

STATE UNIVERSITY OF MEDICAL AND APPLIED SCIENCES, IGBO-ENO, ENUGU STATE

**FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
DEPARTMENT OF MECHANICAL ENGINEERING**



STUDENTS' HANDBOOK

UNDERGRADUATE DEGREE PROGRAMME

2024

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Principal Officers of the University

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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 programmes 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 fulltime 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: In pursuit 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 endeavour 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 endeavouring to alleviate their pains.

Service: Commitment to the wellbeing 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 fulfil 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.

Introduction

Mechanical Engineering is one of the oldest engineering disciplines in the world. It has strong relationship with virtually all other engineering disciplines.

The history of mechanical engineering dates to ancient Greece and China where mechanisms like screw pumps, steam engines, clocks, seismometers and even differential gears were invented.

Chain drives, escarpments, crankshafts and camshafts date to the Middle Ages.

Mechanical Engineering turned analytical with the Newton’s law of motion and invention of calculus.

We can thus define Mechanical Engineering as the discipline that applies the principles of engineering mathematics, physics and material science, etc. for the design, analysis, manufacturing and maintenance of mechanical systems. It is the branch of engineering that involves the design, production and operation of machinery. It seeks to improve the quality of life by providing knowledge and expertise in the areas of mechanical process, plant design, operation and process ergonomics. Mechanical Engineers create and

develop mechanical systems for all mankind. The department offers courses leading to the award of Bachelor of Engineering (B.Eng.). It is hoped that at the appropriate time, the department will commence postgraduate studies leading to the award of Master's Degree (M.Eng.) and Doctor of Philosophy (Ph.D.) in Mechanical Engineering.

Overview

This curriculum was prepared in compliance with the Core Curriculum and Minimum Academic Standards (CCMAS) for the education and training of students studying for first degree in the programme of the Mechanical Engineering discipline in the Nigerian University System. The components of the minimum standards described here will enable the graduates of the programme to acquire sufficient theoretical and practical knowledge to contribute to national advancement and be competitive in the globalized environment.

Philosophy of B.Eng. Mechanical Engineering

Engineering profession per se is as old as man himself. This is because although formal engineering had its origin in the west, the third world also unknowingly had its own brand of engineering, though crude and undeveloped then.

For instance, the first and simplest machine the lever system had long been invented and used in Africa, in fact, in Nigeria through the skill of climbing palm tree by the local palm wine tapers. The challenges in engineering are numerous ranging from construction and improving on these through research.

The philosophy of Mechanical Engineering programme in State University of Medical and Applied Sciences is to produce well-trained programmed graduate professionals equipped with sufficient theoretical background, practical background and design skills necessary for complete engineering practice comprising management, among others. The curriculum is therefore designed to develop those engineering skills for manpower development for providing solutions to address the emerging challenges of self-reliance through industrial and national development.

In every programme, there must be a goal set aside to be achieved. The fundamental objectives of this programme is to train and produce graduates who having been well grounded in science, can and will apply the knowledge of this science to practical use through engineering. Hence, the specific aims of the programme are to produce well trained Mechanical Engineers who can:

- I. Design and make components, machines, equipment and systems with local and advanced raw materials, and meet international standards.
- II. Install and maintain engineering systems that will perform optimally in our local and advanced environment.
- III. Stimulate and develop the interest of the students in research through contact teachers and exposure to current engineering technologies and breakthroughs.
- IV. Be self-reliant and so enhance employment opportunities in our developing economy.
- V. Equip the students with the knowledge and techniques of maintenance and management of engineering projects and outfits.

Objectives

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

1. actively engage in engineering practice or in other fields, such as education, science, business, public policy, politics or governance for sustainable development;
2. retain intellectual curiosity that will motivate them to pursue meaningful lifelong learning via graduate education in engineering or related fields, participation in professional development and/or industrial training courses, and/or obtain engineering certification;

3. develop successful careers as mechanical engineers and apply their mechanical engineering education to address the full range of technical and societal problems with professional engineering competence, creativity, imagination, confidence and responsibility;
4. occupy positions of increasing responsibility and/or assignments and aspire to positions of leadership within their profession for enhanced community participation and qualitative service delivery; and
5. exhibit the highest ethical and professional standards, and, as agents of positive change, communicate the importance and excitement of Mechanical Engineering.

Programme

The students are expected to spend a total of five years to obtain the B.Eng. (Mechanical Engineering) Degree. The programme structure is as follows:

First Year: Common university courses which include the basic sciences of mathematics, physics and chemistry, introduction to computer and the general studies courses of use of English, social science and humanities. These are accomplished through the formal University lectures, practical, assignments and examinations.

Second Year: Common faculty of engineering courses which include fluid mechanics, engineering drawing, materials science, workshop processes and practice, strength of materials, thermodynamics, engineering mathematics, etc. These courses are accomplished through the formal University lectures, practical, tutorials, assignments and examinations.

Third Year: 300 level common engineering courses and 300 level Mechanical engineering core courses. These are accomplished through formal University lectures, tutorials, practical, assignments and examinations.

Fourth Year: 400 level courses Mechanical engineering courses are studied through the formal University lectures, tutorials, practical, assignments and examinations during the first semester and a six (6) month industrial attachment period (Students' Industrial Work Experience Scheme-SIWES) in the second semester.

Fifth Year: 500 level core Mechanical engineering courses which come in the form of specialization courses, research and design projects, including electives which tend to broaden the technological base of the programme. These are also accomplished through the formal University lectures, tutorials, practical, assignments and examinations. A final year B.Eng. thesis is submitted and defended by each graduating student.

Areas of Specialization and Research Activities

The following are areas of specialization offered by the department. These are also the focal areas of research and development activities in the department.

1. General
2. Workshop/Drawing/Design/Laboratory.
3. Project
4. Strength of Materials /Elasticity
5. Mechanics of Machines /Vibrations/Control.
6. Mechanics of Fluids
7. Thermodynamics.
8. Heat Transfer.
9. Law/Management/Technology Policy
10. Metallurgy
11. Etc

Students Industrial Work Experience Schemes (SIWES).

The SIWES programme provides a vital technological enrichment of formal engineering education. The Mechanical Engineering student undergoes a 6-month industrial attachment in the second semester of the 400 level.

Job Opportunities

The technological growth of any country depends to a large extent on the ingenuity of its high caliber technical manpower. For the well-trained and conscientious mechanical engineers, interesting and challenging job opportunities abound in Nigeria. These range from the design, development, operation and maintenance of plant, machinery and equipment, to the management of technical systems of man and machines. Mechanical engineers are urgently needed in such industrial sectors like Mechanical, Oil and Gas and Pharmaceutical Industries, Food Processing and Beverages and Breweries, Power Production and Generation and Metallurgy, Public Utilities, Construction Industries, Hospitals and Biomedical Engineering, Sanitary and Sewage, Defense Security, Industrial Standardization and Water Resources, Manufacturing and Metal Processing, Universities, Polytechnics and Research Institute

Admission and Graduation Requirements

Admission Requirements

Admission into the department may either be by Unified Tertiary Matriculation Examination (UTME) or Direct Entry (DE).

1. Five years Integrated Programme

The candidates seeking admission must satisfy all the University entry requirements including credit level passes in English Language, Mathematics, Physics, Chemistry and Biology or Agricultural Sciences in GCE, SSCE, NECO, NABTEB; obtained at not more than two sittings.

2. Direct Entry Candidates

Candidates seeking admission through Direct Entry will normally enroll in the second year of the programme. To qualify for admission, the candidates must satisfy the requirements as specified in (1) above. In addition, the candidates must have passed GCE Advanced Level or IJMB or JUPEB equivalent in at least two subjects, one of which must be Chemistry and either Physics or Mathematics. These passes in the two subjects must be obtained in one sitting. Candidates with OND must pass in good credit level.

3. Transfer Students

Transfer students from recognized Universities shall be admitted in accordance with the condition stipulated in the Undergraduate Academic Regulation of State University of Medical and Applied Sciences.

Deferment of Admission

Deferment of admission may be granted provided the candidate meets the University's policy on the deferment of admission.

B.Eng. Award Requirements

To be eligible for the award of B.Eng. Degree in Mechanical Engineering, the student must satisfy the following conditions:

- a. The stipulated University and Departmental entry requirements
- b. The approved requirements of the Faculty of Engineering and the Built Environment including General Studies with respect to work load, registration of courses, programme duration and full payment of all approved fees.

- c. The programme requirements include:
- Satisfactory completion of all approved courses.
 - Satisfactory completion of Industrial Attachment with a recognized institution/establishment/company.
 - The student must be found worthy in character.

Performance Evaluation Criteria

The students are examined by a combination of the following methods:

- Continuous Assessment
- Formal Semester Examination
- Laboratory and Industrial Training Reports
- Seminar and Project Presentation

An external Examiner is invited in the final year to assess the final year courses, projects and to certify the overall performance of the graduating students as well as the quality of teaching.

Approved Scoring and Grading System

- Every course is continuously assessed using quizzes, tests, assignments and they carry 30 marks of the total score for the course and are administered during lecture period (before the semester examination).
- The entire semester's work is further assessed during the semester examination
- The final score obtained by the student in a particular course is thus the sum of what the student obtained in both continuous assessment and semester examination in that course.
- All registered courses other than those audited are to be passed by the student
- Grade points earned in all attempts are used for computation of the Cumulative Grade Point Average (CGPA).
- Students are not permitted to repeat any course which they have passed.

Classification of the Degrees Awarded by the University

The system employed in the calculation of class of degree is based on CGPA and is depicted in the Table below.

Table 1: Score and Grade Point (GP) for GPA/CGPA Calculations

(i) Credit Units	(ii) Percentage Score	(iii) Letter Grade	(iv) Grade Point (GP)	(v) Grade Point Average (GPA)	(vi) Cumulative Grade Point Average (CGPA)
Vary according to contact hours assigned to each course per week per semester and according to students' work load	70-100 60-69 50-59 45-49 40-44 0-43	A B C D E F	5 4 3 2 1 0	Derived by multiplying (i) by (iv).	Derived by multiplying (i) by (iv) and dividing by total credit units

The total score for a course is obtained by adding the score made by the student in the Continuous Assessment (maximum of 30 marks) and in the examination (maximum of 70 marks).

Table 2: Degree Classifications Based on CGPA

Cumulative Grade Point Average (CGPA)	Class of Degree
4.5-5.00	First Class
3.5-4.49	2 nd Class Upper
2.4-3.49	2 nd Class Lower
1.5-2.39	Third Class
<1.5	Fail

Registration of Courses

- Students are required at the beginning of every session to register the courses approved for their level.
- The University has designated periods for normal and late registration of courses every session. Usually, late registration attracts penalty.
- Students are advised to go to the staff (course Adviser) assigned to their level for proper guidance on registration of courses.
- Students are not allowed to sit for examination in courses for which they had not earlier registered. If the student succeeds in sitting for the examination without notice, the result obtained will not be used in the computation of Grade Point Average (GPA).
- Failed courses must be registered before the level ones.

Course Loading

The normal course credit load for a full-time range from 18 (minimum) to 24 (maximum) units per semester. By implication, no students are allowed to register less or above the stipulated credit units in a semester. The total credit units for both failed courses and current courses must not exceed the set maximum.

Academic Advising

Students counseling is of primary importance at the Departmental level. Department course advisers are appointed for every class of the programme. The students are advised to consult the course advisers first on most issues.

Class Attendance

Students are encouraged to attend lectures and do all their prescribed assignments as required. However, a minimum of 75% attendance to lectures and practical sessions is required for a student to be eligible to write the semester examination in each course.

Continuation, Probation and Withdrawal

- Continuation: A student shall be allowed to continue in his/her programme if at the end of the session, he/she makes a CGPA of 1.00 or above.

- b. Probation: A student shall be placed on probation for a period of one academic session if at the end of the session he/she makes a CGPA of less than 1.00,
- c. Withdrawal: A student shall withdraw from the programme if at the end of the probation period he/she fails to make a CGPA of 1.00 and above.
- d. Temporary Withdrawal on health ground or any other accepted reason may be allowed but not for a period of more than two academic session. Procedure for such temporary withdrawal shall be as explained in the Undergraduate Academic Regulation of State University of Medical and Applied Sciences.
- e. Any student who withdraws from his/her programme without formal approval shall be deemed to have abandoned the programme and shall therefore not be re-admitted into the programme.

Duration of Programme

A minimum of five years and a maximum of seven years is allowed for a student admitted into the programme through UME/Pre-degree, or a minimum of four years or maximum of six years for a student admitted through direct entry, to obtain a B.Eng. Degree in Mechanical Engineering. Any student who fails to obtain his/her degree after the stipulated period shall be asked to withdraw from the programme.

Examination Malpractice

Any student caught in any examination malpractice shall sign the examination misconduct report form. This will be forwarded to Senate to determine the gravity of the offence and give appropriate punishment as contained in the Students' Handbook. The punishment may range from expulsion from the University, repeat the academic year, award on "F", or a warning.

Review of Examination Answer Scripts of Aggrieved Students

Any student who is not satisfied with the score he/she was awarded in any course may apply for the review of his/her exam answer scripts. The procedure for such applications shall be as approved by State University of Medical and Applied Sciences.

Graduation Requirements

To be eligible for the award of Bachelor of Engineering (B.Eng.) with honours in Mechanical Engineering, a student must successfully complete all his or her courses and satisfy both the internal and external examiners in the written and practical projects.

List of Staff

S/N	NAME	DISCIPLINE	HIGHEST QUALIFICATIONS	STATU S	SPECIALIZATI ON
1	Dr Okwudili Simeon Ogbonna	Mechanical Engineering	PhD	Full Time	Materials Science and Manufacturing Technology

2	Asso. Prof. Agbo CO	Mechanical Engineering	PhD	Part Time	Design
3	Dr Peter Ugwu Nwachukwu	Mechanical Engineering	PhD	Full Time	Materials Technology and Mechanics
4	Agashi Boniface Emeka	Mechanical Engineering	Master of Engineering (M.Eng.)	Full Time	Energy and Power Technology
5	Enyi Charles Chijike	Mechanical Engineering	Master of Engineering (M.Eng.)	Full Time	Materials Technology and Mechanics
6	Onovo Anthony Chinweuba	Mechanical Engineering	Master of Engineering (M.Eng.)	Full Time	Material Science and Production Engineering
7	Engr. Chinachi Emeka	Mechanical Engineering	Master of Engineering (M.Eng.)	Full Time	Energy and power
8	Eze Chijioke Chibuzo	Geology/Mecha tronics	BSc	Full Time	Machining
9	Egbuagu Vintus Mmaduabuchi	Mechanical Engineering	HND	Full Time	Casting

List of Courses

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	-
CHM 101	General Chemistry I	2	C	30	-
CHM 107	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
MEE 101	Introduction to Mechanical Engineering	1	C	15	-
SUMAS-COS 101	Introduction to Computer Application	2	C	30	-

SUMAS-GET 109	Environmental Awareness and Protection	2	C	30	-
Total Units = 20					

100 Level (Second Semester)					
Course Code	Course Title	Units	Status	LH	PH
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 102	General Chemistry II	2	C	30	-
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 108	General Practical Physics II	1	C	-	45
PHY 102	General Physics II	2	C	30	-
PHY 104	General Physics IV	2	C	30	-
SUMAS-GET 106	Applied Mechanics	3	C	45	-
SUMAS-GET 108	Occupational Safety	2	C	30	-
Total Units = 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 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I	3	C	9 Weeks	
SUMAS-MEE 243	Measurement and Instrumentation	3	C	45	-
SUMAS-GET 203	Engineering Graphics and Solid Modeling II	3	C	30	45
Total Units = 25					

200 Level (Second Semester)					
Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
SUMAS-GET 214	Engineering Economics	2	C	30	--
Total Units = 18					

300 Level (First Semester)					
Course Code	Course Title	Units	Status	LH	PH
GET 301	Engineering Mathematics III	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
*GET 399	SIWES III	4	C	12 Weeks	45
SUMAS-MEE 311	Manufacturing Processes	2	C	30	-
SUMAS-MEE 313	Mechanical Engineering Design I	2	C	30	-
SUMAS-MEE 361	Engineering Thermodynamics II	2	C	30	-
SUMAS –MEE 323	Mechanics of Materials Laboratory I	1	C	-	45
Total Units = 20					

300 LEVEL (Second Semester)					
Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 302	Engineering Mathematics IV	3	C	45	-
*GET 304	Technical Writing and Communication (Including Seminar Presentation Skills)	3	C	45	

GET 306	Renewable Energy Systems and Technology	3	C	30	45
MEE 306	Computer Aided Design and Manufacture	1	C	15	
SUMAS-CHE 312	Waste Processing Technology	1	C	30	-
SUMAS-MEE 322	Mechanics of Materials Laboratory	1	C	-	45
SUMAS-MEE 332	Mechanics of Materials	2	C	30	-
SUMAS-MEE 304	Introduction to Heat Transfer	2	C	30	-
Total Units = 20					

400 LEVEL First Semester					
Course Code	Course Title	Units	Status	LH	PH
MEE 401	Mechanical (Machine) Engineering Design II	2	C	30	-
MEE 402	Theory (Mechanics) of Machines I	2	C	30	-
MEE 403	Applied (Engineering) Thermodynamics I	2	C	30	-
MEE 404	Applied Fluid Mechanics	2	C	30	-
MEE 405	Heat and Mass Transfer	3	C	45	-
MEE 407	Advanced Mechanics of Materials	2	C	30	-
SUMAS-MEE 406	Introduction to Mechatronics	2	C	15	45
SUMAS-MEE 412	Turbomachinery	2	C	30	-
SUMAS-MEE 421	Thermo-fluids Laboratory II	1	C	-	45
SUMAS-MEE 408	Mechanics of Machines Laboratory II	1	C	-	45
SUMAS-MEE 409	Technology Development Policy	1	C	45	-
Total Units = 20					

400 LEVEL (Second Semester)					
Course Code	Course Title	Units	Status	LH	PH
GET 402	Engineering Project I	2	C	-	90
GET 404	Engineering Valuation and Costing	2	C	30	-
GET 499	SIWES	4	C	24 Weeks	
Total Units = 8					

500 LEVEL (First Semester)					
Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering (Project) Management	3	C	45	-
MEE 501	Applied Design	2	C	15	45
SUMAS-MME 531	Mechanics of Materials II	3	C	45	-
SUMAS-MEE 551	Fluid Dynamics II	3	C	45	
SUMAS-MEE 561	Engineering Thermodynamics IX	3	C	45	-
Total Units = 14					

500 LEVEL (Second Semester)					
Course Code	Course Title	Units	Status	LH	PH
GST 502	Engineering Law	2	C	45	-
MEE 590	B.Eng. Project	6	C	-	270
SUMAS-MME 534	Materials of Engineering Applications	3	C	45	-
SUMAS-MEE 586	Engineering Economy	3	C	45	
Total Units = 14					

Electives

500 LEVEL- OPTION 1: THERMEMAL AND FLIUD ENGINEERING					
Course Code	Course Title	Units	Status	LH	PH
SUMAS-MEE 552	Computational Fluid Dynamics	3	E	45	-
SUMAS-MEE 555	Aerospace Engineering Fundamentals	3	E	45	-
SUMAS-MEE 557	Fluid Power Transmission Systems	3	E	45	-
SUMAS-MEE 563	Automotive Engine Fundamentals	3	E	45	-
SUMAS-MEE 565	Fundamentals of Nuclear Engineering	3	E	45	-
SUMAS-MEE 569	Direct Energy Conversion principles	3	E	45	-
SUMAS-MEE 572	Thermal Engineering and Advanced Heat Transfer	3	E	45	-
SUMAS-MEE 568	Power Plant Engineering	3	E	45	-
SUMAS-MEE 547	Automobile Engineering	3	E	45	-
SUMAS-MEE 562	Refrigeration and Air- conditioning	3	E	45	-

500 LEVEL- OPTION 2: DESIGN, MATERIAL AND MANUFACTURING					
Course Code	Course Title	Units	Status	LH	PH
SUMAS-MEE 513	Manufacturing and Tools Engineering	3	E	45	-
SUMAS-MEE 515	Design of Welded and Cast Structures	3	E	45	-
SUMAS-MEE 533	Engineering Metallurgy	3	E	45	-
SUMAS-MEE 543	Vibrations and Control	3	E	45	-
SUMAS-MEE 512	Design of Pressure Vessels	3	E	45	-
SUMAS-MEE 532	Theory of Elasticity	3	E	45	-
SUMAS-MEE 572	Introduction to Composite Materials	3	E	45	-
500 LEVEL- OPTION 3: INDUSTRIAL ENGINEERING AND MANAGEMENT					
Course Code	Course Title	Units	Status	LH	PH
SUMAS-MEE 581	Quality Assurance and Reliability	3	E	45	-
SUMAS-MEE 545	Mechatronics	3	E	45	-
SUMAS-MEE 541	Systems Engineering	3	E	45	-
SUMAS-MEE 544	Production and Inventory Design	3	E	45	-

Courses and Description

First Year Courses

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation

to national development;

5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

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

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

Learning Outcomes

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

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs);

and

5. identify and evaluate safety and risk in engineering practice.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete

terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

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

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using 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.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

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

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

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

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

Learning Outcomes

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

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;

5. perform redox titration;
 6. record observations and measurements in the laboratory notebooks; and
- Engineering and Technology 645 New
7. analyse the data to arrive at scientific conclusions.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moivre's theorem, n th 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;

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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).

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

Learning Outcomes

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

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

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines.

Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola.

Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

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

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

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

precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

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

Learning Outcomes

On completion, the students should be able to:

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

Course Contents

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

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

Learning Outcomes

On completion, the student should be able to:

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, Engineering and Technology 648 New 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.

PHY 102: General Physics II (2 Units C: LH 30)

Learning Outcomes

On completion of this course, the student should be able to:

1. Understand and apply coulomb's law and Gauss's theorem;
2. Analyse and design capacitor circuits;
3. Apply Ohm's law and Kirchoff's law to D.C circuits;
4. Use DC bridges and potentiometer for measurement;
5. Solve problems related to magnetic fields, forces and electromagnetic induction;
6. Analyse A.C circuits, including calculating power, impedance, and phase relationships;
7. Analyse and design simple rectifier circuits;
8. Calculate electrical energy, and power in D.C circuits.

Course Contents

Coulomb's law. Gauss's theorem. Capacitors. Ohm's law. Kirchhoff's laws, electrical energy, D.C. bridges and potentiometer. Magnetic effect of current, electromagnetic induction, moving coil and ballistic galvanometer. Multimeter, D. C. And A. C. Meters and generators. Hysteresis. Power in A. C. circuit, semiconductors, conductivity and mobility. Rectification.

MEE 101: Introduction to Mechanical Engineering (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. identify the various branches of mechanical engineering discipline and their applications to the solution of societal problems;
3. demonstrate appreciation of the problem of climate change; and
4. demonstrate appreciation of the role of energy systems to environmental sustainability.

Course Contents

Historical development of the mechanical engineering discipline. Philosophy and scope of contemporary mechanical engineering course programme. Overview of mechanical engineering special fields: applied (solid) mechanics, fluid and thermal engineering (thermodynamics and heat transfer). Industrial/production engineering and engineering management sciences. The linkage between mechanical engineering and other engineering disciplines and the sciences. The concept of innovation. Illustrations of wide variety applications of mechanical engineering. The role of mechanical engineers in the society and human development. Professional ethical responsibility. Climate change, renewable energy and environmental sustainability.

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 Mechanical 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 excellent.

Overview

The study of vibrations, waves, and optics is vital to the training of Mechanical Engineering graduates because their applications are used in solving Mechanical Engineering related

problems. This highlights the importance of preparing students in Mechanical 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 analyse 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 Engineering 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 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 formula 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.

SUMAS-GET 108: 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

Minimum Academic Standards

As described in CCMAS

Second Year Courses

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 assess 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.

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

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

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept,

design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and

8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. 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 (callipers, micrometres, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, and metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. Machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines. Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

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

Learning Outcomes

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

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various pipe fittings (valves, orifices, bends and elbows) on fluid flow in pipes;

5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

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

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

Learning Outcomes

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

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system, surrounding, closed and open system, control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators

and heat pumps; and

13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

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

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

Course Contents

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

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

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

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;

5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity.

Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

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

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

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

Course Contents

Introduction to computers and computing; computer organisation – data processing,

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

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

Learning Outcomes

SIWES I should provide opportunity for the students to:

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

Course Contents

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

SUMAS-MEE 243: Measurement and Instrumentation [3 Units, C: LH 45]

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 restore the dignity of man 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

GET 203: Engineering Graphics and Solid Modeling I (3 Units C: LH30; PH45)

Learning Outcomes

Students should be able to:

1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multiphysical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modelling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modelling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modelling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

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

Third Year Courses

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;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

Linear Algebra. Tensor algebra and analysis, Elements of Matrices, Determinants, Inverses of Matrices, bases representation of tensors. The Euclidean point space and vector spaces.

Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Basic transformations: identity, spherical, Projection and Coordinate Transformation as tensors, Traces, Determinants and other scalar invariants. Equivalent stresses and strains as examples of scalar invariant. Applications to design, analyses and optimization. Eigenvalues, Eigenvectors of tensors. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar and fields. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications: Determinations and applications to field equations in linear and nonlinear mechanics. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeros. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

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

Learning Outcomes

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

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

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturm-Liouville boundary value problems. Solutions of equations in two and three dimensions by separation of variables.

Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Hankel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. Runge-Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

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

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

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

Course Contents

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

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

Learning Outcomes

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

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, Poisson 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 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

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

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

Course Contents

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

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 Solid works: 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 solid works; and
- d. technical report writing.

MEE 301: Computer-Aided Design and Manufacture (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. visualise and apply basic drafting fundamentals;
2. prepare and edit engineering drawings;
3. explain the concepts and underlying theory of modelling and the usage of models in different engineering applications;
4. compare the different types of modelling techniques and explain the central role solid models play in the successful completion of CAD/CAM-based product development;
5. produce CAD drawings (create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications);
6. use and assess commercial CAD/CAM tools efficiently, effectively and intelligently in selected engineering applications;
7. take active role in product design and development process as well as prototyping;
8. model 3D part and assemblies using SolidWorks program (or alternative CAD software);
9. analyse the part design using one of the computational methods (e.g. stress analysis) - calculate part features using math skills;
10. demonstrate proficiency in the concepts of computer-aided manufacturing and a number of applied associated processes; and
11. explain the basic concepts of CNC programming and machining.

Course Contents

Introduction to computer aided design (CAD). Basic data structuring technique. Computer

graphics. Geometric transformation techniques. Mathematical bases for surface modeling: curves, surfaces and solids. Principles of solid modeling and application. CAD software. Introduction to CAM: Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems. Type of automation and benefits of soft or flexible automation. Automation in material handling and assembly. CNC machines: Introduction, classification, design and control features including interpolations. Numerical control and NC part-programming. Introduction to Robotics: Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications. Manual CNC programming (milling and turning). Basic and advanced CAD/CAM for CNC (milling and turning). Group project assignment.

SUMAS-CHE 312: Waste Processing Technology [1 Units, 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 Mechanical 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 gasifier.

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 waste management;
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-MEE 311: Manufacturing Processes [2 Units, C: LH 15]

Senate-Approved Relevance

This course covers common manufacturing processes for product realization, material selection, automation and disruptive manufacturing technologies. The student stands to benefit from improved knowledge of material selection, processing considerations with respect to final product design, performance.

Overview

This course introduces a wide range of manufacturing processes including machining, injection molding, casting, and 3D printing; and explains the fundamental and practical aspects of manufacturing at scale.

Course Objectives

The objectives of the course are to:

1. identify and explain manufacturing concepts, processes and equipment utilized in a manufacturing setup.
2. Utilize the knowledge and skills from the course to choose careers in manufacturing process namely: turning and boring operations, drilling, milling, planning, shaping and grinding processes.
3. Develop an understanding of machine tool installation, testing and maintenance
4. Equip the students with the ability to provide solutions and solve manufacturing engineering technology related problems.

Learning outcomes:

At the end of the course the graduate engineer should be able to:

1. Exhibit skills in Molding/Casting d. Welding e. Finishing and Assembly of Materials.
2. Integrate different manufacturing processes into an effective system for producing goods that can compete in the world market.
3. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
4. Effectively function on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 313: Mechanical Engineering Design I [2 Units, C: LH 30]

Senate-Approved Relevance

In every walk of engineering, planning must be obviously followed by design, and then finally, production or execution in accordance with the design consideration needs to be done. Machine design is an important part of engineering science because it deals with the study of relative motion among the various parts of a machine as well as forces applied to them. Specifically, machine theory and machine design investigate the dynamics of machine components. An engineer's understanding of this subject is critical for designing the various segments of a machine. Machine theory is divided into four sub-branches: kinematics, dynamics, kinetics, and statics.

This course provides a foundational understanding to the mechanical engineering students in the area of machine design.

Overview

Analysis of stresses and deflections due to complicated loading. Investigation of specific design problems through application of theory of elasticity, failure criteria, energy approach, and numerical methods.

Course objectives

1. To introduce the student to the basic principles of Design
2. To expose the student to the fundamentals in the Design process
3. To inculcate in the students, the behavioural attitude associated with Design
4. Identify sources of imperfection in design
5. List at least 5 design rules

Learning Outcomes

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

1. Understand the meaning of the word 'Design' as applied in Engineering or elsewhere.
2. Understand that there is a general principle that there must be followed in the design process.
3. Understand that there is nothing like a perfect answer to a design problem.
4. Understand the use of the following tools: Specifications, Conceptual designs and Bill of quantities during the design process.
5. Apply all of the above basic rules in the design process exercise involving all the machine components as listed above.

Course Content

Principles of Design. Selection of Materials. Design and composition of cast, forged and welding housings and structures; design of plastic parts. Precautions for manufacture. Simple stress analysis. Use of threaded and non-threaded fasteners. Elastic deformation of machine parts. Design of screws. Strength under combined load; Failure theories; Repeated loading.

Shaft design. Flexible mechanical elements: Couplings, clutches and brakes. Mechanical springs. Anti-friction rolling contact bearings.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 361: Engineering Thermodynamics I [2 Units, C: LH 30]

Senate-Approved Relevance

The importance of Engineering thermodynamics in everyday life cannot be overemphasized as it enables one to understand the interaction between heat and changes in a system. This course is designed primarily for 300 level undergraduate students studying towards a Bachelor's degree in Mechanical Engineering. Those who need continuous professional development can also benefit from the course. This course will provide an intermediate level understanding on the theory of thermodynamics. The course would also help to train high-quality graduates who are well skilled and knowledgeable in the in the design, development and use of various energy systems and thermal processes.

Overview

This course aims to give students of mechanical engineering a thorough grounding in the fundamental ideologies in areas of entropy, entropy balances for closed systems and control volumes and isentropic processes as necessary tools among others for research and evaluation of thermodynamic systems. The ideas of irreversibility as a limiting factor in thermodynamic systems' efficiencies are elaborated together with the notion of exergy/availability as the theoretical maximum amount of work that can be obtained from a system at any state points P_1 and T_1 and P_o and T_o . Students are further exposed to isentropic efficiency relations of turbines, nozzles and compressors that form the basis for the evaluation and computation of real-life state parameters involving those systems. What constitutes thermodynamic cycles and their use in illustrative understanding of vapour and gas-based electric power generation are elaborated. Additionally, students are brought up to speed in this course in understanding of air standard Otto cycle; Diesel cycle and dual cycle as foundational philosophies in the development and analysis of auto-based engines.

Course Objectives:

The objectives of this course are:

1. Ground and internalize in the students the fundamental ideas of entropy as an important state property arising from the 2nd Law of thermodynamics and the Clausius inequality.

2. Expose them to the compendium of entropy data for water and refrigerants necessary in calculations.
3. Bring students up to speed on what constitutes isentropic processes, Tds relations, entropy balances for closed systems and control volumes
4. Sustain students' interests by working through basic definitions of isentropic efficiency relations and their use in finding solutions in real-life systems-turbines, nozzles and compressors.
5. Introduce students to the basic idea of irreversibility as a component part of real processes and limiting factor in thermodynamic systems efficiencies.
6. Facilitate in students a good understanding of the concepts of availability/exergy, exergy reference environment, dead state and exergy equations.
7. Arm the students with basic ideas of thermodynamic cycles and their use in working through real-life vapour power and gas power plants and the attendant parameters for efficiency assessment.
8. Impact on the students a good perspective on the concepts of air-standard Otto cycles, Diesel cycles and dual cycles.
9. Treat the students to a cocktail of example problems involving thermodynamic systems; piston-cylinder arrangement; T-s diagrams; adiabatic and isothermal expansion processes; exergy transfer accompanying work; rate of exergy destruction; Rankine cycle; Gas power cycle etc

Learning Outcomes

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

1. Distinguish between Dead State and flow exergy in a system
2. Determine the heat transfer, change in entropy, amount of entropy, change in exergy, exergy transfer accompanying heat transfer, exergy destruction and the exergy of a system contained in closed rigid boundaries
3. Understand the energy balance equation of the control volume
4. Represent thermodynamic processes in a T-s and H-s diagrams and be able to solve problems in steam power plants involving such concepts as dryness fraction, superheated steam, etc. using property tables.
5. Appreciate the effect of irreversibilities in a gas turbine system and the advantages of introducing intercooling, reheating and heat exchange in a gas turbine complex.
6. Apply appropriate equations and solve problems involving different configurations of a gas turbine system

7. Understand the working principles of Otto; Diesel and Dual cycles
8. Visualize and appreciate the place of thermodynamics in design, research, construction, assessment and optimization of energy production systems.

Overall, at the end of the course, we would be turning over to the next class a prepared, practice-oriented, fit-for purpose students with requisite exposure in the fundamental concepts of thermodynamics and with the right attitude to continue the next layer of the course in the 4th year.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 322: Mechanics of Materials Laboratory [1 Unit, C: PH 45]

Senate-Approved Relevance

Train students with the ability to conduct experiments on the mechanics of materials and to develop the technical report writing ability of the student.

Overview

In this course the student will develop a working knowledge of experimental techniques and equipment commonly used in engineering practice. The student will become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.

Course Objectives

The goal of the mechanics of materials lab is to demonstrate to undergraduate students the basic principles of strength and mechanics of materials, as well as structural analysis, through a series of experiments.

Learning Outcomes

At the end of the course, the student will:

1. Become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer based data acquisition.
2. Refine his/her report writing skills

Course Content

Uncertainty analysis, statistical analysis. Tensile test of ductile and brittle materials using the Universal Testing Machine. Poisson's ratio. Torsion Testing. Bending – Modulus of Elasticity. Principal stresses and strains (Strain gauge application). Beam deflection test. Column loading test. FEA demonstrations.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 332: Mechanics of Materials Laboratory I [2 Units, C: PH 45]**Senate-Approved Relevance**

Train students with the ability to conduct experiments on the mechanics of machines and to develop the technical report writing ability of the student.

Overview

In this course the student will develop a working knowledge of experimental techniques and equipment commonly used in engineering practice. The student will become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.

Course Objectives

At the end of the course, the student will:

1. Become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.
2. Refine his/her report writing skills

Learning Outcomes

At the end of the course, the student will:

1. Become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.
2. Refine his/her report writing skills

Course Content

Linear acceleration trolley experiment. Angular acceleration. Wall jib crane. Simple screw jack. Weston differential pulley block. Belt friction. Compound pendulum. Flywheel.

Minimum Academic Standard

As described in CCMAS

SUMAS-- MEE 332: Mechanics of Materials I [2 Units, C: LH 30]

Senate-Approved Relevance

To train high-quality graduates who are well skilled and knowledgeable in the practice of Mechanical Engineering in the society. The ideas embodied in the course provides an avenue for the students to grasp and appreciate all the areas of Mechanical Engineering concepts by inculcating an introductory real time practical Mechanical Engineering knowledge into them (students), which will later be expanded in subsequent years. It is geared towards consolidating the theoretical principles of the course with numerous practical experiences that are required to position graduates for a robust Technological disposition for later service to humanity. The relevance is typified in the capacity of SUMAS graduates of Mechanical engineering to manage large production and industrial concerns requiring ample human and material resources, as well as capacity to develop and maintain critical infrastructural facilities in leading engineering concerns

Overview

Mechanics of Materials I involves a detailed examination of the principles governing the internal effects of stress and strain in solid bodies subjected to external loading. The goal is to teach engineering students how to create solid components and structures using materials and geometry. Students learn to compare material strength to internal stresses and material deformation to internal strains. Mechanical characteristics of materials, forms of loads, plane-stress and plane-strain conditions, beam and shaft design, and buckling are all covered. The design of solid components and structures studied in this course is critical for tackling many engineering difficulties. Students in this course improve on their expertise from Statics. Pupils learn how to assess the strength of solid materials and structures.

Objectives

The goal of the course is to teach students how to analyse and design various machine and load bearing structures. After completing this course, each student should have:

1. A fundamental grasp of engineering mechanics, as well as the capacity to apply that understanding to evaluate and solve a particular problem.
2. Fundamental knowledge of material characteristics and mechanical deformation.
3. The capacity to build and analyse structures to support loads within a certain limit of safety using modern scientific and engineering concepts.

Learning outcome

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

1. Learn the fundamental ideas of stress and strain, as well as their connection, using strain-stress equations to solve problems for simple 3-dimensional elastic solids.
2. Compute and draw stress diagrams for bars and basic constructions.
3. Solve issues involving pure and non-uniform beam bending and other basic structures.
4. Solve torsional deformation issues for bars and other basic two-dimensional structures.
5. Understand the idea of buckling and be able to solve isolated bar issues
6. Be familiar with at least one structure-evaluation software package.

Course Contents

The main themes to be addressed during the course are: Fundamentals of stress and strain analysis; Hooke's Law., Allowable stresses, allowable loads and safety factors, Shear forces and bending moments, Torsional loading, Impact loading, Compression and Shear Torsion, Buckling, Deflections of beams, Thick and thin-walled cylindrical pressure vessels, statically determinate and indeterminate structures, Numerical calculation of structures by computer

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 304: Introduction to Heat Transfer [2 Units, C: LH 30]**Senate-Approved Relevance**

To train high-quality graduates who are well skilled and knowledgeable in the practice of Mechanical Engineering in the society. The ideas embodied in the course Introduction to Heat Transfer provides an avenue for the students to grasp and appreciate the fundamental principles of heat transfer in Mechanical Engineering by inculcating an introductory knowledge of conduction and radiation heat transfer into them (students), which will later be expanded in subsequent years. It is geared towards consolidating the theoretical principles of the course with analytical problem-solving experiences that are required to position graduates for a robust Technological disposition for later service to humanity. The relevance is typified in the capacity of SUMAS graduates of Mechanical engineering to manage large production and industrial concerns requiring ample human and material resources involving thermal systems, as well as capacity to develop and maintain critical infrastructural facilities in leading engineering concerns.

Overview

In this course the student will develop a working knowledge of the fundamental principles and analytical methods of conduction and radiation heat transfer as presented in the course document. The student will become familiar with the governing equations, boundary conditions, thermal resistance concepts, steady and transient conduction solutions, blackbody and graybody radiation, view factors, and radiation network analysis for engineering applications

Course Objectives

At the end of the topics under conduction and radiation heat transfer, students should be able to:

1. Derive the general heat conduction equation in Cartesian, cylindrical and spherical coordinates and apply it (with appropriate boundary conditions) to obtain analytical solutions for steady-state one-dimensional conduction through plane walls, cylinders, spheres and composite systems.
2. Construct thermal resistance networks, calculate the overall heat transfer coefficient and determine the rate of heat transfer through single-layer and multi-layer plane, cylindrical and spherical surfaces as well as through extended surfaces (fins), evaluating fin efficiency and effectiveness.
3. Apply the lumped-capacitance method and transient conduction charts to predict temperature–time histories and heat transfer rates during unsteady-state conduction in simple geometries.
4. Define blackbody radiation characteristics and apply the Stefan–Boltzmann law, Planck’s law and Wien’s displacement law to compute emissive power, spectral distribution and radiation heat transfer between black surfaces.
5. Determine view factors (shape factors) for common geometries and construct radiation network models to analyse net radiation exchange between gray, diffuse and opaque surfaces, incorporating surface resistance and space resistance.

Learning Outcomes

Upon successful completion of the course, students are expected to:

1. Derive the general heat conduction equation in Cartesian, cylindrical and spherical coordinates and successfully apply it (with appropriate boundary conditions) to obtain analytical solutions for steady-state one-dimensional conduction through plane walls, cylinders, spheres and composite systems.

2. Construct thermal resistance networks, accurately calculate the overall heat transfer coefficient and determine the rate of heat transfer through single-layer and multi-layer plane, cylindrical and spherical surfaces as well as through extended surfaces (fins), while correctly evaluating fin efficiency and effectiveness.
3. Apply the lumped-capacitance method and transient conduction charts to predict temperature–time histories and heat transfer rates during unsteady-state conduction in simple geometries.
4. Define blackbody radiation characteristics and correctly apply the Stefan–Boltzmann law, Planck’s law and Wien’s displacement law to compute emissive power, spectral distribution and radiation heat transfer between black surfaces.
5. Determine view factors (shape factors) for common geometries and construct radiation network models to analyse net radiation exchange between gray, diffuse and opaque surfaces, incorporating surface resistance and space resistance.

Course Content

Kinetic Theory of Matter and Conduction; Fourier’s Law of Conduction: Homogenous and Heterogenous Materials, Isotropic and Anisotropic Materials, Variations of k with Temperature, Effect of Alloying, Effects of Density and Wetness, Effective Thermal Conductivity, Units of Thermal Conductivity; Differential Form of Fourier’s Law: Two Dimensional Heat Transfer in Stationary Media, Applications to Steady 1-D Conduction, Conduction Treated in Cylindrical and Spherical Co-ordinates: Two Dimensional Equation of Conduction in Cylindrical Co-ordinates, Two Dimensional Equation of Conduction in Spherical Co-ordinates; Electrical Analogy of Heat Transfer: Concept of Thermal Resistance, Thermal Resistances in Series, Thermal Resistances in Parallel; Composite Bodies: Mixed Series and Parallel Composites, Overall Heat Transfer Coefficient; Thermal Insulation: Optimum Insulation Thickness from Heat Transfer Considerations, Insulation Economics: Marginal Savings Criterion for Optimal Insulation Thickness, Extended Surfaces (Fins): Analysis of fins, Fin Efficiency η_{fin} ; Thermal Radiation: Generation and Emission of Thermal Radiation, Radiation Properties of Real Substances: Emissivity, Absorption, Reflection and Transmission of Thermal Radiation, Emissivity and Absorptivity; Laboratory Black Body, Exchange of Radiant Energy Between Surfaces: Types of Surfaces, View Factor, Radiant Energy Exchange Between Two Black Body Surfaces, Radiant Energy Interchange in an Enclosure with n Black Body Surfaces, Electrical analogy for Radiant Energy Exchange Between Black Body Surfaces, Analysis of the Thermal Radiation Network, Radiant Energy Exchange Between Gray Surfaces

Minimum Academic Standard

As described in CCMAS

Fourth Year Courses

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 of 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.

MEE 401: Mechanical (Machine) Engineering Design II (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate proficiency in the principles of design;
2. demonstrate proficiency in the selection of materials for design;
3. carry out simple stress analysis; and

4. demonstrate proficiency in principles of coupling, clutches and brakes.

Course Contents

Journal bearings. Application of Hertz stress theory. Fluid couplings. Lubrication mechanics: hydrodynamic theory applied to tapered wedge and journal bearings and hydrostatic lubrication applied to journal bearings. Gears and power transmission systems. Elements of fluid power system design. Design of cylinders, pipes and pipe joints, tubes, plates and flywheel. Seals, packaging, gaskets and shields. Failure analysis; various types of joints, design of machine elements; system design, design of gear systems; material selection in design; design; design and production matching; optimisation in design D

MEE 402 Theory (Mechanics) of Machines II (2 Units E: LH 30)

Learning Outcomes

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

1. identify the forces acting on a mechanism and the resolution of the forces;
2. demonstrate understanding of the performance of various mechanisms and principal machine elements as regards their kinematics and dynamics;
3. identify the types of motion and their applications;
4. identify forces on shaft and bearing due to single revolving mass;
5. demonstrate procedure for balancing several masses in different transverse planes;
6. prepare professional quality solutions and presentations to effectively communicate the results of analysis and design;
7. translate ideas and imaginations into conceptual designs using the tools of conventional engineering drawings and computer aided designs; and
8. use the knowledge of the course to solve real life problems related to production processes and to develop machines.

Course Contents

Force analysis of mechanisms, fluctuation of kinetic energy and inertial effects. Complete static and dynamic analysis. Flexible shaft couplings: belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery. Vibration of machinery; free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts and torsional vibrations.

MEE 403: Applied Engineering Thermodynamics (2 Units E: LH 30)

Learning Outcomes

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

1. apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon;
2. identify fuel types, availability, utilisation and its conversion to energy, understand fuel chemistry, combustion analysis, develop combustion equations and conduct exhaust and flue gas analysis in the laboratory;
3. identify enthalpy changes, determine heating values of fuels, steam generators;
4. identify type of boilers, fuels and combustion controls in boilers and power plant efficiency;
5. perform air standard cycle analysis, refrigeration and heat pump cycles and demonstrate their various application in internal combustion engines/refrigeration systems;
6. demonstrate proficiency in energy analysis, fuel combustion and thermal systems design; and
7. provide solution to thermodynamic problems in HVAC systems, power plant, engines or renewable energy technology.

Course Contents

Multistage reciprocating compressors. Rotary compressors – centrifugal and axial-flow; stagnation properties. Simple gas turbine plant. The steam power plant. Combustion of fuels; chemistry of common hydrocarbon fuels, combustion with deficiency or excess air. Thermo-chemistry: Hess' Law of Heat Summation; heats of combustion and reaction; ideal adiabatic flame temperature. Reciprocating internal combustion engines. General thermodynamics relations. Kinetic theory of gas. Mixture of gases, psychometry, air-conditioning and cooling towers. Introduction to heat transfer.

MEE 404: Applied Fluid Mechanics (2 Units E: LH 30)

Learning Outcomes

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

1. identify the various types of fluids and flows;
2. carry out simple calculations on floating and submerged surfaces;
3. explain the concept of fluid machinery for prototype development;
4. explain concepts of boundary layer;
5. explain and derive the Navier–Stokes equation for conservation of momentum and conservation of mass for Newtonian fluids;

6. describe machines that transfer energy between a rotors and a fluids;
7. identify pump types performed by simple pump selection, including both turbines and compressors; and
8. perform simple CDD grid processing, calculations and result processing.

Course Contents

Unsteady flow; oscillation in U-tube; surge tank; water hammer. Open-channel flows. Introductory concepts of boundary layer and re-circulating flows, mathematical derivation of Navier-stokes equations and its application. Dimensional analysis and similitude. Introduction to turbo machinery; characteristic curve for axial-flow and centrifugal pumps, fans, blowers, impulse and reaction turbines. Pump selection and application. Pipeline systems (Series and Parallel). Open channel flow. Overview of computational fluid dynamics (CFD)

MEE 405: Heat and Mass Transfer II (3 Units C: LH 45)

Learning Outcomes

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

1. explain the principle of heat by diffusion under steady or unsteady conditions;
2. explain continuity and momentum equations and their roles in convection heat transfer analysis;
3. recognise convection heat transfer in laminar and turbulent flows;
4. determine heat transfer coefficients in internal and external flows;
5. identify dimensionless groups in convection heat transfer;
6. identify combined modes of heat transfer;
7. perform simple heat exchanger analysis and design;
8. demonstrate an understanding of heat and mass transfer modes and models;
9. demonstrate understanding of the different types of interface reactions;
10. explain comparison of Fick's and Fourier's laws and similarities between conduction and mass transfer in stationary systems; and
11. apply principles of heat and mass transfer phenomena to selected processes.

Course Contents

Convection heat transfer: Newton's law of cooling. Energy equation of convection.

Continuity and momentum equations and their roles in convection heat transfer analysis. Convection heat transfer in laminar and turbulent flows. Internal and external flows. Heat transfer coefficients. Dimensional analysis and dimensionless groups in convection heat transfer. Convection heat transfer correlations. Heat exchanger analysis and design. Combined modes of heat transfer.

Mass transfer: Mechanisms of mass transfer. Fick's law of mass diffusion. General diffusion law. Rate equations. Comparison of Fick's and Fourier's laws. Equations of mass transfer in stationary systems. Similarities between conduction and mass transfer in stationary systems. Mass transfer coefficient. Electrical analogy of mass transfer. Equimolar counter diffusion. Drying and humidification of solids and gases. Types of dryers. Evaporation. Mass transfer correlations in convective systems.

MEE 407: Advanced Mechanics of Materials (2 Units C:LH 30)

Learning Outcomes

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

1. explain the theory, concepts, principles and governing equations of solid mechanics;
2. demonstrate the ability to deconstruct complex problems to produce effective outcomes;
3. perform simple analysis on thick cylinders; compound cylinders, rotating disks and bending of flat plates;
4. perform simple analysis on beams on an elastic foundation;
5. explain two-dimensional theory of elasticity and apply to elastoplastic problems;
6. use analytical, experimental and computational tools needed to solve the idealised problem;
7. Use these solutions to guide a corresponding design, manufacture, or failure analysis;
8. explain the selection, design and stress analysis of composite materials;
9. analyse the stresses in simple structures as used in industry, and
10. use interpersonal understanding, teamwork and communication skills working on group assignments.

Course Contents

Thick cylinders; compound cylinders. Rotating disks. Bending of flat plates. Beams on an elastic foundation. Membrane stresses in shells of revolution. Two-dimensional theory of elasticity. Elastoplastic problems and limit theory.

SUMAS-MEE 406 Introduction to Mechatronics (2 Units, C: LH 30)**Senate – Approved Relevance**

It is entrenched in the programs of SUMAS to train quality and seasoned graduates who are very sound and versatile in mechanical systems design and analysis, with the capacity to solve complex engineering problems; have the ability to use sustainable and environmentally friendly means to generate solutions associated with physical materials for the benefit of humankind both locally and internationally. The idea is to produce high quality mechanical engineers with the ability to compete favorably and prominently with their counterparts globally. They are to be graduates with sound moral character who equipped with sufficient skills will be to contribute immensely to the solution of societal problems as associated with Nigeria and the entire world.

Course Overview

Mechatronics is a multi-disciplinary field that intersects mechanical, electronic, and software engineering. Most modern products are mechatronic products where mechanical components are integrated with electrical, electronic, and control components to achieve high-level system functionalities. Exposure of mechanical engineering graduates to the course mechatronics, increases their career opportunities and exposes them to the fundamental principles employed in the development of smart electro-mechanical systems and their applications.

Objectives

The objectives of the course are to:

- 1) expose the students to the concept of mechatronics, mechanical components, and motor systems;
- 2) provide examples of existing embedded systems-based products and describe the special requirements placed in developing such systems;
- 3) describe the basic concept of control systems;
- 4) discuss I/O and device driver interfaces to embedded processors with networks, multimedia cards, and disk drives;
- 5) describe the principles of automatic programming;
- 6) Explain Industrial automation;
- 7) Explain the functions of Micro-controller; and
- 8) Describe industrial communication processes.

Learning Outcomes

This course is designed in such a way that graduate students will be able to:

- 1) describe the basic concept of mechatronics;
- 2) develop the mathematical model of the physical systems;
- 3) analyze the stability and response of closed and open loop systems;
- 4) describe the working of various blocks of basic industrial automation systems;
- 5) demonstrate proficiency in automation programming/troubleshooting related to programmable logic controllers;
- 6) Explain numerical control system;
- 7) Explain Networking of field devices; and
- 8) Develop System integration.

Course Contents

Mechanical components and motion systems. Control systems. Power and driving systems. Solenoid and robust sensing. Actuators. Numerical control. Event-driven programming. Modeling and simulation. System integration. Introduction of robotics. Fundamentals of kinematics and dynamics. Industrial automation and control. Microcontroller and embedded systems. Robotic Systems. Discrete and continuous variable control systems. Industrial communication and embedded computing. Networking of field devices. Translation and rotation. Denavit-Hartenberg parameters. Forward and inverse kinematics. Jacobian. Dynamics. Equations of motion. Newton-Euler formulation. Sensors and actuators. Strain gauge. Resistive potentiometers. Tactile and force sensors. Tachometers. LVDT and Piezo electric accelerometer. Hall Effect sensors. Optical encoders. Pneumatic actuators. Hydraulic actuators. Servo valves. DC motor, stepper motor, and drives.

Control of manipulators. Feedback control of 2nd order linear systems. Joint control. Trajectory control, controllers. PID control.

Minimum Academic Standards

As described in CCMAS.

SUMAS-MEE 412: Turbomachinery [2 Units: C: LH 30]

Senate- Approval relevance

One of the focus of the State University of Medical and Applied Sciences (SUMAS) is on excellent hands-on-skills training of students to improve their capacity to create ground-breaking research directed towards solving the technological problems of Nigeria and the world at large. In this regard, training highly skilled graduates engineers with sound knowledge and competences in the design, manufacture and maintenance of Turbomachinery is primary to ensuring industrialization in line with the vision of the State University of Medical and Applied Sciences (SUMAS) which is “to become a leader in the discovery, dissemination and application of new knowledge in areas of technology, and the built environment for the development of self and society”.

Overview

Turbomachinery in mechanical engineering, describes machines that transfer energy between a rotor and a fluid, including both turbines and compressors. While a turbine transfers energy from a fluid to a rotor, a compressor transfers energy from a rotor to a fluid. The turbomachine is used in several applications, the primary ones being electrical power generation, aircraft propulsion and vehicular propulsion for civilian and military use. The units used in power generation are steam, gas and hydraulic turbines, ranging in capacity from a few kilowatts to several hundred and even thousands of megawatts, depending on the application. In aircraft and heavy vehicular propulsion for military use, the primary driving element has been the gas turbine.

This course is designed to broaden the Students' knowledge of Turbomachinery and related systems with a view to increasing their technical aptitude and competence. This will enable them be at their best in actively leading research and development in the design, manufacturing, maintenance and management of these modern fluid and hydraulic driven machineries and equipment that are capable of increasing the electricity generation in Nigeria. Turbomachinery

is as course/subject is therefore a necessity for students studying Mechanical Engineering in Nigerian Universities.

Objectives of the course

The objectives of the course are to:

1. Describe the application of fundamentals of thermodynamics;
2. Explain how Fluid motion can be applied to obtain the operating conditions of turbomachines.
3. explain vapor and gas power systems;
4. explain hydraulic systems and characteristic curves of turbomachines;
5. describe specific speed and specific diameter of turbomachines;
6. explain Cordier diagram for turbomachine selection and its relevance engineering.

Learning Outcomes

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

1. Demonstrate a basic understanding of laws of fluid flow and thermodynamics in association to turbomachinery
2. Analyze turbomachinery problems associated with industry;
3. identify some parts in gas turbine systems;
4. Develop technical skills to analyze Turbomachinery; and
5. Explain the design procedure of components such compressor intake, diffusers, and gas turbine exits

Course Contents

Introduction to Turbomachinery, covering definitions, classifications like pumps, compressors, and turbines, and their applications in energy systems. Basic Principles of Fluid Mechanics in Turbomachines, reviewing conservation laws for mass, momentum, and energy in incompressible and compressible flows. Euler's Turbomachinery Equation, focusing on the derivation of energy transfer, torque, and power calculations; Velocity Triangles and Flow Analysis, including absolute and relative velocities, blade speed ratios, and velocity diagram construction. Dimensional Analysis and Similarity Laws, exploring non-dimensional parameters like specific speed and flow coefficient for scaling and model testing. Performance Characteristics, analyzing head-capacity curves, efficiency maps, and operating conditions. Centrifugal Pumps, addressing impeller and volute design, priming, cavitation, and NPSH requirements. Axial Flow Pumps, examining flow through axial impellers and their design differences from centrifugal pumps. Hydraulic Turbines, covering impulse (Pelton) and reaction (Francis, Kaplan) turbines, specific speed, and draft tubes. Centrifugal Compressors, studying radial flow, diffuser design, slip factor, and surge/stall issues; Axial Flow Compressors, delving into multi-stage design, blade loading, and cascade aerodynamics. Steam Turbines, exploring impulse and reaction staging, velocity compounding, and reheat cycles; Gas Turbines, analyzing Brayton cycle, component matching, and intercooling/reheating. Nozzles and Diffusers in Turbomachinery, covering convergent-divergent nozzles, shock waves, and diffusion losses; Blade Design and Aerodynamics, focusing on airfoil theory, cascade performance, and various losses. Special Topics like Wind Turbines and Fans, discussing horizontal/vertical axis designs, Betz limit, and propeller fans. Testing, Maintenance, and Case Studies, evaluating performance, vibration analysis, failure modes, and applications in Nigerian power plants.

Minimum Academic Standards

As described in CCMAS. In addition, the Faculty and departmental libraries and thermodynamics & fluid mechanics laboratories are well equipped with relevant equipment, text books and software accessible to lecturers and students as specified in the CCMAS.

SUMAS-MEE 421–Thermo-Fluids Laboratory II (1 Unit; C; LH = 0; PH = 45)**Senate-Approved Relevance**

Train students with the ability to conduct experiments on thermos-fluids laboratory II and to develop the technical report writing ability of the student.

Overview

In this course the student will develop a working knowledge of experimental techniques and equipment commonly used in engineering practice. The student will become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.

Course Objectives

The objectives of this course are to:

1. Teach students how to use the relevant theories and data obtained from experiments to evaluate the performance of different thermal and Fluid systems such as Internal combustion systems, Gas turbines, Marcet boiler, and etc.
2. Equip the students with the necessary skills to design and carryout experiments.
3. Expose students to technical report writing.

Learning Outcomes

At the end of the course, the student is expected to:

1. Understand and apply the relevant theories governing the operation of different thermos-fluid systems.
2. Demonstrate competence in the preparation of technical reports.
3. Effectively design experiments for evaluating the performance of various types of thermos-fluid systems.

Course Content

Wind lift and drag. Kaplan pump performance measurement. Turbine tests. Internal combustion engine tests. Gas turbine demonstration unit. Throttling calorimeter experiments. Marcet boiler tests. Pipeline network software tools (EPANET).

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 408–Mechanics of Machines Laboratory II [1 Unit; C; LH = 0; PH = 45)**Senate-Approved Relevance**

Train students with the ability to conduct experiments on the mechanics of machines II and to develop the technical report writing ability of the student.

Overview

In this course the student will develop a working knowledge of experimental techniques and equipment commonly used in engineering practice. The student will become familiar with the design and implementation of various sensors, statistical data analysis, experimental planning and computer-based data acquisition.

Course Objectives

The objectives of Mechanics of Machine Laboratory II are to acquaint students with the knowledge of motion conversion using different mechanism, the experiments and where their applications can be found.

Learning Outcome

At the completion of this course, students should be able to

1. Identify various mechanisms in mechanics of machine laboratory and their uses.
2. Carry out experiments in motion conversion using the identified mechanisms.
3. Gain the knowledge of slider crank mechanism in converting rotational to translational motion, and application in internal combustion engine.
4. Understand the concept of four bar, cam and follower mechanisms and applications in converting rotational to reciprocating motions, and conversion of reciprocating motion back to rotational motion and their applications in various mechanical devices.
5. Learn how power is transmitted from gear box to rear axle in automobile vehicle using universal joint or Hooke' joint principles.
6. Understand quick return motion mechanism and its application in mechanical devices.

Course Content

The slider crank experiment. Four bar mechanism. Hooks joints. Disc and cam follower experiment. Whitworth quick return mechanism. Slotted link. Scotch yoke, Geneva stop and Oldham coupling.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 409–Technology Development Policy [1 Unit; C; LH = 30; PH = 0]**Senate-Approved Relevance**

Train students with aggregate of management and operations capabilities, facilities-use, skills, knowledge, right thoughts and organization required to successfully create a useful and sustainable service or product within the constraints of limited resources. The students learn how to nurture those capabilities and optimize their applications in the creation of products, prescription of active industrial and technological policies for subnational or national goals and interests. The relevance is evident in the presence of SUMAS Mechanical Engineering graduates in almost every recognized industry across the globe. There are vast number of our graduates who have become captains of excellent industries, while many others have occupied technological policy positions in the Society. In all, the knowledge gained from the Course has helped our graduates to record great success in both private and public enterprises as well as in State and National governments.

Overview

Technology development policy are mainly decision-making measures designed for the creation, funding, supporting and mobilization of scientific and technological resources for promoting scientific and technological development. The course raises the social and economic standards of living and maintains profitability of investments. By carefully deepening the optimal site selection and locational considerations in students, it strengthens ecological conservation, improve public well-being, boost enterprise competitiveness and promote the gradual sustainable development of human society through suitable policy prescription and implementation.

Course Objectives

The objectives of the course are to:

1. Equip students with the requisite scientific and management skills to develop small, medium and large-scale service and goods producing enterprises
2. Equip students with the right disposition to handle material, machine and intellectual resources in both the industries and society
3. Equip graduates with right policy formulation capabilities that can match the ever changing and continuing revolutions to sustained industrial growth and national development.
4. Equip students with requisite scientific decision models that can boost global trade and technology plans to engender standard quality of life for citizens through global competitive systems of utilizing natural and human resources in a sustainable manner.

Learning outcome

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

1. know the historical trends and lessons from industrialization of developing and developed countries as well as formulate productive policies for technology development
2. Source funds for financial investments and optimal returns
3. Define and differentiate between production, productivity, productivity index and its effect in industrial development as well as develop techniques for increasing productivity
4. Apply management techniques to design, analysis and optimization of organizations
5. Know the basic procedures for work measurement, time study and methods study
6. know the necessary considerations for factory design, location and management
7. Understand the effects of improved working conditions on technology development and economic growth.

Course Content

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

Minimum Academic Standard

As described in CCMAS

GET 402 Engineering Project I (2 Units: C; PH 90)**Learning Outcomes**

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

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

Course Contents

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

GET 404 Engineering Valuation and Appraisal (2 Units: C; LH 30)**Learning Outcomes**

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

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

GET 499: Students Industrial Work Experience III (4 Units C: 12 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly, and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively 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 appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Logbook 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.

Final Year Courses**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.

MEE 503: Applied Design (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate proficiency in systematic scientific design methodology;
2. demonstrate creative application of the design process to engineering problems;
3. demonstrate proficiency in design for the manufacture of complete mechanical systems and devices;
4. undertake a group design project;
5. submit reports showing all calculations, justification for choice of design and instructions on detail design, manufacture, testing and use; and
6. demonstrate use and evaluation of a CAD/CAM software package in the actual manufacturing design project.

Course Contents

Scientific Design Methodology: creative application of the design process to engineering problems with emphasis on the manufacture of complete systems to accomplish overall

objectives of minimum weight, high efficiency while satisfying the design constraints. An appreciation of the process of engineering design, and of systematic procedures and tools usable in the design process, with particular reference to mechanical systems and devices. Topics include systematic problem definition, search for possible solutions, statistical analysis of stress/strength interference, experiment planning techniques, optimum design for minimum weight and cost, and management of the design process. Design Project: Students will be required to conduct a design project under supervision, using the presented techniques, and taking at least to a workable layout drawing of a device. The design should involve simple mechanical systems (e.g. testing and assembling devices, heat drive, etc.) for a specified duty, analyse its operating conditions and after considering the design criteria, choose between potential solutions. Reports submitted by students should contain all calculations, a comparison of potential solutions, justification for the design finally chosen, and instructions on detail design, manufacture, testing and use. Use and evaluation of several CAD/CAM software packages. Students will gain experience with CAD/CAM software while carrying out an actual manufacturing design project.

MEE 509: Project (6 Units C:L H/PH 270)

Learning Outcomes

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

1. identify an engineering research problem;
2. demonstrate proficiency in PowerPoint presentation in a seminar;
3. demonstrate a methodology for actualising aims and objectives of a research project;
4. partake in a group research project efficiently; and
5. submit report comprising a topic, abstract, problem statement, aims and objectives, methodology, experimentation and/or analysis, results and analysis, conclusion and recommendation.

Course Contents

Final-year projects are assigned at the beginning of each academic year. Each final year student chooses a project supervisor in consultation with the final-year project coordinator. The process is entirely interactive, but the coordinator ensures that there is an even distribution of students amongst the lecturers. The final topic is decided by the student and his supervisor, selected from the fields of mechanics of solids and fluids, materials science, machine design, heat power, heat transfer, production technology, industrial engineering and management. Each student presents at least two seminars as part of their final year

project, usually at the beginning and ending of the second semester. Each student is required to submit a report of their findings and undergo an oral examination. All seminars are scored by a panel of lecturers.

SUMAS-MEE 531-Mechanics of Materials II [3 Units; C; LH = 45; PH = 0]

Senate-Approved Relevance

Theory of Elasticity is a special branch of Mechanics of Materials. The latter is a course in mechanics in which the physical and mathematical principles of mechanics are employed to determine the properties of a structure or machine from known properties of materials. In general, the function of the theory of elasticity is to mathematically incorporate the loadings on a body with the geometry of the body and, if necessary, with the properties of the materials composing the body, so as to obtain knowledge of the internal “forces” within the body.

Overview

The course is designed to help the student to develop insight into, and an understanding of the elastic behaviour of engineering materials. These skills are inculcated by letting the student go through the acts of formulating, solving, and interpreting the solutions to a wide variety of structured material dynamics problems. In this way the student is enabled to build a reservoir of experience which he/she can draw upon for further insight and intuition when faced with new unstructured problems.

Course Objectives

The key objectives of the course are:

1. To develop a working knowledge of the relations between the loads applied to a non-rigid body made of a given material and the resulting deformations of the body.
2. To develop a thorough understanding of the relations between the loads applied to a non-rigid body and the stresses produced in the body.
3. To develop a clear insight into the relations between stress and strain for a wide variety of conditions and materials.
4. To develop adequate procedures for finding the required dimensions of a member of a specified material to carry a given load subject to stated specifications of stress and deflection.

Learning Outcomes

At the end of the course the student will be able to:

1. Define the terms body forces, surfaces, stresses, normal stresses, and shear stresses and to formulate a means of expressing these quantities mathematically.

2. Define the state of stress, i.e., equilibrium equations of stress throughout a body in terms of the components of stresses acting on the Cartesian coordinate system.
3. Investigate the equilibrium conditions that must exist for the entire stress field in a body.
4. Formulate the Laws of Stress Transformation
5. Gain a better intuitive view of the mechanism of stress relations throughout a body and an understanding of the equations.
6. Define the term strain and investigate the state of strain in a body.
7. Derive the conditions of compatibility of strain with displacement in a body in terms of strain.
8. Define the state of strain at point in a body and the Laws of transformation of strain.
9. Analyse the stresses and deformations within a body subject to a prescribed system of forces by solving which describe the stress and strain fields.
10. Determine by theoretical analysis or by experiment the limiting values of load which a structural or machine member can sustain without suffering damage, failure, or comprise of function.
11. Investigate the Theories of Failure of load resisting elements.
12. Determine the body shape and select those materials which are most efficient for resisting a prescribed system of forces under specified conditions of operations such temperature, humidity, vibration, and ambient pressure.

Course Content

Strain energy, principle of virtual work. Castigliano's theorem, principle of least work. Statically indeterminate beams. Plastic analysis. Columns – stability of elastic mechanical systems. Long straight columns effect of and conditions. Eccentric loading. The secant formula. Empirical formulae for intermediate and short columns. Impact loading.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 551–Fluid Mechanics II [3 Units; C; LH = 45; PH = 0]

Senate-Approved Relevance

The knowledge of course helps the student analyse the behaviour of liquids and gases and using that knowledge in the design and development of machinery and systems that can and/or do influence that behaviour (pumps, fans, turbines, piping systems, etc.)

Overview

This course provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyse, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

Course Objectives

The course is designed to help mechanical engineering student: explain the basic concepts in fluid mechanics; describe the physics and formulate mathematical descriptions of viscous flows; Interpret Navier-Stokes equations and how to obtain the exact solutions of canonical problems; Identify the fundamental concepts in vorticity dynamics, boundary layer theory, and turbulence; and formulate physical model and mathematic model to solve typical fluids problems of engineering importance.

Learning Outcomes

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

1. Explain the basic concepts in fluid mechanics; describe the physics and formulate mathematical descriptions of viscous flows;
2. Interpret Navier-Stokes equations and how to obtain the exact solutions of canonical problems;
3. Identify the fundamental concepts in vorticity dynamics, boundary layer theory, and turbulence;
4. Formulate physical model and mathematic model to solve typical fluids problems of engineering importance.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 561–Engineering Thermodynamics IV [3 Units; C; LH = 45; PH = 0]

Senate-Approved Relevance

Thermodynamics is an important part of physics and engineering. As a result, it is an important area of study for those interested in science and technology. Thermodynamics is also useful in ecology, energy, and other fields of study. Furthermore, analogous concepts (particularly those analogous to entropy) are used in information theory/computer science. This course would help the engineering student advance in the field of thermodynamics.

Overview

This is a high level in thermodynamics. It covers the determination of thermodynamic properties of pure substances and mixtures, application of the laws of thermodynamics for a control volume, explaining the second law of thermodynamics, including why it is necessary, and how it is defined (Kelvin-Planck and Clausius), explaining the concept of entropy, including the Clausius Inequality, using thermodynamic tables, setting up entropy balances.

Course Objectives

The course is geared towards: (1) explain thermodynamic laws, variables and functions and their practical significance, (2) Deriving important thermodynamic relations, (3) Performing numerical calculations of thermodynamic variables, and (4) Applying thermodynamic principles to analyse practical problems

Learning Outcomes

At the end of the course, the student is able to:

1. Explain thermodynamic laws, variables and functions and their practical significance
2. Derive important thermodynamic relations
3. Perform numerical calculations of thermodynamic variables
4. Apply thermodynamic principles to analyse practical problems

Course Content

Non-ideal pure substances. Equations of state and compressibility factors. General thermodynamic relations: Maxwell's relations, T-ds equations, energy equations, Clausius

Claperon equation, difference in heat capacities, Joule Thompson's coefficient. Mixtures and solutions: Ideal gas mixtures; gas-vapour mixtures; psychometry; psychometric chart; air-conditioning processes; cooling towers. (Fugacity and activity coefficients). Thermodynamics of chemical reactions: first law and second law analyses of reacting systems. Chemical equilibrium and Dissociation. Introduction to phase and chemical equilibrium.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 534– Materials for Engineering Applications [2 Uni; C; LH = 45; PH = 0]

Senate-Approved Relevance

Materials are essential elements of every engineering design. A knowledge of the various types of engineering materials and the various factors that affects the selection of such materials is very important.

Overview

This course looks at the various engineering materials available such as Metallic and non-metallic compounds. It also examines the structure, composition, mechanical and thermal properties of materials as well as the modification of properties through changes in microstructure (Heat treatments). Welding Metallurgy; modern techniques of welding and applications, destructive and non-destructive testing of materials, ultrasonic and X-ray tests are considered.

Course Objectives

The objectives of material for engineering application are to:

1. Equip students with the knowledge of classification of engineering materials
2. Help student understand the structures, compositions and properties of engineering materials
3. Acquaint students with the knowledge of modification of properties of engineering materials.
4. Aid students in the knowledge of various welding techniques and their various applications.
5. Understand the various factors in material selection by the students
6. Identify materials for various engineering applications.

Learning outcomes

When the course is completed, students should be able to:

1. Classify engineering materials.

2. Know the composition and properties of various engineering materials.
3. Change the microstructure through various heat treatment processes so as to modify the properties of engineering materials.
4. Gain the knowledge of different welding techniques and their application
5. Know the factors involved in engineering material selection.
6. Select engineering materials for various application.

Course Contents

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 586 – Engineering Economy [3 Units; C; LH = 45; PH = 0]**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:

7. Equip students with grounded skill of economic decision making in engineering considerations.
8. Take students through a taxonomy of engineering costs and valuation.
9. Educate students on the principle of time value of money and cash flows.
10. Introduce the economic methods for evaluating capital projects and mainstream cash flow analysis.
11. Acquaint students with the understanding of Sensitivity and Breakeven analysis.
12. Introduce the required elements of Accounting in Engineering.

Learning Outcome

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

6. Take economic and optimal cost decisions in Engineering.
7. Compute fixed and variable costs, recurrent and non-recurrent costs, life-cycle costs, as well as cost estimation models.
8. Compute cash flows; time value of money; simple interest, compound interest, interest formulas, economic analysis with spreadsheets.
9. Undertake economic Sensitivity and Breakeven analysis, compare alternatives and decision analysis as well as uncertainty (Risk) analysis.
10. 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-MEE 552– Computational Fluid Dynamics [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

Computational fluid dynamics (CFD) is a science that, with the help of digital computers, produces quantitative predictions of fluid-flow phenomena based on the conservation laws (conservation of mass, momentum, and energy) governing fluid motion. Computational Fluid Dynamics (CFD) is very important to various aspects of engineering that involves fluid flows. CFD simulation is used to optimize heat transfer in everything from automobile engine designs to coffee machine designs. It is also vital to a myriad of other simulation types mentioned on this list (like HVAC) — where heat transfer is an integral component of a product's core function

Overview

The course covers the numerical solution of equations governing fluid flow and would be of interest to aspiring and professional engineers and scientists with chemical/ mechanical/ civil/ aerospace engineering applications. In all of these fields, one must deal extensively with fluid flow phenomena and resolve flow-related features of processes and equipment. Although the equations governing fluid flow were developed more than 150 years ago, they have only recently been solved in practical applications where the flow occurs. The course covers the fundamental techniques for numerically solving these equations.

Course Objectives

The course provides an introduction to computational fluid dynamics.

1. The students will train the numerical solution of model problems by developing and testing own MATLAB programs.
2. The students will learn to assess the quality of numerical results and the efficiency of numerical methods for basic fluid flow model problems.

Learning Outcomes

After completion of this course, the student will have knowledge on:

1. Classification of the basic equations of fluid dynamics.
2. Basic space and time discretization methods.
3. Numerical solution of advection, diffusion and stationary problems.
4. Numerical solution of conservation laws.
5. Analysis of accuracy and stability of finite difference methods for model equations.

Furthermore, the student would have skills on:

1. Practical use and programming of numerical methods in fluid dynamics.
2. Checking and assessing the accuracy of numerical results.
3. Assessing the efficiency of numerical methods.
4. Consistency analysis and von Neumann stability analysis of finite difference methods.
5. Choosing appropriate boundary conditions for model problems.
6. The use of some CFD tools.

Course Content

Introduction to CFD and CFD software (Open FOAM, ANSYS Fluent, COMSOL, Star CD, etc.). Defining a CFD problem: Creating and Importing Geometry in block Mesh. Kinematic properties of fluids and conservation laws. Navier-Stokes equations and similarity. Initial and Boundary Conditions: practical guidelines. Turbulence: basics and introduction. Turbulence: applications of models. Computational methods – discretisation. Solution Procedures. Post Processing – analysis of results. Validation and Verification.

SUMAS-MEE 555– Aerospace Engineering Fundamentals [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

Aerospace Engineering is a very important aspect /specialization of mechanical engineering. Aerospace Engineers are involved primarily in designing aircraft and propulsion systems and in studying the aerodynamic performance of aircraft and construction materials. They work with the theory, technology, and practice of flight within the Earth's atmosphere. This course is designed as a "top-up" for engineering final year students with little or limited previous knowledge of aeronautical engineering.

Overview

This is an introductory course on Aerospace engineering for a senior year mechanical engineering student. It provides the fundamental principles of flight mechanics and the fundamental concepts of subsonic and supersonic aerodynamics to helicopter analysis. It describes the principles of propulsion system design and operation.

Course Objectives

The objectives of the course are to:

1. Relate the principles of flight mechanics and the fundamental concepts of subsonic and supersonic aerodynamics to helicopter analysis.
2. Describe the principles of propulsion system design and operation.
3. Analyse the design and operation of military rotorcraft.
4. Analyse the performance of various types of propulsion units fitted to modern rotorcraft.

Learning Outcomes

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

1. Acquire skills such as programming in a variety of languages; general purpose application tools; modelling and simulation techniques; and applications of associated software in design.
2. Master the principles of propulsion design and operations.

Course Content

Classification of aerospace vehicles; parts of aircraft; standard atmosphere. 1-D Compressible flow aerodynamics: conservation equations, viscosity and speed of sound. Air foils; wing aerodynamics: geometric and nomenclature, lift, drag, characteristic curves, etc., high-lift

devices. Aircraft structures: materials, loads, structural elements. Aircraft instruments and systems. Aircraft propulsion: propeller propulsion; jet propulsion, air breathing propulsion cycles basics; types of jet engines (Turboprop, Turbojet, Turbofan, Ducted Fan & Ramjet). Diffusers & Nozzles. Aircraft engine selection. Flight mechanics: performances, stability and control.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 557– Fluid Power Transmission Systems [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

Transportation, construction, agriculture, and other off-road applications, machining, ship control, space technology, aircraft, and many more applications incorporate fluid power technology. In recent years, the academic world has tried to keep up with the increasing demand for engineering and technical specialists in hydraulic and pneumatic systems by offering new courses, or even a fluid power option. However, properly trained people are still at a premium in this area, and many fluid power manufacturers have undertaken educating their own and their customers' staff members to meet this professional expertise need.

Overview

Fluid power plays an important role in many sectors of the economy: aerospace, machine tools, agricultural, industrial, processing equipment, transportation vehicles, etc. This course builds on the Fluid Mechanics and Dynamics courses and provides students with a theoretical framework as well as practical knowledge of fluid power systems. This course covers various aspects of pneumatics and hydraulic system designs. It covers valves and actuators, design of hydraulic circuits, pneumatic and hydraulic system designs.

Course Objectives

To know the concepts of hydraulics & pneumatics, components of hydraulic and pneumatic circuits and applications of hydraulics and pneumatics in various systems and combination circuits.

Learning Outcomes

At the end of the course, the student is expected to be able to:

1. Understand the purpose and applications of fluid power systems.
2. Explain the functions, types, construction and working of different types of valves and actuators.
3. Understand purpose, types construction and working of different components of different hydraulic circuits.

4. Explain purpose, applications, types, construction and working of different components of pneumatic system

Course Content

Properties of hydraulic fluids. Dynamic flow analysis; Hydraulic, pneumatic, and fluids systems and components; characteristic of flow and pressure control valves, actuators, position motors, pumps. Hydro-static and hydrodynamic power transmission systems. Filtration and heat control in hydraulic systems. Seals and packings. System design and circuit analysis. Introduction to pneumatics Pneumatic logic control. Applications and testing procedures.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 563– Automotive Engine Fundamentals [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

Automotive engines find application in different types of locomotives. It is very important to understand the mechanism of operation of such systems and how to evaluate the performance of the system under various conditions.

Overview

This course introduces students to the systems and components of modern automobiles, basic hybrid/electric vehicles, and maintenance items that modern automobiles require.

Course Objectives

The objectives of this course are to help the learners:

1. Understand the basic components, concepts, and general terminology often associated with automotive engines.
2. Understand the operation of internal combustion engines.
3. Understand the design and operating characteristics of conventional spark-ignition (gasoline), compression-ignition (diesel), and stratified charged spark-ignition engines.
4. Perform theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses.
5. Calculate engine operating parameters.
6. Understand the implications of a tradeoff between performance, efficiency, emissions.
7. Assess the relation between engine power output to the required power for vehicle propulsion.

8. Discuss and evaluate the design of engine components.

Learning Outcomes

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

1. Describe basic components, concepts, and general terminology often associated with automotive engines.
2. Understand the operation of internal combustion engines.
3. Understand the design and operating characteristics of conventional spark-ignition (gasoline), compression-ignition (diesel), and stratified charged spark-ignition engines.
4. Perform theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses.
5. Calculate engine operating parameters.
6. Understand the implications of a tradeoff between performance, efficiency, emissions.
7. Assess the relation between engine power output to the required power for vehicle propulsion.
8. Discuss and evaluate the design of engine components.

Course Content

Power Cycle Thermodynamics: Basics of Otto and Diesel cycle; Mixtures and Solutions. Power Plants for Automobiles: Elements of Petrol and Diesel Engines, Engine Performance curves. Piston Engine Components and Electronic Controls. Engine Tribology (Friction, Lubrication and Wear). Engine Modelling. Engine Vibration and Balance. Fuels and Combustion. Engine Exhaust Emissions: Air pollution, control measures and Euro-norms. Engine Manufacturing.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 565– Fundamentals of Nuclear Engineering [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

To train high-quality graduates who are well skilled and knowledgeable in the practice of Mechanical Engineering in the society. The ideas embodied in the course provides an avenue for the students to grasp and appreciate all the areas of Mechanical Engineering concepts by inculcating an introductory real time Mechanical Engineering knowledge into the students, which will later be expanded in subsequent years. It is geared towards understanding and applying the theoretical principles of the course that are required to position graduates for a robust Technological disposition for later service to humanity. The relevance is typified in the capacity of SUMAS graduates of Mechanical engineering to manage large production and

industrial concerns requiring ample human and material resources, as well as capacity to develop and maintain critical infrastructural facilities in leading engineering services.

Overview

Nuclear Engineering deals with the study of the nucleus of an atom for the purposes of extracting energy and other applications in solving human problems. The course introduces students to the application of nuclear engineering in Agriculture, Medicine, Archaeological studies, and industries. It also provides the students the basic knowledge of the configuration and operation of nuclear reactors, shields, water moderators and coolants.

Course Objectives

The objectives of the course are to:

1. Prepare the students to understand basic fundamentals of nuclear engineering.
2. Understand the nucleus of an atom.
3. Enable the student to understand the operation of nuclear reactors.
4. Offer students the knowledge of fundamental applications of nuclear engineering in everyday life as well as industrial application.
5. Introduce the student to radiation protection and safe guards, hazards and health reaction radiation.

Learning outcome

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

1. Understand basic knowledge of nuclear engineering.
2. Understand the fundamentals of different nuclear reactors and their operation.
3. Understand different types, control and moderation of homogeneous and heterogeneous nuclear reactors.
4. Identify biological effects of nuclear radiation and its application in medicine, agriculture, industry and environment.
5. Acquire basic knowledge of radiation protection principles and reactor safe-guards. They will be equipped with knowledge of radiation hazards and their health implication.
6. Understand thermal problems in reactor coolants, reactor structural and moderator materials
7. Carry out basic analysis of nuclear energy production from nuclear engineering systems
8. Ready to undertake advanced studies in nuclear engineering and its applications in power generation

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 569 – Direct Energy Conversion principles [3 Units; C; LH = 45; PH = 0]

Senate-Approved Relevance

Energy is the key driver of modern development in any country or economy. It is a catalysis for development. Energy often exists in forms that are not very useful, so they have to be converted from their natural form to a form that can be more useful. This course looks at the various principles used for converting energy from one form to another. It exposes the mechanical engineering student to the fundamental principles and the most suitable methods for converting energy from one form to another.

Overview

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

Course Objectives

The course has the following objectives - to:

1. Develop an analytical and quantitative framework for comparing the five major direct energy conversion methods and develop an approach for making choices based on specific optimization goals.

2. Develop a thermodynamic framework that includes other basic principles for energy conversion (basic principles of heat transfer, quantum mechanics, the solid state, transport theory and electromagnetics).
3. Develop the models necessary to study, analyse and design energy conversion systems through the application of these principles.
4. Develop the problem-solving skills essential to good engineering practice in the energy conversion systems area.
5. Develop the framework for understanding of uses of energy storage and ways of its storage.

Learning Outcomes

The learning outcomes are closely related to the objectives in that they serve as the parameter for assessing whether the objectives have been achieved. The students should be able to

1. Apply energy conversion models to real life situations and be able to solve the ensuing problems.
2. Analyse the performance of each conversion method in order to determine the optimum performance level of each case with respect to efficiency and energy capability.
3. Apply the knowledge of semiconductors to analyse the thermoelectric and PHotovoltaic systems.
4. Evaluate each method for sustainability with respect to the available input energy resource.
5. Determine the maximum thermal efficiency obtainable from a thermoelectric generator using a (i) multistage approach and (ii) segmented arm approach.
6. Explain other useful approaches for enhancing thermoelectric properties, such as (i) band structure engineering, and (ii) by doping and exploring new materials with complex crystalline structure.
7. Evaluate the figure of merit, Z , boundary imposition on the performance of the thermoelectric generator.
8. Analyse the feasibility of a solar electric generating system for a power system and be able to compare generating loads and costs with conventional fossil fuel plant.
9. Show that for a solar cell, the dark current has a strong dependence on temperature and be able to discuss the limitations on photovoltaic energy converters.
10. Size a photovoltaic system for electrical use.
11. Evaluate practical direct energy conversion systems and be able to make recommendations for the improvement of the given system.
12. Design and fabricate systems which run based on the learned principles.

13. Generate hypothetical hybrid combinations of the systems and evaluate the potentials of such combinations for power generation.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 572–Thermal Engineering and Advanced Heat Transfer [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

With long-term development goals in mind, the heat and power sector is undergoing a revolutionary shift toward greener energy, and global businesses must adapt to meet ever-increasing current and future demands. Domestic and industrial heat contribute significantly to global GHG emissions, and reducing this is a critical challenge for future engineers seeking to build a greener society. Highly skilled, passionate and knowledgeable heat (thermal) engineers are urgently needed to transition our heat systems to a green, sustainable footing.

Overview

The course covers the following: Advanced heat transfer: unsteady conduction, analytical methods, graphical and numerical methods, electrical analogue circuits. Energy transfer with change of phase, iterative processes in combined modes. Solar Energy: nature of solar radiation, direct, diffuse and reflected irradiance, ephemeris transit, equation of time. Solar flux, solar collectors, applications of solar energy and prospects. Thermal management in electronic systems: Introduction to packaging and heat transfer principles, cooling technologies, thermal measurements and systems analysis, emerging electronics cooling technologies

Course Objectives

The objectives of this course are to:

1. Enhance the understanding of heat transfer processes and their relevance to industrial problems
2. Understand the derivation and physical meaning of energy transport equations

3. Strengthen analytical, numerical and computational skills to solve complex heat transfer problems
4. Provide experience in treating multimode heat transfer effects and in solving realistic engineering problems.

Learning Outcomes

At the end of the course, the students are expected to:

1. Analyse complex heat transfer problems.
2. Design heat transfer equipment and carryout performance evaluation.

Course Content

Advanced heat transfer: unsteady conduction, analytical methods, graphical and numerical methods, electrical analogue circuits. Energy transfer with change of phase, iterative processes in combined modes. Solar Energy: nature of solar radiation, direct, diffuse and reflected irradiance, ephemeris transit, equation of time. Solar flux, solar collectors, applications of solar energy and prospects. Thermal management in electronic systems: Introduction to packaging and heat transfer principles, cooling technologies, thermal measurements and systems analysis, emerging electronics cooling technologies

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 568 –Power Plant Engineering [3 Units; Compulsory; LH = 45; PH = 0]

Senate-Approved Relevance

Power Plant Engineering basically focuses on power generation principles for real world applications. More specifically this course is focused on application of energy principles and power generation cycles. The main purpose of implementing this course in curriculum is to learn about how the power is generated in a power plant and its applications.

Overview

The course looks at the various sources of energy and the energy conversion principles. It also looks at the combustion processes of fuels, internal combustion engines, thermal power plants such as Steam power plants, Gas turbine plants, hydroelectric power plant, and Nuclear power plant.

Course Objectives

1. Expose the student to various sources of energy and the energy resource availability.

2. Explain the components, principles and working of conventional & non-conventional power plants.
3. Introduce students to different aspects of power plant engineering.
4. Familiarize the students to the working of power plants based on different fuels.

Learning Outcome

At the end of the course, a student will be able to:

1. Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
2. Analyze the working and layout of steam power plants and the different systems comprising the plant.
3. Combine concepts of previously learnt courses to define the working principle of diesel power plant, gas power plants, its layouts and compare it with plants of other types.
4. Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.
5. Discuss the working principle and basic components of the hydroelectric plants and the economic principles and safety precautions involved with it.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 547– Automobile Engineering [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

Automotive Engineering is an important aspect of mechanical engineering that deals with the development, production, installation and disposal of various types of automotive systems and components. This course is very helpful to students who wish to take up a career in the field of automobile engineering.

Overview

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

Course Objectives

The objectives of this course are to make the student learn:

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels, Suspension, frame, springs and other connections
4. Emissions, ignition, controls, electrical systems and ventilation

Learning Outcomes

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

1. Identify the different parts of an automobile
2. Understand the principles and working of different systems of automobiles.
3. Understand the principles and design of different systems of automobiles.
4. Explain the working of various parts like engine, transmission, clutch, brakes
5. understand the principles and working of Electrical systems of automobiles.
6. Understand the design and working principles of Chassis systems of automobiles.
7. Understand the specifications of automobiles.
8. Describe how the steering and the suspension systems operate.
9. Evaluate the performance of automobiles.
10. Develop a strong base for understanding future developments in the automobile industry

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 562– Refrigeration and Air-conditioning [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

The primary goal of using air conditioning and refrigeration is to reduce the temperature of a specific area in comparison to its surroundings. These can be found in a variety of domestic and industrial appliances such as air conditioners and refrigerators. This course is designed to give the student a foundational understanding of the working principles of an air-conditioning/refrigeration system.

Overview

This course covers various types of refrigeration and air-conditioning systems and refrigerants. Elements and Design of Refrigeration systems. Reverse application of refrigeration – heat pumps. Steady state and transient cooling load calculations. Principles of air-conditioning with emphasis on thermodynamic processes involving air, water, vapour mixtures. Production of atmospheric and thermal environments for human activity. Heat sources and climatic considerations. Comfort and physiological aspects. psychometry and psychometric processes.

Course Objectives

The objectives for this course are for the students to:

1. Understand the basic principles and methods of refrigeration and air conditioning.
2. Investigate different refrigeration cycles and assess their performance using Mollier charts and/or refrigerant property tables.
3. Compare the properties, applications, and environmental issues of various refrigerants.
4. Recognize the fundamental air conditioning processes using psychometric charts.
5. Determine the cooling load for various applications in residential and industrial air conditioning.
6. Investigate the various equipment-operational principles, operational and safety controls used in refrigeration air conditioning systems.

Learning Outcomes

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

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system.
2. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems.

3. Present the properties, applications and environmental issues of different refrigerants.
4. Calculate cooling load for air conditioning systems used for various.
5. Operate and analyze the refrigeration and air conditioning systems.

Course Content

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

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 513– Manufacturing and Tools Engineering [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

Manufacturing engineering encompasses the steps needed to manufacture products after they've been designed and tested. Manufacturing engineers focus on the design and operation of integrated systems for producing high-quality, economically competitive goods. They design the processes and facilities for making many of the products we take for granted every day. They develop and deploy the necessary machine tools, computer networks, robots and automation procedures, materials handling equipment, and quality control workflows. They plan factory operations to ensure timely production, consistent quality, and a safe workplace.

Overview

This course covers the following aspects Manufacturing unit processes and material considerations, Powder forming techniques; theory and practices of powder consolidation, design considerations. Joining techniques, Machining theory and practice. Fundamental aspects of machine tool design and control, machine tool dynamics and computer aided design.

Course Objectives

To provide an overview of the concepts, theory, operation, and application of manufacturing processes with an emphasis on the production of durable goods from engineering materials. The student will apply quantitative analysis techniques to the solution of manufacturing problems, as well as gain an understanding of the appropriate processes to specify while designing products for manufacturing.

Learning Outcomes

At the end of the course:

1. Students will demonstrate the ability to break down manufacturing processes for analysis.
2. Students will demonstrate the ability to identify known and unknown parameters including initial and boundary conditions for major manufacturing processes.
3. Students will demonstrate the ability to draw clear and appropriate free body diagrams and control volumes of select manufacturing processes.
4. Students will demonstrate the ability to apply the fundamental principles from prerequisite courses in mechanics, materials and thermo-fluids to analyze manufacturing processes
5. Students will demonstrate the ability to integrate the relevant core principles in mechanical engineering (mechanics, materials and thermo-fluids) to solve problems in manufacturing.
6. Students will demonstrate the ability to carry out manufacturing process design based on first principles.
7. Students will be able to interpret product requirements, manufacturing process capability data and apply them to select and/or synthesize suitable manufacturing process(es)

Course Content

Manufacturing unit processes and material considerations. Casting techniques. Solidification and heat flow theory, defect formation, casting design, metal forming. Elementary plasticity theory, plastic failure criteria, force and work calculations. Power forming techniques; theory and practices of power consolidation, design considerations. Joining techniques. Heat flow and defect formation theory, residual stresses. Machining theory and practice. Heat treatment and surface hardening. Diffusion theory, principles of wear resistance. Metrology. Additive manufacturing: (1) History and prospects of 3D printing; (2) Scientific processes; (3) Materials; Polymer, Ceramics, Metal and composites; (4) Design and Fabrication. Tools engineering: tool materials, plastic mould design, jig and fixture design principles, die design, mechanized

assembly, and functional ganging. Fundamental aspects of machine tool design and control, machine tool dynamics and computer aided design.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 515–Design of Welded and Cast Structures [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

Welded and Cast Structures are very prominent in a lot of engineering applications. For this reason, it is very important that the mechanical engineering undergraduate student is thoroughly equipped with the knowledge and skills to be able to design, Analyze and manufacture them.

Overview

This course presents the concepts behind welding and joining technology. These include welding and joining techniques, equipment and consumables, weldability of engineering materials, economics, standards, health and safety, testing and repair. The concepts are then applied to the design and fabrication of engineering components, process plant and structures. The importance of selecting the correct welding process and parameters for a particular application will be demonstrated by investigating several case studies. Since a weld/joint can have a profound effect on the performance of a component depending on the in-service conditions it experiences, the influence of service environment will be investigated. At the end of the course students should have the concepts to assist in the selection of processes and parameters to make appropriately designed, sound joints, fit for service in the operating environment.

Course Objectives

1. Enable students understand how to account for the various design factors in the use of casting as a manufacturing method.
2. Enable students understand how to account for the relevant design factors in the implementation of welding as a manufacturing method.
3. Enable students appreciate the various methods of preventing the production of defective weldments and castings.
4. Acquaint students with the techniques of assessing quality of welded as well as cast components.

5. Enable students understand the importance of quality control in welding and casting operations.
6. Enable students understand the criteria for material and process selection.
7. Enable students understand how to determine the cost of manufacturing equipment.
8. Enable students to plan and execute simple manufacturing operations using casting and welding manufacturing methods.

Learning Outcomes

The students upon completion of this course will be able to:

1. Understand elastic, plastic and creep behaviour of welded connections.
2. Learn how to conduct analysis of the stresses operational on welded connections, the impact of Stress fatigue on welded joint as well as methods of prevention of fatigue cracks in welded joints.
3. Understand weldability of materials and be able to select the most appropriate welding process for a particular welding design and the relevant design considerations.
4. Define weldment, welds and different weld types, as well as types of welded joints and the factors to consider when designing weldments like pressure vessels.
5. Perform welding design calculations with due consideration given to welding parameters as well as the determination of appropriate weld size for a given joint and sizing of welded components.
7. Specify welds using symbols and standard welding codes.
8. Understand methods of assessing the quality of a welded connections, importance of quality control and inspection in welding operations and welding defects.
9. Appreciate the various criteria for material and process selection in welding operations.
10. Understand the general casting processes, casting stages, castability and casting design considerations.
11. Learn the design, sizing and techniques of casting process components like moulding, pattern and core making.
12. Understand gating system, types of gating and design of gating system as well as the importance of good gating system design to achieving a quality casting.
13. Conduct quality control assessment of casting as well as the determination of casting defects.
14. Understand the various components of equipment costing.
15. Carry out practical/ laboratory work involving the production and evaluation of weldments and castings.

Course Content

Review of elastic, plastic, and creep behaviour of materials and introduction of low-cycle and multi axial stress fatigue. Welding and casting processes. Design of weldments and castings with application to pressure vessels and other structures. Analysis of industrial welding processes. Material and process selection, codes and specifications, costing equipment. Laboratory experience in the production and evaluation of weldments and castings.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 533– Engineering Metallurgy [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

This course provides a broad introduction to the fundamental principles of metallurgy. The course is very useful to Engineers and Materials Technologists, Mechanical, Industrial, Aerospace and Manufacturing Engineers Forging, Casting, Rolling and Extrusion Process Engineers, Laboratory Managers.

Overview

This course provides a broad introduction to the fundamental principles of metallurgy. The student will gain an understanding of basic and practical applications in various fields of metals and alloy behaviour and manufacturing processes.

Course Objectives

1. Provide students with the understanding of heat treatment, and the various methods of materials refinement.
2. Acquaint students with knowledge of the various materials strengthening techniques.
3. Provide students an understanding of the mechanisms of fracture and the methods of protection against material fracture.
4. Expose students to the techniques of material structure determination and characterization.
5. Understand methods of controlling the degradation of engineering materials.
6. Enable students understand material conservation and the various approaches to engineering material conservation.

7. Acquaint students with basic knowledge for analysis of material processing operations.
8. Enable students to appreciate the reason for the modification of the properties of a given engineering material to enable it perform better in a given service operation.
9. Equip students with the knowledge necessary for proper selection of materials for specific engineering application.

The Learning Outcomes:

1. The students upon completion of this course will be able to:
2. Appreciate the importance of Materials Engineering and the reasons for the modification of the properties of engineering materials for their respective engineering applications.
3. Understand heat treatment, and the various heat treatment techniques as applicable in engineering materials.
4. Appreciate the various material strengthening techniques, and when to apply each of them to enhance or improve existing materials.
5. Describe and interpret the mechanical properties of metals/material.
6. Identify the relationships between the crystal structure, grain size and the properties of metals.
7. Draw strain-stress graphs and their applications in the selection of materials for different applications.
8. Understand cooling curves, and the relationship between cooling curves and equilibrium diagram of a system of alloy.
5. Appreciate and apply phase rule in the refinement of metals.
6. Construct and interpret the phase diagrams of metals and the applications of phase transformation.
7. Understand diffusion and the mechanism of diffusion in solids, and the various applications of diffusion in metallurgical processes.
8. Understand hardenability and graphitization processes as well as their effects on the performance of components made of cast irons, steels.
9. Describe Quenching and its applications in various material processing operations.
10. Understand dislocation, types and sources of dislocation and the impact of dislocation on the behaviour of metals.
11. Understand X-ray and electron diffraction techniques as well as their application in material

structure determination.

12. Explain Fracture of materials, fatigue, and the creep behaviours of materials and their applications in design.
13. Understand corrosion, types of corrosion and the interaction between metals and their environment during their service life, and how to mitigate the negative effect of such interactions on the properties of metals/materials.
14. Appreciate conservation of engineering materials, the need for conservation of engineering materials and the methods of conservation of engineering materials.
15. Appreciate transport processes as applicable in material processing operations.
16. Apply knowledge gained to produce solutions to societal problems that meet specific needs, with consideration of public health, safety and welfare, as well as global, social, environmental, and economic factors.

Course Content

Age-hardening and isothermal transformation processes, quenching and tempering, hardenability and graphitization processes. Fracture mechanics applied to metal, ceramics and polymers. Dislocation. X-ray and electron diffraction. Industrial metallurgy, corrosion and high temperature oxidation theories. Material conservation. Quenching of metals, glasses, polymers textiles, paper and wood. Transport processes; analysis of heat and mass transfer in materials processing operations.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 543– Vibrations and Control [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

It is important for students to learn how to treat vibration phenomena in machines and systems by transforming the physical model into a mathematical model and solving it by using the appropriate mathematical operations to find the response and analyze this response and bring it back to its physical concept. This course would provide the mechanical engineering student with a strong background in this area.

Overview

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

Course Objectives:

1. To introduce the student to the basic principles of Vibrations.
2. To expose the student to the fundamental tools involved in the study of Vibrations.
3. To impart in the students the ability to excite a system into vibration, draw the ensuing free body diagram; set up the equations of motion and ultimately solve the resulting equations for the natural circular frequency of the system in question.

Learning outcomes:

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

1. Understand what is vibration.
2. Grasp what type of motion is tackled in the analysis of vibration: The Simple Harmonic Motion as opposed to Smooth-moving rotating motion as can be found in ceiling fans.
3. Use block and free body diagrams to illustrate different degrees of freedom, forced and damped vibrations in action.
4. Set a system into 'vibration' and consequently (1) draw the ensuing free body diagram (2) set up equations of motion representing the order/degree in question (3) and solve the resulting equations for the natural circular frequency of the system.
5. Differentiate between linear vibration systems as against torsional systems.

Course Content

Free and forced oscillations of single degree of freedom systems. Damped vibrations. Vibration isolation and measurement. Two and multiple-degrees of freedom systems. Electro-mechanical analogies. Linear systems of the first order. Response to standard inputs. The closed loop control system. Block diagram algebra. Stability analysis. Electrical systems. Dynamics of Machinery: Kinematic and dynamic analysis and synthesis of mechanisms and machines.

Design and analysis considerations in reciprocating and rotating machinery. Vibrations in machinery: Vibrations of systems with more than one degree of freedom. Vibration and shock isolations; Experimental investigation of dynamic systems.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 512– Design of Pressure Vessels [3 Units; E; LH = 45; PH = 0]**Senate-Approved Relevance**

A pressure vessel is a container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. They have wide application in industries including oil & gas, chemicals, petrochemicals. The knowledge and skills that can be obtained from this course are enormous and very important for any engineer that seeks a career in this aspect of mechanical engineering.

Overview

Pressure vessels are compressed gas storage tanks designed to hold gases or liquids at a pressure substantially different from the ambient pressure. They have a variety of applications in industry, including in oil refineries, nuclear reactors, gas reservoirs. Pressure vessels are containers used to handle fluids which are highly toxic, compressible and which work at high pressures as well as nontoxic such as steam. Failure of pressure vessels has adverse effects on the surrounding and the industry which can cause loss of life, property and damages. The design of pressure vessel depends on factors such as pressure, temperature, material selected, corrosion, loadings, and many other parameters depending on the applications. The use of Finite Element Methods and Analysis techniques provide results on failure in pressure vessels and the use of software in pressure vessel design is utilized for simulation before actual modelling takes place. The pressure vessel is designed according to the standard available codes such as ASME (American Society of Mechanical Engineers) Section VIII Division 1, EN/DIN (European) Code, IS (Indian Standard) Code. The design of pressure vessel is based on parameters such as pressure, temperature, corrosion, material selection, etc., the study of such parameters helps in designing of the vessel.

Course Objectives

The objectives of the course are to:

1. Understand the engineering and design calculations in designing pressure vessels.

2. Describe fatigue analysis and explain theories of failure and design margins
3. Understand and describe the application of code organization, scope and ASME section VIII-1 in pressure vessel design.
4. Identify the basic calculations for some loadings and situations not addressed by the code.
5. Introduce the use of software in modelling and simulating the design of pressure vessel.

Learning Outcomes

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

1. Determine the adequate design conditions.
2. Design and calculate all the main components of pressure vessels under internal and external pressure.
3. Understand the calculation of conical heads and transitions.
4. Design different type of nozzles and supports due to wind and seismic.
5. Perform calculations to determine the minimum wall thicknesses of all the main components of pressure vessels based on pressure and design temperature.
6. Identify materials and describe fabrication requirements.
7. Identify design rules and stress analysis methods.
8. Explain pressure testing and pressure relief requirements.
9. Describe and understand scope, purpose, and organization of the Code: ASME Section VIII-1.
10. Define allowable materials, explain how to reclassify materials and identify material traceability requirements.
11. Explain how to apply the Code rules to common design and fabrication situations.
12. Apply gained knowledge to pressure vessel design, which is the backbone of Oil and Gas.
13. Get familiar with the terminology and acquire vocabulary and fundamentals.
14. Use software in modelling and simulating pressure vessel before actual fabrication takes place.

Course Content

Overview of pressure vessels. Overview of pressure vessel design codes (e.g. the ASME Section VIII). Design PHilosoPHY. Structural design criteria; Stress/failure theories. Load categories; Failure categories; Stress categories and limits. Design of cylindrical shells, heads and covers, nozzles and openings. Fatigue assessment of pressure vessels. Bolted flange

connections. Design of vessel supports. Use of pressure vessel design software. New trends in pressure vessel design.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 532– Theory of Elasticity [3 Units; E; LH = 45; PH = 0]

Senate-Approved Relevance

The course is designed to help the student to develop insight into, and an understanding of the elastic behaviour of engineering materials. These skills are inculcated by letting the student go through the acts of formulating, solving, and interpreting the solutions to a wide variety of structured material dynamics problems. In this way the student is enabled to build a reservoir of experience which he/she can draw upon for further insight and intuition when faced with new unstructured problems.

Overview

Theory of Elasticity is a special branch of Mechanics of Materials. The latter is a course in mechanics in which the physical and mathematical principles of mechanics are employed to determine the properties of a structure or machine from known properties of materials. In general, the function of the theory of elasticity is to mathematically incorporate the loadings on a body with the geometry of the body and, if necessary, with the properties of the materials composing the body, so as to obtain knowledge of the internal “forces” within the body.

Course Objectives

The key objectives of the course are to:

1. Develop a working knowledge of the relations between the loads applied to a non-rigid body made of a given material and the resulting deformations of the body.
2. Develop a thorough understanding of the relations between the loads applied to a non-rigid body and the stresses produced in the body.
3. Develop a clear insight into the relations between stress and strain for a wide variety of conditions and materials.
4. Develop adequate procedures for finding the required dimensions of a member of a specified material to carry a given load subject to stated specifications of stress and deflection.

Learning Outcomes

At the end of the course the student will be able to:

1. Define the terms body forces, surfaces, stresses, normal stresses, and shear stresses and to formulate a means of expressing these quantities mathematically.
2. Define the state of stress, i.e., equilibrium equations of stress throughout a body in terms of the components of stresses acting on the Cartesian coordinate system.
3. Investigate the equilibrium conditions that must exist for the entire stress field in a body.
4. Formulate the Laws of Stress Transformation
5. Gain a better intuitive view of the mechanism of stress relations throughout a body and an understanding of the equations.
6. Define the term strain and investigate the state of strain in a body.
7. Derive the conditions of compatibility of strain with displacement in a body in terms of strain.
8. Define the state of strain at point in a body and the Laws of transformation of strain.
9. Analyze the stresses and deformations within a body subject to a prescribed system of forces by solving which describe the stress and strain fields.
10. Determine by theoretical analysis or by experiment the limiting values of load which a structural or machine member can sustain without suffering damage, failure, or comprise of function.
11. Investigate the Theories of Failure of load resisting elements.
12. Determine the body shape and select those materials which are most efficient for resisting a prescribed system of forces under specified conditions of operations such temperature, humidity, vibration, and ambient pressure.

Course Content

Anti-elastic bending. Theory of plates and shells. Thermal stresses. Stresses in rotating discs. Theory of elasticity. Equilibrium and compatibility equations. Airy's stress function with applications to simple problems. Crack mechanics, stress-function, approach to fracture mechanics. Direct stiffness method, the finite element method for stress analysis. Plastic theory.

Course Content

1. Theoretical development and analysis of the concept of stress: Introduction-Definitions, Terminology, and Assumptions.
2. The Equations of Equilibrium; Equality of Shear Stresses on Perpendicular Planes; Some Direction Cosine Relationships.
3. The Laws of Stress Transformation; Principal Stresses, Planes, and Directions: Definitions and Properties.

4. Principal Stresses, Planes, and Directions: Method of Determination; Invariant of Stress; Equations of the State of Stress Referred to the Principal Coordinate System.
5. Theory of Strain: Analysis of Strains; Strain Defined; Equations of Compatibility; State of State of Strain at a Point.
6. Theory of Elasticity- Engineering Materials; Generalized Hooke's Law; Measurement of Strain: Bonded strain Gauges.
7. Fundamental Boundary-Value Problems of Elasticity; Requirement for Solution.
8. Simple Method for Solving Elasticity Problems in Simply connected Bodies; Uniqueness of Solutions.
9. Theory of Plates and Shells: Asymmetrically loaded members – Thick-Walled Cylinders; Maximum Tangential Stress.
10. Compound Cylinders; Rotating Disks of Constant Thickness.

Minimum Academic Standard

As described in CCMAS SUMAS-MEE 536– **Introduction to Composite Materials [3 Units; E; LH = 45; PH = 0]**

Senate-Approved relevance

Composites continue to receive adequate attention owing to their improved overall properties making them easily applicable across several industrial sectors not limited to automobiles, aerospace, military, marine, and structural applications. These properties such as high strength-to-weight ratio, high fracture toughness, high stiffness and improved wear and corrosion resistance has fuelled the need to incorporate the study of composites into the Mechanical Engineering undergraduate curriculum. In addition to joining the long list of institutions that are currently prioritizing research in composites, students will be able to provide solutions nationally to the issues that border around material selection for specific manufacturing needs.

Overview

Composites are a category of engineering materials that are formed by the macro-physical combination of distinct materials where the aim is to combine beneficial properties of the constituent materials. The purpose of this module is educating the prospective students on the importance of composites in engineering, classifications, and modes of fabrication. In addition, potential areas of application will also be explored.

Course Objectives

The objectives of the course are to:

1. Understand the basic concepts of composites
2. Understand the major classification of composites.
3. Introduce the students to the reinforcements and their classifications.

4. Understand the application of sustainability approaches in composite design and fabrication.

Learning outcome

At the end of the module, it is expected that the students should be able to;

1. Understand the concept of composites.
2. Understand the various classification of composite materials
3. Identify several post processing requirements of various reinforcements.
4. Understand the various fabrication routes for composites.
5. Understand the load transfer mechanism in composites.
6. Correctly classify various sustainable reinforcements used in composite fabrication.
7. Understand the potential applications of composites.
8. Understand the merits and limitation in the application of composites.
9. Understand the appropriate combination of reinforcements and the matrix materials.
10. Understand the role of composites in cost reduction of the material selection process in the engineering design process.

Course Content

Introduction. Reinforcements and Matrices. Microstructure. Mechanics of Composite Materials. Anisotropy and Laminate Theory. Micromechanics and Interface. Strength and fracture. Thermal Response. Fabrication Techniques. Composite Designs.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 581– Quality Assurance and Reliability [3 UNITS; E; LH = 30; PH = 0]

Senate-Approved Relevance

Quality assurance and reliability is very important in any engineering project - product design, production system design or machine design. The course aims to deliver the insights, knowledge and skills necessary to operate engineering projects with professional standards by maintaining quality and reliability. The course covers a broad range of topics for all engineering graduates that include total quality management, productivity and cost relationships; quality systems and their components, international standards; interaction between quality and design functions; quality control; quality improvement; process capability and improvement studies; control charting; techniques for quality studies and design for quality improvement.

Overview

This Course introduces the principal concepts and issues related to the quality assurance in modern industrial activities and presents the classical techniques for reliability analysis used in the current practice of maintainability Engineering. It is aimed at providing an organic view of the subject to students who might have interest in the area.

Course Objectives

The main objectives of the course are to:

1. Introduce students to Quality and its improvement in the Modern Industry/Business
2. Discuss Quality improvement methodology and overview of the statistical tools essential for modern professional practice.
3. Study adaptive quality control, design of quality control systems
4. Define Reliability and estimates of Hazard rates and Failure distributions for reliability of components, units and/or systems.
5. Establish relation between probability density function, hazard rate function and reliability function, Mean Time to Failure
6. Undertake Reliability Analysis of Simple Serial and Parallel Systems, Generic-Parts-Count Reliability Analysis, Probabilistic Reliability with Info-Gap-Uncertain PDF, Uncertainty and Robustness, Deriving the Robustness Function

Learning Outcomes

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

1. Know the concept of quality assurance in the industry/Business
2. Understand and apply the quality improvement methodologies essential for professional practice
3. Understand the major aspects of quality control and their area of application
4. Define Reliability and estimates of Hazard rates and Failure distributions for reliability of components, units and/or systems
5. Establish relation between probability density function, hazard rate function and reliability function, Mean Time to Failure.
6. Undertake simple reliability analysis of components, units and systems

Course Content

Definition of Quality, Quality function, Dimensions of Quality, Quality. Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories' costs and hidden costs. Brief discussion on

sporadic and chronic quality problems. Introduction to Quality function deployment. Quality Assurance. Statistical Process Control. Control Charts for Variables. Control Charts for Attributes. Sampling Inspection. Reliability and Life Testing. Define Reliability and estimates of Hazard rates and Failure distributions for reliability of components, units and/or systems. Relation between probability density function, hazard rate function and reliability function, Mean Time to Failure. Reliability Analysis of Simple Serial and Parallel Systems, Availability, Maintainability of different system configurations. Uncertainty and Robustness, Deriving the Robustness Function and physics of failure functions.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 545– Mechatronics [3 UNITS; E; LH = 30; PH = 0]

Senate-Approved Relevance

Mechatronics course provides an introduction to the application of electronic control systems in mechanical and electrical engineering. It would give a framework of knowledge that allows students to develop an interdisciplinary understanding and integrated approach to mechatronic engineering. Mechatronics course is also designed to help mechanical engineering students understand the key elements of Mechatronics systems, representation into block diagram, understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.

Overview

This course covers Introduction to Digital Control Systems: Analog control systems and digital control systems. Control system design and analysis. Modelling of dynamic systems. Response characteristics of a control system. Hardware (microprocessors) and software for implementing a digital controller. Design, analysis and simulation of digital control systems by MATLAB/Simulink. Electronic Control Systems in Mechanical Engineering: Robotics and automation. Mechatronic applications: structural control, home automation, robotics. Sensors: tactile, proximity and range sensors, force and torque sensors. Actuators in control systems: system drives, hydraulic systems, DC motors, stepping motors, AC motors. Feedback devices: encoders, pulse digitizers, resolvers, induction. Counting devices: flip flops, counters, decoders, digital to analogue converters. Mechatronic design process.

Course Objectives

The overall objectives are as follows.

1. To educate knowledgeable, skilled, and modern mechanical engineers capable of responding to changing engineering and technology needs through continuous self-renewal and a desire for lifelong learning.
2. To integrate teaching and research for effective application of knowledge and acquired skills.
3. To educate Mechanical Engineers who are ethically conscious and sensitive to current issues of Mechatronics in the industries.
4. To train Mechanical Engineers with strong communication and teamwork abilities.
5. To set a significant example not only for the institution but also for the entire country in promoting and establishing such interdisciplinary undergraduate study programs, which have a growing reputation and widespread acceptance around the world.
6. To provide students with a solid foundation in mathematical, scientific, and engineering fundamentals in order to solve engineering problems.
7. To prepare Mechanical Engineering students to identify, analyze, and solve engineering problems in the field of mechatronics. Through an interdisciplinary approach, learners will be able to build and program technology systems such as CNC machines, rapid prototyping systems, industrial robotics, and so on.
8. To prepare students to use modern tools involving various engineering disciplines to simulate and solve real-world problems (particularly in domains such as product/process development, automation, real-time control, manipulation in hostile environments, and so on). By using a concurrent design approach, students will be able to synthesize data and technical concepts for innovative product design and process automation.
9. Mechatronics will aid students to have an interest in research and lifelong learning, as well as the ability to promote entrepreneurial ideas.

Learning Outcomes

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

1. Have the ability to identify, formulate, and solve complex engineering problems using engineering, science, and mathematical principles.
2. An ability to use engineering design to produce solutions that meet specified needs while taking into account public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. The ability to effectively communicate with a variety of audiences.
4. The understanding of ethical and professional responsibilities in engineering design situations and the ability to make informed decisions that take into account the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to work effectively on a team in which members provide leadership, foster a collaborative and inclusive environment, set goals, plan tasks, and achieve objectives.
6. An ability to design and carry out appropriate experiments, analyze and interpret data, and draw engineering conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8. Capability to solve real-world problems creatively by using a concurrent interdisciplinary approach to engineering design.
9. Capability to design and program advanced manufacturing systems like CNC machines, rapid prototyping systems, and industrial robotics.
10. Capability to select appropriate sensors, actuators, and control systems in domains such as industrial automation, process control and automotive electronics based on application requirements.
11. Capability to use embedded software and hardware to simulate, analyze, and design complex interdisciplinary technology systems.
12. Communicate effectively with the engineering community and society at large about complex engineering activities, such as understanding and writing effective reports and design documentation, making effective presentations, and giving and receiving clear instructions.

Course Content

Introduction to Digital Control Systems: Analog control systems and digital control systems. Control system design and analysis. Modelling of dynamic systems. Response characteristics of a control system. Hardware (microprocessors) and software for implementing a digital controller. Design, analysis and simulation of digital control systems by MATLAB/Simulink. Electronic Control Systems in Mechanical Engineering: Robotics and automation. Mechatronic applications: structural control, home automation, robotics. Sensors: tactile, proximity and range sensors, force and torque sensors. Actuators in control systems: system drives, hydraulic systems, DC motors, stepping motors, AC motors. Feedback devices: encoders, pulse digitizers, resolvers, induction. Counting devices: flip flops, counters, decoders, digital to analogue converters. Mechatronic design process.

Minimum Academic Standard

As described in CCMAS

SUMAS-MEE 541– Systems Engineering [3 Units; Compulsory; LH = 45; PH = 0]

Senate-Approved Relevance

Train students with aggregate of management and operations capabilities, facilities-use, skills, knowledge, right thoughts and organization required to successfully create a useful and sustainable service or product within the constraints of limited resources. The students learn how to nurture those capabilities and optimize their applications in the creation of products, prescription of active industrial and technological policies for sub-national or national goals and interests. The relevance is evident in the presence of SUMAS Mechanical Engineering graduates in almost every recognized industry across the globe. There are vast numbers of our graduates who have become captains of excellent industries, while many others have occupied technological policy positions in the Society. In all, the knowledge gained from the Course has helped our graduates to record great success in both private and public enterprises as well as in State and National governments.

Overview

In a world in which the processing power of computers has exponentially increased over the last century enabling the unbridled use of several powerful mathematical modeling techniques (Multiple Objective Programming, Dynamic Programming, Laplace Transforms, Fourier Series etc.), the traditional engineering design process gave way to the industrial product development process, which in turn has yielded to augmentation techniques which seek to leverage multidisciplinary design optimization. The phrase “techniques which seek to leverage multidisciplinary design optimization” is a succinct definition of Systems Engineering which is formally defined by the International Council on Systems Engineering (INCOSE) as “an interdisciplinary approach and means to enable the realization of successful systems AND which integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation”

Course Objectives

The objectives of the course are to:

1. Drive home the multidisciplinary nature of all real-world systems engineering systems development efforts

2. Engender confidence in students to pursue original research and development of systems by demonstrating how all system development challenges essentially reduce to an objective function that is subject to sets of
 - a. Problem-solving constraints (time, money, corporate collective knowledge, communicative ability, etc.)
 - b. Solution constraints (safety, reliability, competitiveness, usability, manufacturability, marketability, legality, etc.)
3. focus the bulk of the course work on the “Analysis” stage of the Product Development Process in order to investigate the commonalities across mathematical models e.g., a. state variables
 - a. range (and alternative) values of variables
 - b. stages in systems
 - c. etc.
4. To introduce students to the different ways in which the practitioners of various disciplines observe and consider systems e.g.
 - a. Analysts use deduction to find output given the system, input and laws.
 - b. Inverse analysts use deduction to find input given the system, output and laws.
 - c. Scientists use induction to find laws given the system, input and output.
 - d. Engineers use synthesis to find the system given input, output and laws.

Learning Outcomes

1. The students would know that no system engineer worth their salt walks around packing formulae in their head. Thus, the utility and indeed fundamental value of a personal library of textbooks and handbooks in the knowledge-area for quick reference was successfully communicated to the students.
2. That students also would know that constant system development using the resources from 1. shall move them along the path from “novice” up to the point of “expert performer” at which time “instruction shall cease and expert instruction will replace it” possibly leading to a contribution of subjective mathematical model on their part for use by the body of engineers in the world.
3. The students would understand the value of becoming more sensitive and observant to the functioning of the world around them, because
 - a. sensitive people (i.e. those that are easily disturbed by things) are more likely to recognize a need and to do something about it
 - b. sensitive people are thus more creative.

Course Content

System modelling: Modelling of systems by algebraic, difference, ordinary differential equations, and partial differential equations. System simulation using analogue, hybrid and digital computers. System optimization using differential calculus, variational calculus, linear programming and dynamic programming. System behaviour: categories of systems, behaviour illustrated by the study of selected mechanical, electrical, hydraulic, industrial, transportation, economic, biological and social systems. System control. Decision analysis. Estimation of input values. Utility and value analysis. Multiple objectives and criteria. Production functions and marginal analysis. Econometrics. Evaluation of a public system.

Minimum Academic Standard

As described in CCMAS

SUMAS- MEE 544 - Production and Inventory Design [3 Units; E; LH= 45; PH = 0]**Senate-Approved Relevance**

This course surveys the design, development, implementation and management of production planning systems, including master production scheduling, aggregate planning, material requirements planning, capacity and inventory planning and production activity control. Students will be exposed to contemporary approaches such as just-in-time, theory of constraints and the relationship of enterprise-level planning and control systems to the overall materials flow.

Overview

This course covers Simple Inventory Control Methods with deterministic and stochastic demand. The EOQ Model. lot sizing. supply chain management. Scheduling. Materials Requirement Planning (MRP). Just-in-Time models. Pull /Push Control Systems and Aggregate Planning.

Course Objectives:

The objectives of the course are to:

1. Introduce basic control methods in raw materials and information management necessary for production of goods and services.
2. Understand flow of materials through production system from purchasing to finished goods.

3. Understand the philosophy of just-in-time and its impact on production management
4. Distinguish features of pull and push manufacturing systems.
5. Demonstrate reduction of setup time and cost which allows economic production by lot sizing.
6. Develop production schedule from forecasting, capacity planning and inventory loads using software packages for MRP implementation in a large manufacturing industry.

Learning Outcome

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

1. Recognize the strategic role of the supply chain and the key parameters of performance by identifying Facilities, Inventory, Transportation, Sourcing, Information and Pricing.
2. Identify analytical decision support tools (both models and applications) as well as the organizational models that successfully allow companies to develop.
3. Analyze and develop simple inventory management policies under deterministic environments.
4. Develop aggregate production plans and detailed schedules through simple policies.
5. Recognize the dynamic interactions among different elements of a supply chain system.

Course Contents

Simple Inventory Control Methods with deterministic and stochastic demand. The EOQ Model. lot sizing. supply chain management. Scheduling. Materials Requirement Planning (MRP). Just-in-Time models. Pull /Push Control Systems and Aggregate Planning.

Minimum Academic Standard

As described in CCMAS