components of Health Information Systems

2. Acquaint students with the role HIMS play in improving healthcare delivery, and management.
3. Help students identify the need for the design, development, and the implementation of health information systems in resource-limited settings
4. Ensure students understand computer simulations techniques and its application the modeling of healthcare data and systems.
5. Develop strategies to improve healthcare delivery using HMIS and simulation tools
6. Explore emerging trends in HMIS

Learning Outcomes:

Upon completion of this course, students should be able to:

1. Develop basic health information systems for clinical and healthcare management
2. Use computer simulation to model patient data, resource allocation, and hospital operations
3. Evaluate the effectiveness of HMIS implementation in developing countries
4. Enhance clinical decision making through integration of healthcare data from multiple sources.

Course Content

Introduction to Health Management Information Systems: definition, scope, components, role in healthcare delivery. Types of Health Information Systems: Electronic Health Records (EHR), Laboratory Information Management Systems (LIMS), Telemedicine and Remote Monitoring Systems. Health Data Management and Processing: data collection, storage, and retrieval. Data standardization and interoperability. Healthcare Database and SQL. Introduction to Computer Simulations, Modelling Healthcare Systems, Simulation Software and Application in Healthcare (e.g MATLAB). Electronic Health Records: structure and functionality, benefits and challenges, case studies. Healthcare Information Systems: regulatory and ethical considerations in health informatics. Technologies for remote healthcare delivery, role of HMIS in telemedicine,

challenges in telemedicine for resource-limiting countries. HMIS in developing countries: challenges, solutions, case studies in Africa.

Minimum Academic Standards

Well-equipped lab with NUC-MAS requirement facilities

SUMAS-BME 413: Biomedical Equipment Design (2 units, Compulsory, LH=15, PH=45)

Senate-approved Relevance

Training high-quality biomedical engineering students in biomedical equipment design as it applies to the development, evaluation, and improvement of medical devices and healthcare technology. This course is SUMAS's mission to improve the quality of life for all by applying design principles and problem-solving methodologies to enhance patient care through innovation in medical equipment design and technology. This is achievable by training biomedical engineers with the relevant skills, knowledge, and ability to design and maintain biomedical equipment, ensuring safety, and efficient delivery of healthcare services.

Course Overview

This course provides students with a comprehensive understanding of the principles and practices involved in the design, development, and evaluation of biomedical equipment. Students will be provided with the requisite knowledge in the biomedical equipment design processes, from conception to prototyping, testing, and regulatory consideration. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to understand the key aspects of biomedical equipment design such as safety, reliability, ergonomics, and compliance with medical standards.

Objectives:

The objectives of this course are to:

1. Acquaint students with the process involved in biomedical equipment design, from conception to commercialization

2. Apply engineering principles to design medical equipment/devices that meet clinical needs in low-resource settings.
3. Understand the regulatory compliance, and ethical issues involved in the design of biomedical equipment
4. Identify a challenge in the healthcare setting and develop a solution.

Learning Outcomes:

Upon completion of the subject, students should be able to:

1. Identity a clinical need and design a biomedical equipment to meet the need
2. Know how to use modern design tools and methods to create and evaluate prototypes of medical devices
3. Test for the performance, safety, and usability of medical equipment.
4. Understand the regulatory standards for medical equipment/device design.

Course Contents:

Introduction to biomedical equipment: overview of design process, clinical application, and interdisciplinary approach (engineering, biology, and medicine). Engineering design principles in biomedical equipment: functionality, safety, reliability, ergonomic, design tools, and techniques (CAD software). Material selection for biomedical devices: selection of biocompatible materials, material properties (durability, flexibility, and safety), case studies (material choice for a specific medical device - implant, prosthetics). Electrical systems in medical devices: sensors, power supply and energy management, safety standards for electrical equipment in medical application. Prototyping: introduction, 3D printing and additive manufacturing in biomedical equipment, design iteration and troubleshooting. Regulatory standards and compliance: regulatory bodies (FDA, ISO), clinical trials and validation process, ensuring safety and effectiveness of medical devices. Market analysis and commercialization strategies for biomedical devices.

Minimum Academic Standards

Well-equipped Biomedical lab with NUC-MAS requirement facilities

SUMAS-BME 441: Medical Imaging 1 (2 units, Compulsory, LH=15, PH=45)

Senate-approved Relevance

Training high-quality biomedical engineers in medical imaging as it applies to the diagnosis and monitoring of medical conditions using imaging technologies by SUMAS's mission of improving the quality of life for all through the integration of imaging technology with healthcare. This is achievable through equipping biomedical engineering students with the expertise, skill, and ability to work with imaging systems such as X-rays, MRI, and ultrasound. This course will ensure students contribute to accurate diagnosis and treatment of diseases through enhanced diagnostic capabilities.

Course Overview

Medical imaging provides an in-depth understanding into the principles, and technology in the use of tools such as magnetic resonance imaging (MRI), Ultrasound, X-ray, computed tomography (CT) in clinical practice. The course focuses on the physical and engineering foundations of imaging modalities, exploring the physics behind image formation, signal processing and quality. Safety, and ethical consideration are also key in the use of medical imaging tools. Emphasis will be on the training of biomedical engineering students to understand the mathematical models that underlie medical imaging and how these are applied to diagnostic and therapeutic settings.

Objectives:

The objectives of this course are to:

1. Acquaint students with the physical principles and operational mechanism involved in the use of medical imaging systems .
2. Understand the physics behind the working medical imaging modalities

3. Understand the working principle of Computed tomography
4. Analyze image quality in terms of spatial resolution, contrast, and noise
5. Understand the ethical and safety principle behind the use of ionizing radiation

Learning Outcomes:

Upon completion of this subject, students should be able to:

1. Understand the physics principles behind X-ray, CT, MRI and Ultrasound imaging systems
2. Evaluate image quality printed from imaging systems based on resolution and noise
3. Apply mathematical model to describe image formation and enhancement
4. Compare the strengths and limitations of different imaging techniques in clinical applications.
5. Understand safety standards for radiation exposure in medical imaging.

Course Contents:

Introduction to medical imaging systems: overview, historical perspective, basic principles. X-ray: physics of production, interaction with matter, application in diagnostic radiology. Computed Tomography: basic principles of CT imaging, components, design, clinical application. Ultrasound Imaging: physics of sound wave Doppler ultrasound and its clinical application, limitation in ultrasound imaging. Magnetic resonance imaging (MRI): principles, hardware (magnet), image formation, image processing techniques in MRI, safety considerations in MRI. Image quality and resolution: factors affecting image quality, technique for improving image quality, imaging processing technique. Radiation safety, ethical and legal consideration in the use of medical imaging. Clinical application of imaging in cardiology, neurology, oncology, and orthopedic. Emerging technologies in medical imaging. Advance technologies in medical imaging: advanced reconstruction algorithms, hybrid imaging systems, future trends in medical imaging.

Minimum Academic Standards

Well-equipped Biomedical lab with NUC-MAS requirement facilities

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.

BME 521: Biomedical Engineering Design (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. employ techniques and tools for the design of biomedical equipment, including innovative ones;
2. utilise engineering tools and software to develop and communicate design concepts;
3. use appropriate standard guidelines to define design inputs for a biomedical device design;
4. explain the design process and use it to develop a design concept for problem-solving;
5. recognise the classical engineering design process;
6. apply the design process in the design of biomedical devices;
7. fabricate biomedical devices applying standard scientific methodologies; and
8. discuss the importance of ethics in biomedical engineering.

Course Contents

Overview of Engineering Design: classical steps in engineering design - identify the need, research the problem, develop possible solutions, select the most promising solution, construct a prototype, test and evaluate the prototype, communicate the design, and redesign. Biomedical Devices: Introduction to biomedical devices; overview of biomedical device design. Biomedical Engineering Design methodology: design tools; design (project) team management; the design process; project definition; project design specification; materials selection. Biomedical engineering manufacturing: prototyping in biomedical device design; testing and optimisation of biomedical design; product documentation; project presentation; manufacturing and quality control. Ethico-legal issues in Biomedical Engineering Design: intellectual property management; regulation of biomedical devices.

BME 522: Equipment Reliability and Safety Technology (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. monitor equipment and assess its accuracy and reliability;
2. discern equipment reliability to equipment design;
3. employ all safety procedures to design and fabricate biomedical devices;
4. apply safety in the instrumentation of equipment; and
5. acknowledge quality assurance in equipment design.

Course Contents

Equipment reliability: Manufacturing and quality control; equipment (project) reliability; equipment maintainability and availability. Equipment safety: Safety consideration in equipment design – reliable equipment earthling reduction of leakage current and operation at low voltage. Safe instrumentation: Physiological effects of electricity, shock hazards, electrical safety codes and standards, power distribution protection, electric system testing. Quality assurance in equipment design.

BME 523: Biomedical Imaging Systems (3 Units C: LH 45)

Learning Outcomes

The student should be able to:

1. describe the relevant basic methods in applied medical image processing;
2. develop an understanding of biomedical imaging instruments to measure signals from biological systems.
3. appreciate the fundamental principles of advanced imaging concepts in fluorescence and nanoscale imaging to study molecular dynamics in living cells;
4. analyse and compare imaging systems for different biological levels: organs, tissues, cells, and molecules, justifying the pros and cons of each technique;
5. critique the design factors that contribute to the construction of advanced bioimaging systems with numerical calculations and physical concepts;
6. design and realise image processing algorithms for a range of applications, including noise cancellation, filtering, segmentation, and rendering;
7. demonstrate their knowledge of characteristics and applications of X-Rays, CT, NMRI, and ultrasound technology; and
8. apply the knowledge of biomedical imaging in medical therapy and rehabilitation.

Course Contents

Introduction to Radiation: review of physical concepts of radiation-atomic and nuclear structures, electromagnetic spectrum, x-ray production, radioactive decay; ionizing and nonionizing radiation; X-ray interaction. Radiation & Imaging Systems: X-rays - characteristics and applications; computerized tomography; technology and applications; gamma camera; nuclear magnetic resonance imaging; systems and applications; ultrasound imaging. Basic

radiobiology: radiation dosimetry and protection; Legislation and regulations for radiation protection.

BME 524: Biomedical Signal Processing (3 Units E: LH 45)

Learning Outcomes

Upon completion of the subject, students should be able to:

1. extract useful information from a biomedical signal;
2. demonstrate an understanding of signal representation and processing across a range of biomedical devices;
3. apply advanced knowledge in biomedical image processing to develop and implement biomedical algorithms for processing biomedical images and critically interpret their success;
4. appreciate the mathematical principles of continuous and digital signal processing;
5. apply specific mathematical techniques to solve problems in the area of biomedical signals; and
6. describe the origin, properties, and suitable models of important biological signals such as ECG, EEG.

Course Contents

Signals: What is a signal? History; categories; application fields. Biomedical Signals: nature, sources, types and examples. Signal Processing: Definition, Stochastic and deterministic signals, Discrete signals, Linear time invariant systems, Duality of time and frequency domain, Hypotheses testing. Biomedical signal Processing: Brain signals-local field potentials(LFP), electrocorticogram, (ECG), electroencephalogram (EEG), and magnetoencephalogram(MEG); Heart signals - Electrocardiogram, Heart rate variability, Fetal ECG; Electromyogram; Gastro-intestinal signals; Acoustic signals. Modeling Biomedical Systems.

BME 526: Computer-Aided Design of Biomedical Systems (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. apply the computer to generate a graphical representation of the human body;

2. use the medium of drawing in engineering communications;
3. describe the general principles involved in the use of engineering drawing;
4. demonstrate skills in computer-aided draughting to produce detailed 2D and 3D drawings;
5. design biomedical engineering products using CAD tools, with engineering drawings as the medium of effective communication;
6. demonstrate skills in interpreting and producing engineering drawing accurately and efficiently; and
7. comprehend the applications of CAD in medical imaging, diagnosis of diseases, etc.

Course Contents

Computer Aided Design (CAD): Introduction; basic principles of CAD; CAD hardware and software; the drawing tools; design management; introduction to 3-dimensional (3-D) design; 3D modeling; the printing and plotting process. Design of biomedical systems: Use of CAD in the design of medical equipment. Practical applications - Biomedical applications of CAD: applications in medical imaging; applications in medical diagnosis of various diseases e.g. lung diseases, breast cancer, stroke, sleep disorder, epilepsy, liver cancer, microcalcifications, and artery disease.

SUMAS-BME 522: Cardiovascular mechanics (2 Units; E; LH:30)

Senate-approved Relevance

Training of high-quality biomedical engineering students *with* analytical skills to assess and evaluate the needs of patients with cardiovascular challenges is in accordance with SUMAS's mission to improve the quality of life for all. Through the requisite skill of modelling blood flow and mechanical forces in cardiovascular system, individuals with cardiovascular issues would be better assisted. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to use engineering principles to develop technological solutions and devices to assist people with cardiovascular challenges recover heart functions lost because of disease or injury in our disease-ridden environment.

Course overview

The course cardiovascular fluid mechanics focuses on fluid mechanical phenomena that occur in the human cardiovascular system. After a physiological introduction, a short review of the equations governing fluid mechanics is given, including the main concepts determining the constitutive equations for both blood and arterial wall. After a brief review of cardiovascular physiology and fluid mechanics, the course will progress from modeling blood flow and mechanical forces in a.) Small-scale steady flow applications to b.) Small-scale pulsatile applications to c.) Large-scale or complex pulsatile flow applications. The course will also discuss how to calculate mechanical forces on cardiovascular tissue (blood vessels, the heart) and cardiovascular cells (endothelial cells, platelets, red and white blood cells), and the effects of those forces. Lastly, the course will focus on the biomechanical issues present in selected medical devices (heart valves, ventricular assist devices, artificial lungs).

Objectives

The objectives of the course are to:

1. demonstrate an overall understanding of biological and physiological interactions in the cardiovascular system, and predict system behaviours in response to hypothetical scenarios.
2. identify relevant cardiovascular anatomy in medical imaging data (ie. magnetic resonance imaging, computed tomography, etc).
3. modify and design computational circuit models which mimic cardiovascular physiology.
4. apply appropriate considerations of cardiovascular biology/physiology in medical device design.
5. comprehend and synthesize primary literature in biomedical engineering and medicine.

Learning Outcomes

Upon completion of the subject, students should be able to:

1. explain the biological and physiological interactions in cardiovascular system.
2. interpret cardiovascular medical image data.
3. evaluate circuit models which mimic cardiovascular physiology.
4. design cardiovascular medical device.
5. apply the existing foundational understanding of engineering to a greater range and depth suitable for a research, clinical or industrial environment.

Course contents

Cardiovascular Anatomy Review. Cardiac Physiology and Biomechanics Modeling. Vascular Structure and Biomechanics. Lumped-parameter Cardiovascular Models. 1D Theory of Blood Flow. Multi-scale Computational Modeling. Blood Properties, Functions, and Behaviours. Cardiac Electrophysiology. Biomechanics in Cardiovascular Diseases. Auto-Regulation and Exercise Conditions. In-vitro Experimental Techniques. Medical Imaging. Blood flow and mechanical forces in the cardiovascular system modelling. Mechanical forces on cardiovascular tissue (blood vessels, the heart) and cardiovascular cells (endothelial cells, platelets, red and white blood cells). Biomechanical issues present in selected medical devices (heart valves, ventricular assist devices, artificial lungs).

Minimum Academic Standards

Well-equipped rehabilitation engineering lab with NUC-MAS requirement facilities

SUMAS-BME 528: Dental Material Science (2 units; C; LH:15, PH:45)

Senate-approved Relevance

Training of high-quality biomedical engineering students with knowledge and skills to develop, manipulate, care, and evaluate materials used in the treatment and prevention of dental diseases, in accordance with SUMAS's mission to improve the quality of life for all. through ensuring Nigerians enjoy healthy oral health. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering having the capacity to understand biomechanical function, physical and chemical properties, and biocompatibility of dental materials; fabricate, manipulate and apply these materials to treat dental diseases such the prevailing periodontal diseases in Nigeria.

Course Overview

Dental Materials is the study of material composition, properties, and the manner in which they interact with their oral environments. The knowledge of dental materials is important to

biomedical engineering students as it enables them to make optimal selection of various dental materials, understand their behavior, deployment, handling and manipulation and safety considerations. This course provides a comprehensive study of dental materials, including the properties and manipulation, biomechanical function, physical and chemical properties, and biocompatibility of dental materials. The study enables the dentist to understand the behaviour of these materials and how to use them to their best advantage.

Objectives

The objectives of the course are to:

- 1. expose students to various categories of dental materials**
- 2. demonstrate an understanding of the dental metals and other materials used in dentistry**
- 3. explain the properties and uses of the various dental materials**
- 4. discuss and demonstrate the procedure for testing of dental materials**
- 5. introduce of students to history of the materials used to produce dental**
- 6. introduce students to tooth morphology and the elements of occlusion**
- 7. expose students to instruments and techniques used to model wax teeth**
- 8. construct life size wax patterns of occluding teeth surfaces.**

Learning Outcomes

Upon completion of the subject, students should be able to:

1. discuss the chemical, physical, and biological properties of various dental materials
2. demonstrate and explain the various uses of gypsum
3. explain the uses and properties of the various categories of dental impression materials
4. explain the rationale and process of gingival retraction used in taking prosthetic impressions
5. explain and demonstrate the use of irreversible hydrocolloid impression material
6. explain the process of the production of diagnostic study casts and their purpose
7. demonstrate the procedure for the fabrication of study casts

8. identify the uses of dental resins and ceramics and their relevance to the practice of dental hygiene
9. explain the basic science of dental resin polymerization and the uses of the various dental resins

Course Content

To study physical and chemical properties of materials used in dental appliance construction. Testing and comparisons of dental materials. Identify and recognizes the history of the materials used to produce dental. An introduction to tooth morphology and the elements of occlusion. Materials, instruments and techniques will be used to model oversized wax teeth. Life size wax patterns of occluding teeth surfaces will be constructed.

Minimum Academic Standards

Well-equipped dental materials lab with NUC-MAS requirement facilities having some of the following small equipments:

- Dental Amalgamators
- Dental Articulators & Articulating Supplies
- Dental Ceramics & Porcelain
- Dental Electrosurgery & Accessories
- Dental Gypsum
- Dental Intraoral Cameras
- Dental Mixing Machines
- Dental Ovens & Furnaces
- Dental Sandblasting Equipment
- Dental Soldering Equipment
- Dental Vibrators.

SUMAS-BME 541: Biomedical Signals and Systems (2 units, E, LH:15, PH:45)

Senate-approved Relevance

Training of high-quality biomedical engineering students with the knowledge and skills to apply

system theory and computational tools to improve diagnostics, monitoring, and treatment in healthcare, in line with SUMAS's mission to improve the quality of life for all. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering having the knowledge, skills, and abilities to handle complex signal processing tasks for the interpretation of biomedical data, such as ECG, and EEG signals, in Nigeria clinics.

Course Overview

This course introduces biomedical engineering students to the mathematical foundation and computational techniques for analyzing continuous-time and discrete-time signals. Key concepts in linear time-invariant systems, impulse response, convolution, filtering, sampling theory, and the Fourier transform are explored. Students will be trained on efficient algorithms such as the Fast Fourier Transform (FFT) to implement signal processing techniques in various applications including speech, biomedical imaging, sensor networks, and communication systems. The foundation for signal processing, communications, and control systems are designed in this course.

Objectives:

The objectives of the course are to:

1. Equip students with real-world problems skills in the field of biomedical imaging, speech processing, and sensor networks using computational techniques.

2. Design filters and other signal processing systems to meet specific need in biomedical settings.
3. Manipulate signals using tools such as Fourier transforms and convolution
4. Use mathematical techniques to analyze continuous-time and discrete-time signals and systems.

Learning Outcomes:

Upon completion of this course, students should be able to:

1. Analyze signal processing using computational tools for simulation
2. Use Fourier Transform and Fast Fourier Transform (FFT) to perform signal processing tasks
3. Identify, and analyze linear systems in time domains.
4. Discuss and describe BME signals in the context of sensing, activation, and transduction as well as their diagnostic application.

Course contents:

Introduction to biomedical signals and systems: overview of biomedical signals (ECG, EEG), continuous-time vs discrete-time signals, signal processing in biomedical applications. Continuous-time and discrete-time signals: properties (periodic, aperiodic, random, etc), operations (scaling, shifting, inversion), system properties (linearity, time-invariance, etc). Linear time-invariant systems (LTI): definition, examples, impulse response and convolution in continuous-time systems, Discrete-time LTI systems - difference equation and convolution sum. Fourier series for periodic signals, Fourier transform for continuous-time and discrete-time signals, properties for Fourier transform. Discrete Fourier Transform (DFT) and its computational aspect. Sampling theory, Z-transform and its application. Digital filters design: FIR and IIR filter techniques. Biomedical signal processing application. Basic concepts in image

processing. Use of signal processing technique in medical imaging (MRI, CT). Speech and multimedia signal processing. Introduction to communication and sensor networks: signal processing, sensor network, examples of biomedical sensor and wearable technology.

SUMAS-BME 541: Biomaterial Host Interactions in Regenerative Medicine (2 units, C, LH:15, PH:45)

Senate-approved Relevance

Training of high-quality biomedical engineering students with the knowledge and skills in the use of biomaterials in advancing regenerative medicine, promoting innovation that supports the healing and functional restoration of tissues through strategic biomaterial design and application, following SUMAS's mission of improving quality of life for all, through innovative biomaterial design. Relevance is seen in the capacity of SUMAS graduates of biomedical engineering to have appropriate skills and knowledge in the design of Biomaterials that can assist in the regeneration of different disease conditions including orthopedic, etc. students will be trained to analyze and control host responses with emphasis on biocompatibility and more.

Course Overview:

This course offers biomedical engineering students an in-depth understanding of biomaterials interaction with host tissues in the context of regenerative medicine. SUMAS's biomedical engineering students will be trained on the theoretical and practical analysis of host responses to synthetic and natural biomaterials with emphasis on biocompatibility, immune interaction, and tissue engineering.

Objectives:

The objectives of the course is to:

1. Train students on the theoretical and practical laboratory experience in biomaterial characterization.
2. Analyze how different synthetic and natural biomaterials influence tissue engineering.
3. Understand how host tissue responds to biomaterials using laboratory techniques

4. Explore different strategies for optimizing biomaterial-host interactions in regenerative medicine.
5. Understand the principles behind biomaterial-host interactions.

Learning Outcomes:

Upon completion of this course, students should be able to:

1. Have the knowledge of biomaterials properties and their impact on tissue response
2. Explain the immune system interaction with biomaterials
3. Understand the strategies for enhancing biomaterial biocompatibility used in regenerative medicine.
4. Have the knowledge of different techniques used for the characterization of biomaterials used in regenerative medicine.

Course contents:

Introduction to biomaterials in regenerative medicine: overview, types of synthetic and natural biomaterials, application in Tissue Engineering and regenerative medicine. Host response to biomaterials: inflammatory response, acute and chronic immune response, mechanism of foreign body reactions. Biocompatibility of biomaterials: definition, importance, factors affecting biocompatibility, case studies on biomaterials biocompatibility. Immune cells and their role in biomaterial interaction, immunomodulation by biomaterials, strategies to minimize immune reactions. Tissue healing and regeneration: Phases of tissue healing, impact of biomaterials on wound healing, regenerative process with biomaterials. Synthetic biomaterials and host interactions. Natural biomaterials and host interactions. Case studies on synthetic, natural biomaterials. Introduction to cell culture for biomaterials, techniques for culturing cells with biomaterials. Optical and Electron microscopy for biomaterial evaluation. Imaging host-biomaterial interactions. Strategies to control host-biomaterial interactions: surface modification,

drug delivery, future trends. Case studies of biomaterials in regenerative medicine: review of clinical applications, successes and challenges in biomaterial research.

Minimum Academic Standards Equipment

Well-equipped equipment biomaterials lab with NUC-MAS requirement facilities

.

SUMAS-BME 541: Stem Cell Engineering (2 units, C, LH:15, PH:45)

Senate-approved Relevance:

Training of high-quality biomedical engineering students with a thorough understanding of the engineering principles, biological foundations, and clinical applications of stem cell technologies. Under SUMAS's mission to improve the quality of life for all through technological innovations that address medical challenges in a resource-limited environment, this course aims to equip SUMAS biomedical engineering students with the skills and understanding to innovate and apply stem cells to address real-world medical challenges. By fostering critical thinking and practical skills, students will be prepared to contribute to advancements in regenerative medicine and to address pressing health issues using sustainable, locally relevant solutions.

Course Overview:

This course Stem Cell Engineering focuses on the principles and application of stem cells in biomedical engineering. The fundamentals of stem cell biology, as well as the engineering tools used for the study, and manipulation of stem cells, will be covered. Emphasis will be on their application to regenerative medicine and tissue engineering. Ethical, clinical, and translation aspects of stem cell Engineering will be taught to biomedical engineering students with a special focus on future biomedical applications.

Objectives:

The objectives of this course are to:

1. Explore the biological properties of various types of stem cells.
2. Expose students to the methods used for the isolation, culturing, and differentiation of

stem cells.

3. Have an analytical knowledge on the engineering techniques applied in the manipulation of stem cells
4. Have a critical knowledge on the ethical and regulatory considerations surrounding stem cell research.

Learning Outcomes:

Upon completion of this course, students should be able to:

1. Analyze the roles of engineering in stem cell manipulation and the application in medicine.
2. Demonstrate an understanding of stem cell biology
3. Understand the therapeutic potential of stem cells.
4. Discuss the ethical, legal, and regulatory implications of stem cell use in medicine
5. Identify some of the challenges facing stem cell applications in medicine in developing countries and provide solutions.

Course contents:

Introduction to stem cell: definition, types, history, importance in medicine. Molecular and cellular characterization of stem cells. Methods for stem cell isolation, culture techniques, and challenges in culturing stem cell. Stem cell engineering and manipulation: genetic engineering, CRISPR-Cas9. Role of stem cell in regenerative medicine and tissue repair. Applications in bone regeneration. Induced pluripotent stem cells. Disease modelling and drug screening using stem cells. Stem cells in neurodegenerative diseases. Stem cells in cardiovascular diseases. Ethical and regulatory issues in stem cell engineering. Translational challenges in stem cell therapy. Stem cell engineering in African healthcare. Future directions in stem cell.

Minimum Academic Standards

Equipment

Well-equipped stem cell lab with NUC-MAS requirement facilities.

SUMAS-BME 594 Biomedical Engineering Project II, 6 Credits

Second phase of research investigations involving the implementation of the designed model; debugging; calibration, testing, data collection and analysis; presentation of a comprehensive emulation of the problem, theoretical investigations, analysis, modeling, design and simulation.

Equipments

Minimum Academic Standard

The professional skills necessary to practice biomedical engineering can be acquired first and foremost from the training using institutional facilities designed and equipped to stimulate the practice of the profession. It should, therefore, be adequate in quality and quantity. The number of laboratories each department has will depend on the number of biomedical engineering specialty options offered. As an example:

1. A one- option department is expected to have one standard multi-specialty workshop and one standard inter-disciplinary laboratory.
2. A two- option department is expected to have one standard multi-specialty workshop and two standard specialty laboratories (reflecting the two options).
3. A three- option department is expected to have one standard multi-specialty workshop and three standard specialty laboratories (reflecting the three options).

List of Workshops/Laboratories/Equipment/Instruments/Tools

General Biomedical Engineering Workshop

1. Lathe machine;
2. Hand tools;
3. Drilling machine;
4. Hand machine;
5. Grinding machine;
6. Folding machine;
7. Work tables and table vices;
8. Standard toolbox for mechanics, electricians and biomedics;
9. Gas and arc welding machines and accessories, and casting facilities;
10. Saw: hack, radial, circular, panel, rip - blade diameter- 400mm with external blades;
11. Marking gauge;
12. Chisel: different sets;
13. Clamp: C-, F- etc;
14. Extra knives carpentry machine planer and thicknesser;
15. Air compressor – for spraying; tank capacity 500 litres complete with accessories - type
spray gun and air blow-gun;
16. Battery: tester, charger and service equipment

Bioengineering/Biotechnology Laboratory Bioinstrumentation Unit

1. CFX96 real-time PCR;
2. Protein/nucleic acid electrophoresis system;
3. UV/VIS spectrophotometre with nanovette;
4. Differential scanning calorimetre (DSC);
5. Semi-dry blotting system with power supply;
6. Impedance aAnalyseAnalyser system with PC;
7. Wet blotting system;
8. Molecular imager;
9. Analog/digital multimetre;
10. Signal generator;
11. Multiple input oscilloscopes; and
12. Relevant analysis software and hardware

Biorheology Unit

1. Spectrophotometre;
2. Turbid, pH metre;
3. Conductivity metre, colourimetre;
4. Digital rotary, viscometre, thermogravimetric aAnalyseAnalyser;

5. Digital thermometer (-50 - 1000°C) with asphalt needle probe 3 mm long;
6. Ion chromatograph equipment;
7. Solid/liquid extraction unit (complete);
8. Filtration unit with plate and frame filter unit Fluid bed dryer, digital;
9. Film and dropwise equipment;
10. Fractional distillation column;
11. Laboratory scale spray dryer;
12. Distillation column (computer interfaced distillation column);
13. Water bath;
14. Autoclave; and
15. Centrifuge.

Biomedical Informatics Laboratory

Digital Unit

1. Digital oscilloscope;
2. Logical circuit EX board A, B;
3. Logic tutor EX board;
4. Basic electrical and electronic application EX board B;
5. Digital system;
6. Project board; and

7. Digital data formatting

Modeling and Simulation Laboratory

1. High-Performance Server
2. Workstations
3. Software licenses-fluent, comsol, etc
4. Routers
5. Switches
6. Servers
7. Large format printer

Computer-Aided Design Unit

1. Computation tool on finite elements such as CATIA; NASTRAN; ABAQUS; IDEAS;
2. MATLAB; ANSYS, PDMS;
3. Workstations (at least one (1) workstation to five (5) students);
4. Printer;
5. Multimedia facilities;
6. Most importantly, the laboratory is expected to install software packages such as AutoCAD for drawing and other specialised packages for virtual laboratory.

Computer-Aided Manufacture

1. CNC machines (lathe, milling, drilling, etc)

Bioprocess Engineering Laboratory

Bioinstrumentation Unit Equipment

1. CFX96 real-time PCR;
2. Protein electrophoresis system;
3. UV/VIS spectrophotometre with nanovette;
4. Nucleic acids electrophoresis system;
5. Differential scanning calorimetre (DSC);
6. Wet/semi-dry blotting system with power supply;
7. Impedance Analyseanalyser system with PC;
8. Impedance Analyseanalyser system with PC;
9. CO2 incubator;
10. Molecular imager;
11. Analog/digital voltmeter;
12. Signal generator;
13. Multiple input oscilloscopes; and
14. Relevant analysis software and hardware.

Clinical Engineering/Medical Engineering/Dental Engineering

Instrumentation Laboratory

1. Control and instrumentation principles(FULL KIT);
2. Analogue and digital control board;
3. Transducers kit: electromechanical, heat, light, etc;
4. Measurement equipment;
5. Precision Modular Servo Control System;
6. Input/Output Potentiometre Unit;
7. Operational Amplifier Unit;
8. Power supply unit;
9. Function/signal generators;
10. Software upgrade to MATLAB 7.XX;
11. NI: cable assembly, interface card;
12. PID unit;
13. Wattmetre;
14. Transfer function analyser;
15. Logic probe /pulser;
16. Resistance /capacitance box

Control Laboratory

1. Process control simulation apparatus

2. Pressure control apparatus

Digital Unit

1. Digital logic analyser

2. Smart logic design experimental kit

3. Digital logic circuit design experiment kit microcomputer trainer

4. AM/FM transmitters and receivers system trainer

5. Programmable logic controller system trainer

6. Analog/digital storage colour display 2/4-channel oscilloscope

7. Arbitrary waveform and Digital Synthesized function Generator

8. Digital spectrum Analyseanalyser (9kHz -3GHz)

9. Instrumentation trainer using transducers complete set

10. Analog/digital communication system trainer

11. Electrical and electronic system trainer

12. Power electronic training system

13. Training kit universal EPROM programmable (48 pins)

14. Bench digital multi-metre digit (various digit ranges)

15. Advanced frequency modulation and demodulation train

16. Decade box: resistance, capacitance, inductance

17. Photo/contact tachometre

18. Portable DC potentiometre

19. PCB Fabrication equipment complete set

Fluid Mechanics Unit

1. Manometres

2. Apparatus for hydrostatic forces on plane and curved surfaces

3. Forced vortex apparatus

4. Stability of floating bodies

5. Hydraulic test benches

6. Apparatus for head losses in pipe fittings

7. Apparatus for the flow of fluid around bodies

8. Hydraulic power circuitry and measurement units

9. Centrifugal pump system

10. Calibration and performance of flow measurement devices

Neural, Regeneration, and Rehabilitation Engineering

Biomechanics Unit

1. Cleve lab virtual instruments

2. Human arm model with angle sensors

3. Goniometre(probe + velero straps)

4. Conductivity sensor and dissolved oxygen

5. Respiration rate sensors

6. Bicycle ergometre

Tissue and Regeneration Medicine Unit

Equipment (Cell Culture Lab)

1. Biosafety (laminar flow hoods) cabinet Type All with stands

2. Incubators

3. Inverted microscopes with digital cameras and PC + cell counting sets

4. Orbital shaker, vortexer, water baths, pH metre, micropipettes, balance

5. Nano ure water system, autoclave liquid N2 storage, microplate reader, and - 80 freezer

6. Protein electrophoresis system

7. Nucleic acids electrophoresis system

8. Cryotome

9. Lab fluoroscopic imaging microscopes

10. Support equipment employed in cell culture and Analysis

Pharmaceutical Engineering

1. Automated biochemical Analyseanalyser

2. Automated cell counter

3. Cell harvesting system

4. Gel electrophoresis instrument

5. Flow cytometry

6. Gas chromatograph mass spectrometre / GC MS instrument

New

PCR Technology

1. DNA thermal cycler / PCR instrument

2. Gradient PCR machine

3. PCR workstation / PCR cabinet

4. PH transmitter

5. Pharmaceutical tablet testing equipment

6. Disintegration tester /disintegration apparatus

7. Dissolution media preparation system

8. Dissolution sampler/dissolution sampling system

9. Electrophysiology equipment

10. Portable laboratory equipment/field testing equipment

11. Handheld XRF Analyser

12. Portable balances.

Staffing

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 equivalent 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 equivalents of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals 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.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals 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. 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 staffs that are computer literate.

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.

Library

There should be:

1. a section for biomedical engineering books, journals and other resource materials in the University library;
2. an electronic library section with some online databases relevant to the biomedical engineering degree programme in the University library;
3. a departmental library with books journals, and other resource materials for biomedical engineering.

LIST OF SUMAS CCMAS TECHNICAL REVIEWER COMMITTEE FOR ENGINEERING & BUILT ENVIRONMENT

- | | | |
|----------------------|--------------------------------------|-----------------------------|
| 1.Prof. E.I.Ugwuja | Biological Sciences | Senate Chairman CCMAS |
| 2. Prof. L.U.Anih | Electrical & Electronics Engineering | Chairman Technical Reviewer |
| 3. Dr.S.O. Ogbonna | Mechanical Engineering | Faculty Chairman |
| 4. Dr. D.C. Ezema | Electrical & Electronics Engineering | Member |
| 5. Engr. N.P. Okozor | Computer /Biomedical Engineering | Member |
| 6. Engr. B.C. Ezea | Civil Engineering | Member |
| 7. Engr. M.O. Ugwoke | Chemical Engineering | Member |
| 8. Arch.J.O. Ezugwu | Architecture | Member |

BIOMEDICAL ENGINEERING DEPARTMENT

THE PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Biomedical Engineering Department established the following educational objectives of the programme in support of the vision and mission of the University. Graduates are expected to be able to attain the following objectives within 5 years following graduation:

PEO1: Apply biomedical engineering knowledge and skills to analyse, design, and solve complex healthcare and engineering problems to world-class standards.

PEO2: Conduct innovative research and develop creative biomedical technologies that advance healthcare delivery and contribute to medical and clinical progress.

PEO3: Address Nigeria's healthcare, technological, and socioeconomic needs through safe, sustainable, and culturally sensitive biomedical engineering solutions.

PEO4: Demonstrate professional integrity, ethical practice, and effective leadership within multidisciplinary biomedical, clinical, and engineering environments.

PEO5: Apply entrepreneurial thinking and commit to lifelong learning, adapting to evolving biomedical technologies and contributing to industry and national development.

PROGRAMME OUTCOMES (POs)

PO1	Engineering Knowledge: apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of developmental and complex engineering problems
PO2	Problem Analysis: identify, formulate, research literature and analyze developmental and complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
PO2.1	Demonstrate ability to solve problems by concepts through the integration of mathematics, science and engineering.
PO2.2	Demonstrate skill in identifying vital information from resources in solving problems.
PO2.3	Demonstrate skill and appropriate technique and ingenuity in solving developmental or engineering problems.
PO3	Design/Development of Solutions: proffer solutions for developmental or complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations
PO3.1	Demonstrate understanding of the impact of engineering decisions and solutions to societal issues.
PO3.2	Demonstrate understanding of solutions to cultural diversity based on our local context in Nigeria.
PO3.3	Demonstrate knowledge of the implications of engineering designs and solutions to the public health and safety of all.
PO4	Investigation: conduct investigation into developmental or complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO4.1	Demonstrate ability to appropriately set-up and conduct experiment to understand and extract underlining and fundamental principles.
PO4.2	Demonstrate ability to apply statistical tools in designing and analyzing experiments.
PO4.3	Demonstrate skill in applying the appropriate research method in solving engineering problems.
PO5	Modern Tool Usage: create, select and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modeling and optimization to developmental and complex engineering activities, with an understanding of the limitations
PO5.1	Demonstrate an understanding of the inherent limitations of software (application) tools, and analytical and numerical techniques.
PO5.2	Demonstrate ability to identify and apply appropriate techniques in investigating and solving problems of engineering relevance.

PO5.3	Demonstrate capability and proficiency in using modern and ICT tools to solve engineering problems.
PO6	The Engineer and Society: apply reasoning informed by contextual knowledge including Humanities and Social Sciences to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice
PO6.1	Demonstrate awareness of legal implications of professional engineering practice.
PO6.2	Demonstrate understanding of the required contribution of engineers to the society.
PO7	Environment and Sustainability: understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
PO7.1	Demonstrate an understanding of the impact of engineering solutions on the society and environment.
PO7.2	Demonstrate ability to recognize and evaluate the ethical dilemmas that may arise in the workplace.
PO8	Ethics: apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice, including adherence to the COREN Engineers Code of Conducts
PO8.1	Demonstrate knowledge and understanding of the COREN Engineers Code of Conduct.
PO8.2	Demonstrate ability to apply professional responsibilities and norms of engineering practice.
PO8.3	Demonstrate understanding and appreciation of diversity.
PO9	Individual and Team Work: function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO9.1	Demonstrate knowledge and understanding in completing set goals and plan tasks
PO9.2	Demonstrate understanding in apply, using skills acquired to examine and adopt ideas as a member or team lead
PO9.3	Demonstrate the ability to work with other engineering discipline or multi-disciplinary settings
PO10	Communication: communicate effectively on developmental or complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO10.1	Demonstrate the skills to communicate within the engineering society and outside engineering profession
PO10.2	Demonstrate the ability to make presentations and be able to communicate the society at large
PO10.3	Demonstrate the ability to use appropriate presentation methods for effective

	communication and follow clear instructions.
PO11	Project Management: demonstrate knowledge and understanding of engineering, management and financial principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments
PO11.1	Demonstrate the ability to conduct, manager and execute projects in multi-disciplinary areas
PO11.2	Demonstrate the ability to work within the budget when executing a project for proper management
PO11.3	Demonstrate recognition or the skills needed for project management
PO12	Lifelong Learning: recognize the need for, and have the preparations and ability to engage in independent and lifelong learning in the broadest context of technological and social changes.
PO12.1	Demonstrate the ability to learn new technology or techniques that will be used for solving life problems and professional development activities
PO12.2	Demonstrate the ability to apply knowledge acquired from teaching, professional journals and industry publications to improve processes and systems