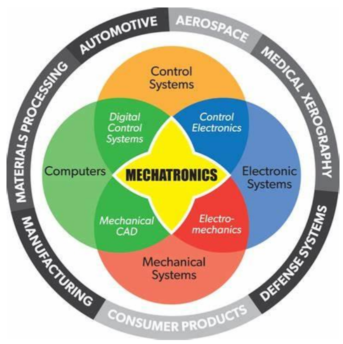
SCHOOL OF SCIENCE AND TECHNOLOGY

PAN-ATLANTIC UNIVERSITY



Programme Manual

B.Eng. Mechatronics Engineering

SST • School of Science and Technology • Pan-Atlantic University

52 km Lekki-Epe Expressway, Ibeju-Lekki, Lagos, Nigeria

Version 2024-08-23

SCHOOL OF SCIENCE AND TECHNOLOGY
PAN-ATLANTIC UNIVERSITY

1.0. Mission

The mission of the School of Science and Technology is as follows:

The School of Science and Technology (SST) is a community of people committed to creating and transmitting knowledge and competencies in science, engineering, and technology by "*forming competent and socially responsible science and engineering professionals who are committed to the promotion of the common good of society and the advancement of the scientific and engineering profession".* In order to achieve this mission, the School seeks to:

- *Provide practice-based, student-centred and industry-relevant programs that address technical expertise, industrial management and ethical responsibility.*
- *Develop partnerships and engage with relevant stakeholders through applied research that provides solutions to industry and societal problems and enhance engineering pedagogy.*
- *Provide entrepreneurship education along with science and engineering education.*
- *Make intellectual contributions which:*
    - *a) Support the practice of science, engineering and technology;*
    - *b) Contribute to the advancement of the science, engineering and technology disciplines; and*
    - *c) Create high quality teaching materials.*
- *Produce graduates who will lead efforts to achieve ever greater scientific, engineering and technology development with high ethical standards.*

2.0 Hands-on training: Student-centred with strong ties to industry

To ensure industry relevance of engineering programmes our pedagogy will be in line with the world-class global best practices having engineering education delivery process that are student-centred with strong ties to industry driven by our programme educational objectives.

2.1 Programme Educational Objectives: The SST programme educational objectives, will be periodically reviewed with the full involvement of all key stakeholders including faculty members, students, advisory board members, alumni, and employers of graduates. Presently, the career and professional accomplishments, that our programmes are preparing graduates to attain within a 3-5 years of graduation are:

Start-ups & innovative Entrepreneurs	Graduates will become principals in the industries associated with engineering and professional engineers starting-up and growing their own new firms. They will become recognised experts working in government, consulting firms, and international organisations around the country and around the world addressing some of the most challenging problems of our times. With reputation as a source of innovative solutions to complex problems, technology leaders in start-up tech companies based on societal demands, national needs, and competitive international markets.

Researchers	Graduates will become leading researchers and who create and disseminate new knowledge in engineering. They will complete masters and PhD programs of respected universities by conducting original research in related disciplines or in interdisciplinary topics, contribute to scientific community with novel research activities, and continue their field in permanent academic positions work in engineering, research and development, production, operations and management departments of Nigerian, African or international companies as engineers who can solve technical problems, take initiative, develop and execute projects, collaborate with others in a team and take the responsibilities of a leader.
Lifelong Learning	Graduates will pursue lifelong learning in generating innovative engineering solutions using research and complex problem-solving skills.
Ethical Professional Engineer	Graduates will demonstrate technical competency and leadership to be working as engineering professionals (registered engineers), acting ethically, adhering to standards, and be committed to the welfare of employees and the general population.

2.2 Student Outcomes/Graduate Attributes: At graduation, our students are expected to know and able to do the following:

WA1: Engineering knowledge	Apply knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions to complex engineering problems.
WA2: Problem Analysis	Identify, formulate, research literature and analyze **complex engineering problems** reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development*(WK1 to WK4)
WA3: Design and development of solutions	Design creative solutions for **complex engineering problems** and design systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net-zero carbon as well as resource, cultural, societal, and environmental considerations as required (WK5)
WA4: Investigation	Conduct investigations of **complex engineering problems** using research methods including research-based knowledge, design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions (WK8).
WA5: Modern Tool Usage	Create, select and apply and recognize limitations of appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to **complex engineering problems** (WK2 and WK6)
WA6: Environment & Sustainability & The Engineer and Society	When solving **complex engineering problems**, analyze and evaluate sustainable developments impacts* to: society, the economy,

	sustainability, health and safety, legal frameworks, and the environment (WK1, WK5 and WK7)
WA7: Ethics	Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).
WA8: Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK9).
WA9: Communication	Communicate effectively and inclusively on **complex engineering activities** with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.
WA10: Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects in multi-disciplinary environments.
WA11: Lifelong learning	Recognize the need for and have the preparation and ability for (i) Independent and life-long learning (ii) Adaptability to new and emerging technologies and (iii) Critical thinking in the broadest context of technological change (WK8).

2.3 Mapping of Student Outcomes to Programme Educational Objectives

Student Outcomes	Start-ups & Innovative Entrepreneurs	Researchers	Lifelong Learning	Ethical Professional Engineer
Engineering knowledge	■	■		
Problem analysis	■	■		
Design /development of solutions	■			
Investigation		■		
Modern tool usage	■	■	■	
The engineer and society				■
Environment & sustainability	■			
Ethics	■			■
Individual and teamwork	■		■	
Communication	■	■		
Project management and finance	■			■
Lifelong learning			■	

3.0 Basic Principles

The following are the basic principles which will inform the teaching imparted in the B.Eng. programmes of the School of Science and Technology:

- Human beings are moral beings whose behaviour are not mechanically determined by either internal or external factors and who cannot attain fulfilment if they restrict their activity to the pursuit of their own individual interests.
- The purpose of an enterprise is not restricted to producing profits for their owners nor can the objective of maximising profit be the supreme standard of decision. Organisations are members of larger societies and must contribute to their common good. The activities of organisations must also be compatible with - and contribute to - the full human development of those who work in them.
- Organisations are not mere production units. First and foremost they must be human communities where all have an opportunity to participate and contribute responsibly to the common good of the organisation and that of society.
- Organisations are not justified in creating and marketing products or services by the mere fact that a demand for them exists or can be created. The value of the organisation's activity ultimately depends on its serving authentic human needs and values.
- Organisations must respect the dignity of all the human persons (employees, customers, suppliers...) with whom they relate in the exercise of their activity. A person's dignity is not respected when one chooses to harm him or her, even if this is done as a means to attain some desirable objective.

4.0 Philosophy

The fundamental aim of the program is tied to that of the University, and it is to form competent and socially responsible data science professionals who are committed to the promotion of the common good of society and the advancement of the data science profession.

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The B.Eng. programme in Mechatronics Engineering of the Pan-Atlantic University is informed by the aspiration to train mechatronics engineering professions to bring knowledge of mechatronics closer to business expertise by equipping participants with the ability to draw meaningful insights from wide range of structured, semi-structured and unstructured data, with varied levels of sizes and complexities. The participants will be trained to uphold the highest intellectual, ethical and professional values that promote creativity, critical knowledge, social responsibility, and the spirit of enterprise. The programme will prepare students for careers in data science in private and public sectors alike. With the skills students will acquire in this programme, they will be better equipped to improve individual and corporate performance, with the resultant impact on national productivity and economic growth.

The general philosophy of the Mechatronics Engineering programme is to produce graduates with high academic and soft skills competence, which can adequately participate, transform, impact on the engineering and allied industries in accordance with National and Global community values, including National Policy on Industrialisation and Self-Reliance. Hence, the programme aims to produce graduates with sufficient academic background and adequate practical experience to solve engineering problems.

5.0 Objectives

The vision of the School is to be internationally recognised as a prestigious institution offering high-class education in Science and Technology disciplines; to be a reference point for research in Africa, and a leading training centre for science and technology practitioners. Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of mechatronics engineers is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Mechatronics Engineering is a branch of engineering that deals with developing products, systems and processes that involve a synergistic integration of aspects of mechanical (such as hydraulics and pneumatics), electronic (as in sensors and communication) and electrical engineering (control), computing, robotics, and information technology. Application areas of mechatronics include such diverse fields as in medical and agricultural equipment, military hardware, oil and gas, automobile, home and industrial automation, etc. The multidisciplinary nature of mechatronics entails design principles, processes, models, toolsets and philosophy that are unique to mechatronics engineers. This enables the design and development of simpler, more economical, and reliable systems.

Mechatronics ensures the production of high-quality systems and equipment with high precision and accuracy and improved production processes through automation. Due to their multidisciplinary skills, mechatronics engineers are on high demand worldwide. Topics covered include mechanism design, motor and sensor integration and theory, microcontroller programming using numerous sensors and actuators, mechanics prototyping, and design. Students will work in teams to complete a hardware-based final project.

The programme has a unique balance of critical analytical subjects and professional skills, which enables students to graduate with the confidence to face challenging engineering situations in the industry. The management skills necessary to operate successfully as a multidisciplinary engineer in modern industry are promoted and developed at all the stages of the course.

The programme's overall objective is to provide students with relevant skills in designing and prototyping of mechatronics or robotic system to accomplish specific tasks or challenge. On completion of the programme, successful students should be able to:

i. demonstrate systematic knowledge and understanding of essential facts, concepts, theories and principles of mechatronics engineering and of the broader multidisciplinary engineering context and its underpinning science and mathematics;
ii. apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the Mechatronics Engineering-related problems;
iii. demonstrate practical engineering skills in the design and development of mechatronics products;
iv. demonstrate the ability to apply appropriate quantitative science and engineering tools to analysing problems;
v. demonstrate creative/innovative ability in the synthesis of solutions and in formulating designs;
vi. demonstrate an understanding of different roles within a team and to exercise leadership;
vii. display well-developed critical thinking capabilities, including analysing, evaluating and critically reflecting on information, decisions and behaviour to enable strategic thinking and adaptability in a constantly changing global environment;
viii. create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, to understand their limitations;
ix. apply independent learning skills that encourage the regular accessing of new knowledge and information;
x. use effective written communication and well-developed interpersonal skills;
xi. design, specify, plan, organise, and implement a mechatronics system;
xii. compare, contrast, and evaluate alternative approaches to mechatronics system designs.
xiii. plan the extension and upgrading of the existing mechatronics system effectively.
xiv. demonstrate a critical awareness and evaluation of current research within engineering;
xv. develop entrepreneurial skills and adequate training in human and organisational skills with a spirit of self-reliance to set up their businesses; and
xvi. possess the appropriate skills and knowledge to pursue further study and professional development opportunities.

Unique Features of the Programme

Some unique features of the programme include:

i. stimulating intellect and encouraging students towards developing ingenuity and originality in problem solving.
ii. encouraging students to maintain intellectual curiosity that will motivate them to pursue meaningful lifelong learning; and
iii. equiping students with the relevant intellectual capacity, contemporary software proficiency, communication, entrepreneurial and
iv. other relevant soft skills like teamwork, flexibility, adaptability and interpersonal knack to engage effectively in engineering practice, business and in leadership roles

Employability Skills

Mechatronics engineers work in companies and firms that require hi-tech input into what they are developing. They may work in a laboratory, a processing plant or an engineering office and research opportunities in emerging fields like bioengineering, nanotechnology, and robotics. Typical job responsibilities of mechatronic engineers are:

i. developing new solutions to industrial problems using mechanical and electronic processes and computer technology;
ii. design and building entirely new products by integrating various technologies, for example, developing robotic vehicles for underwater exploration;
iii. building and testing factory production lines by introducing automation to improve existing processes;
iv. maintaining and improving on previous industrial and manufacturing processes and designs, for example, robotic lawnmowers and robot floor cleaners;
v. designing, developing, maintaining and managing high technology engineering systems for the automation of industrial tasks;
vi. applying mechatronics or automated solutions to the transfer of material, components or finished goods;
vii. applying advanced control systems, which are usually computer-driven;

viii. apply electronics and mechanical processes and computers to tasks where the use of human labour may be dangerous (like underwater exploration, mining or forestry);
ix. studying the feasibility, cost implications and performance benefits of new mechatronics equipment; and
x. carrying out the modelling, simulation, and analysis of complex mechanical, electronic or other engineering systems using computers.

21st Century Skills

The programme has emphasised 21st-century skills -- problem-solving, collaboration (teamwork), digital literacy, communication, learning to learn/metacognition, creativity and innovation, information literacy, critical thinking/decision making, artificial intelligence (AI) through collaborative research projects and group assignments.

i) Compatibility of programme with institutional mission:

The programme reinforces the mission of the university.

ii) Relevance to national needs: (evidence of relevance from National Manpower Board to be attached)

It is envisaged that the program will contribute to national development through the provision of competent mechatronic engineers that can solve both local and international problems, thus saving and earning foreign exchange for the country. Given the drive of the country towards equitable and sustainable economic growth and development by attracting foreign and domestic investments, this objective in turn implies an increased ability of this nation's people to compete globally. A strong base of scientific knowledge on mechatronics has become a key success factor.

The establishment of this programme will also have other indirect benefits to the Nation, such as:

a) It will have entrepreneurial orientation so that the graduates will be able to start well-managed and sustainable engineering ventures that will contribute to the economic life of the country.
b) It will develop content in mechatronics engineering business studies that can be useful to other universities and institutions of higher learning in the country.
c) Thanks to the program, the School, with its high quality of education, will attract and retain human resources that would otherwise leave the country to pursue this kind of education in foreign

universities. Nigeria will therefore retain qualified manpower for nation building, as well as considerable savings in foreign exchange.

d) Research carried out at the School will be relevant to the needs of the environment. Industry and government institutions will thus be able to benefit from the dissemination of research results, as they will provide useful information and guidance for the good governance of organizations. Research will also provide specific solutions to the problems of industry and society.

e) The School will help put more professionalism into mechatronic engineering and related engineering and technology industry that in turn can translate into national economic growth thus preventing the outsourcing of professionals and facilities for key functions in engineering and the technology industry as obtains at the moment.

f) The School will attract people from other African countries to its programmes and may thus contribute to economic development of Nigeria and Africa at large. Nigeria would thus be an agent of economic development in Africa and play the leading role in the African continent in this industry that belongs rightly to her by virtue of her human and material endowments.

6.0 Admission and Matriculation Requirements

Prospective students would need to satisfy the following general requirements:

(a) Admissions shall be through the Joint Admissions and Matriculations Board (JAMB);

(b) For admission to 100-Level through the Unified Tertiary Matriculation Examination (UTME), candidates should:

   i. Obtain at least five (5) credit passes at Senior Secondary School Certificate Examination (SSSCE) or equivalent in relevant subjects including English Language, Mathematics, Physics and Chemistry in not more than two sittings;
   ii. Score preferably a minimum of 220 points in UTME. The minimum point required is subject to review by the University from time to time.
   iii. Pass the Post-UTME interview organized by the university.
   iv. It is also desirable for candidates to pass Further Mathematics and Technical Drawing at credit level, such candidates shall have added advantage.

(c) For admission into 200-Level (Direct Entry), candidates should (in addition to 5 SSCE credits in relevant subjects including English Language and Mathematics in not more than two sittings):
Pass Mathematics, Physics and Chemistry at GCE ‘A’ level or equivalent. Holders of National Diploma at minimum of Upper Credit level are eligible for

consideration for admission into 200 level. They are also required to pass the interview organized by the university.

(d) *Inter-University Transfer Mode*
Students can transfer into 200-Level courses provided they have the relevant qualifications and pass the interview organized by the Pan-Atlantic University (PAU). PAU is to satisfy itself that the grades obtained by such candidates from their previous institution are acceptable.

7.0 The Semester Course System

The undergraduate programmes will run on the Semester Course basis. There shall ordinarily be two semesters in an academic year, except the University Council through Senate shall provide otherwise.

(i) Instruction in the programme shall be by courses.
(ii) There shall be five levels of courses in line with the years of study. Level or year 1 courses are 100, 101 etc. and Level 2 or year 2 courses are 200, 201 etc.
(iii) Students will be required to complete their registration for the courses within the period stipulated by the School. Amendment of this registration will be allowed through the addition or deletion of courses but it must take place within three weeks of the commencement of lectures.

8.0 Examination and Grading System

Students will be evaluated through a combination of Laboratory Experiments, Continuous Assessment Tests (30%), End-of-Semester Examinations (65%), Class participation (5%) and Class/Laboratory Attendance.

To be eligible to sit for any examinations, students will be expected to attend a minimum of 80% of the lectures of any course registered for. The School reserves the right to prevent any defaulting student from sitting for the relevant examination.

All courses registered for will be taken into consideration during the computation of results. Students will not be credited for courses which they did not register for, even if they are inadvertently allowed to take the examinations and pass them. Failure to take the examination in a course for which one has registered will attract a score of 0.0, which will have the consequent effect of lowering the student's Grade Point Average.

(i) Special examinations to enable a student graduate may in exceptional circumstances be held by order of Senate.
(ii) Grades will be awarded based on the scores of the students as follows:

Percent score	Grade point	Letter Grade
70 – 100	5.0	A
60 – 69.9	4.0	B
50 – 59.9	3.0	C
45 – 49.9	2.0	D
0 – 44.9	0.0	F

For the purpose of description, a score below 2 Grade Points constitutes a failure.

The following qualifications shall be applied to the grades:

A	Very Good
B	Good
C	Fair
D	Pass
F	Poor Performance

(iii) To obtain the Cumulative Grade Point Average (CGPA) of the student, the grade point assigned to the mark obtained in each course is multiplied by the units of that course. The total from all the courses is added up to give the total weighted grade point. This total is then divided by the total number of units taken by the student to give the grade point average.

(iv) For the purpose of calculating a student's CGPA, grades obtained in ALL registered courses, whether compulsory or optional and whether passed or failed, must be included in the computation.

9.0 Retention and Progression

To remain in the School, students will be required to ensure that their CGPA does not fall below a certain minimum standard. A student must pass all the specified courses, and obtain a minimum CGPA of 1.5 at the end of every semester. Any student who does not meet this requirement will be placed on probation. If after one semester on probation the CGPA remains below 1.5, the student shall be asked to withdraw. A student on probation should register for a maximum of 18 credit units.

10.0 Period of Study and Requirements for the Award of a Degree

The normal period of study for a degree shall be ten (10) semesters. The minimum number of course units for the award of a degree shall be 178.

The determination of the class of degree shall be based on the weighted grade points of all the courses taken. The award of the degree shall be dependent on the student having obtained a Cumulative Grade Point Average of at least 1.5 in addition to fulfilling other minimum requirements for an honours degree.

The following classes of degree are approved for the CGPA indicated:

Class of Degree	**Cumulative GPA**
First Class	**4.50 - 5.00**
Second Class (*Upper Division*)	**3.50 – 4.49**
Second Class (*Lower Division*	**2.40 – 3.49**
Third Class	**1.50 – 2.39**
Fail	**Less than 1.5**

The maximum number of semesters for the award of an honours degree shall be fourteen semesters.

11.0 Graduation Requirements

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

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5 – year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.

2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4– year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), eight credit units of University General Study courses and four credit units of Entrepreneurship courses.

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

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

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100L	**38**
GET	**3**
GET 100 Remedial Technical Drawing	0
GET 101 Engineer in Society	1
GET 102 Engineering Graphics and Solid Modelling I	2
GST	**6**
GST 111 Communication in English	2
GST 112 Nigerian People and Culture	2
MEE 192 Introduction to Christian Theology	2
MCE	**2**
MCE 101 Introduction to Mechatronics Engineering	2
Science	**25**
CHM 101 General Chemistry I	2
CHM 102 General Chemistry II	2
CHM 107 General Practical Chemistry I	1
CHM 108 General Practical Chemistry II	1
MTH 101 Elementary Mathematics I	2
MTH 102 Elementary Mathematics II	2
MTH 103 Elementary Mathematics III (Vectors, Geometry and Dynamics)	2
PAU-MEE 112 Probability for Engineers	3
PHY 101 General Physics I (Mechanics)	2
PHY 102 General Physics II (Behaviour of Matter)	2
PHY 103 General Physics III (Electricity and Magnetism	2
PHY 104 General Physics IV (Vibration, Waves, and Optics)	2
PHY 107 General Practical Physics I	1
PHY 108 General Physics Practical II	1
200L	**4**
GET	**36**
GET 201 Applied Electricity I	3
GET 202 Engineering Materials	3
GET 203 Engineering Graphics and Solid Modelling II	2
GET 204 Students Workshop Practice	2
GET 205 Fundamentals of Fluid Mechanics	3
GET 206 Fundamentals of Thermodynamics	3
GET 207 Applied Mechanics I	3
GET 208 Strength of Materials	3
GET 209 Engineering Mathematics I	3
GET 210 Engineering Mathematics II	3
GET 211 Computing and Software Engineering	3
PAU-MEE 202 Applied Electricity II	3
PAU-MCE 204 UNIX and Robot Operating System	2
GST	**6**

ENT 211 Entrepreneurship and Innovation	2
GST 212 Philosophy, Logic, and Human Existence	2
PAU-MEE 202 The Nature of Human Beings	2
SIWES	**3**
GET 299 SIWES I (Project-based with Engineering Design)	3
300L	**50**
EEE	**4**
PAU-MCE 310 Analogue Electronic Circuit	2
PAU-MCE 322 Digital Electronics	2
GET	**16**
GET 301 Engineering Mathematics III	3
GET 302 Engineering Mathematics IV	3
GET 304 Technical Writing and Communication (including Seminar Presentation Skills)	3
GET 305 Engineering Statistics and Data Analytics.	3
GET 306 Renewable Energy Systems and Technology	2
GET 307 Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3
GST	**2**
ENT 312 Venture Creation	2
MCE	**8**
MCE 321 Design of Mechatronic Engineering and Robotics Systems I	2
PAU-MCE 302 Introduction to Robotics	2
PAU-MCE 315 Control Systems Engineering I	3
PAU-MCT 312 Signals and Systems	2
MEE	**16**
MEE 306 Computer-Aided Design and Manufacture	3
PAU-MCE 313 Manufacturing and Engineering Technology	2
PAU-MEE 307 Theory of Machines I	3
PAU-MEE 309 Professional and Personal Skills	2
PAU-MEE 310 Fluid Mechanics II	2
PAU-MEE 331 Engineering Graphics and Solid Modelling III	2
PAU-MEE-306 Thermodynamics II	2
SIWES	**4**
GET 399 SIWES II (Industry)	4
400L	**30**
GET	**6**
GET 402 Engineering Project I	2
GET 404 Engineering Valuation and Appraisal	2
PAU-MEE 402 Engineering Economics	2
MCE	**10**
MCE 401 Computer Vision and Image Processing	2
MCE 403 Microcontroller and Embedded Systems	2
MCE 405 Control Engineering	2
MCE 407 Industrial Automation & Control	2

MCE 409 Sensors and Actuators for Embedded Systems	2
SIWES	**4**
GET 499 SIWES III (Industry)	4
Elective	**10**
MEE 401 Mechanical (Machine) Engineering Design II	2
MEE 402 Theory (Mechanics) of Machines I	2
MEE 404 Applied Fluid Mechanics	2
MEE 405 Heat and Mass Transfer	2
PAU-IPE 422 Production and Inventory Systems Design	2
500L	**29**
GET	**7**
GET 501 Engineering (Project) Management	2
GET 502 Engineering Law	2
PAU-MCE 510 Engineering Management	3
MCE	**8**
MEE 591 B.Eng Project I	3
MEE 592 B.Eng Project II	3
PAU-MEE 521 Design of Mechatronics Engineering and Robotics Systems	2
MEE	**4**
MEE 501 Applied Design	2
PAU-MCE 518 Industrial Automation and Control II	2
Elective	**10**
PAU-MEE 503 Applied Thermodynamics II	2
PAU-MEE 504 Mechanical (Machine) Design Engineering III	2
PAU-MEE 522 Automotive System Design	2
PAU-MCE 511 Mobile Robotics and Community Manufacturing	2
PAU-MCE 509 Hardware Design Techniques and Verification	2
Grand Total	**192**

Level	GST/ENT	Basic Science	Discipline/ GET	MEE	EEE/ IPE	Programme (MCE)	SIWES*	Elective	Total Units
100	6	25	3			2	-		36
200	6	-	34			2	3		43
300	2	-	16	16	4	8	4		52
400	-	-	6			10	4	10	30
500	-	-	7	4		8	-	10	29
Total	14	27	66	20	4	30	**11***	20	192
								(14)	**178**

*All 11 SIWES units credited in the 2nd Semester of 400-level

Course Structure at 100-Level Mechatronics Engineering Degree Programme

Course Code	Course Title	Units	Status	LH	PH
First Semester					
GET 100	Remedial Technical Drawing	0	E		45
GET 101	Engineer in Society	1	C	15	
MCE 101	Introduction to Mechatronics Engineering	2	C	30	
GST 111	Communication in English	2	C	30	
CHM 101	General Chemistry I (Physical)	3	C	30	
CHM 107	General Practical Chemistry I	1	C		45
MTH 101	Elementary Mathematics I	2	C	30	
PHY 101	General Physics I (Mechanics)	2	C	30	
PHY 102	General Physics II (Behaviour of Matter)	2	C	30	
PHY 107	General Practical Physics I	1	C		45
MEE 192	Introduction to Christian Theology	2	C	30	
	Sub Total	**18**			
Second Semester					
GST 112	Nigerian People and Culture	2	C	30	
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 102	General Chemistry II (Inorganic)	3	C	30	
CHM 108	General Practical Chemistry II	1	C		45
MTH 102	Elementary Mathematics II	2	C	30	
MTH 103	Elementary Mathematics III (Vectors, Geometry and Dynamics)	2	C	30	
PHY 108	General Physics Practical II	1	C		45
PHY 103	General Physics III (Electricity and Magnetism	2	C	30	
PHY 104	General Physics IV (Vibration, Waves, and Optics)	2	C	30	
PAU-MEE 112	Probability for Engineers	3	C	30	
	Sub Total	**20**			
	TOTAL UNITS	**38**			

Course Structure at 200-Level Mechatronics Engineering Degree Programme

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
First Semester					
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 203	Engineering Graphics and Solid Modelling II	2	C	15	45
GET 207	Applied Mechanics I	3	C	30	45
PAU-MEE 292	The Nature of Human Beings	2	C	30	
PAU-MCE 204	UNIX and Robot Operating System	2	C	15	45
ENT 211	Entrepreneurship and Innovation	2	C	30	-
		23			
Second Semester					
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 208	Strength of Materials	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
PAU-MEE 202	Applied Electricity II	3	C	30	45
GST 212	Philosophy, Logic, and Human Existence	2	C	30	-
Get 299	SIWES	3	C	9 wk	
	TOTAL UNITS	**22**			

SCHOOL OF SCIENCE AND TECHNOLOGY
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Course structure at 300-Level Mechatronics Engineering

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
First Semester					
GET 301	Engineering Mathematics III	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
PAU-MEE 313	Manufacturing and Engineering Technology	2	C	15	45
PAU-MEE 307	Theory of Machines I	2	C	15	45
PAU-MEE 331	Engineering Graphics and Solid Modelling III	2	C	15	45
PAU-MCE 302	Introduction to Robotics	2	C	15	45
PAU-MCE 310	Analogue Electronic Circuit	2	C	15	45
PAU-MCE 315	Control Systems Engineering I	3	C	30	45
MCE 321	Design of Mechatronics Engineering and Robotics Systems I	2	C	30	-
	Sub Total	**24**			
Second Semester					
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication (including Seminar Presentation Skills)	3	C	45	-
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
MEE 306	Computer-Aided Design and Manufacture	3	C	30	45
PAU-MEE-306	Thermodynamics II	2	C	15	45
PAU-MEE 310	Fluid Mechanics II	2	C	15	45
ENT 312	Venture Creation	2	C	15	45
PAU-MEE 309	Professional and Personal Skills	2	C	30	
PAU-MCE 312	Signals and Systems	2	C	30	
PAU-MCE 322	Digital Electronics	2	C	15	45
GET 399	SIWES II	4	C		
	Sub Total	28			
	TOTAL UNITS	**52**			

Course structure at 400-Level Mechatronics Engineering

Course Code	Course Title	Units	Status	LH	PH
MEE 401	Mechanical (Machine) Engineering Design II	2	C	30	-
MEE 405	Heat and Mass Transfer	2	E	45	-
MCE 401	Computer Vision and Image Processing	2	C	30	-
MCE 403	Microcontroller and Embedded Systems	2	C	30	-
MCE 407	Industrial Automation & Control I	2	C	30	-
MCE 409	Sensors and Actuators for Embedded Systems	2	C	30	-
MCE 405	Control Engineering	2	C	15	45
	TOTAL UNITS	**14**			
Second Semester					
MEE 402	Theory (Mechanics) of Machines I	2	E	30	-
MEE 404	Applied Fluid Mechanics	2	E	30	-
PAU-MEE 402	Engineering Economics	2	C	45	
GET 402	Engineering Project I	2	C		90
GET 404	Engineering Valuation and Appraisal	2	C	30	
PAU-IPE 422	Production and Inventory Systems Design	2	E	30	
GET 499	SIWES	4	C		90
	TOTAL UNITS	**16**			

SIWES Courses

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I (University)	3	C	9 weeks
GET 399	SIWES II (Industry)	4	C	12 weeks
GET 499	SIWES III (Industry)	4	C	12weeks
Total		**11***		

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

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Course structure at 500-Level Mechatronics Engineering

Course Code	Course Description Semester I	Units	Status	LH	PH
First Semester					
GET 501	Engineering (Project) Management	3	C	45	-
MEE 501	Applied Design	2	C	15	45
PAU-MEE 503	Applied Thermodynamics II	2	E	30	
PAU-MEE 521	Design of Mechatronics Engineering and Robotics Systems	2	E	30	
MEE 591	B.Eng Project I	3	C		135
	Sub Total	12			
Second Semester					
GET 502	Engineering Law	2	C	30	-
PAU-MEE 504	Mechanical (Machine) Design Engineering III	2	**E**	30	
MEE 592	B.Eng. Project II	3	C	-	135
MCE 501	Design of Mechatronics Engineering and Robotics Systems	2	E	-	90
PAU-MCE 503	Applied Thermodynamics II	2	C	30	
PAU-MCE 507	Signals and Systems	2	E	45	
PAU-MCE 509	Hardware Design Techniques and Verification	2	E	30	
PAU-MCE 510	Engineering Management	2	E	30	
PAU-MCE 511	Mobile Robotics and Community Manufacturing	2	E	15	45
PAU-MCE 515	Engineering Valuation and Appraisal	2	E	30	
PAU-MCE 518	Industrial Automation and Control II	2	E	15	45
PAU-MCE 522	Automotive System Design	2	E	30	
	Sub Total	25			
	TOTAL UNITS	**31**			

Course Contents and Learning Outcomes

100 Level

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

Learning Outcomes

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

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

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). 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 listthe major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade andeconomic 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 udiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

9. perform integration application to areas, volumes.

Course Contents

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

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

Learning Outcomes

On completion, the students should be able to:

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

Course Contents

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

PHY 102: General Physics II (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; Bernoullis 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, 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.

MCE 101: Introduction to Mechatronics Engineering & Robotics (2 Units C: LH 15)

Learning Outcomes

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

- explain the characteristics and components of mechatronics systems;
- discuss recent trends in Mechatronics;
- describe the techniques used in designing a mechatronics process;
- identify, select, and integrate mechatronics components to meet product requirements; and
- develop kinematic, dynamic and control models for robots.

Course Contents

Introduction to mechatronics systems -- Measurement Systems, Control Systems, Microprocessor-based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Level. Temperature, Light Sensors – Selection of Sensors. Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – DC Motors – AC Motors – Stepper Motors. Introduction to Robot and Robotics, Three laws of robotics, History, Issues of industrial robot usage, Robot Types, limitations, Architecture and Configuration of Robots, Applications of Robots, Robots Classification, Robot Repeatability and Accuracy, Robot component, Degree of freedom, Drive Technologies, Coordinate Systems, three related frames, Rotational about fixed frames (x,y,z). Transformation of Coordinate Frame, Forward Kinematics, Orientations, Translation of rigid body. Introduction to robotics, mobile robots, swamp robot and industrial robots, Robot Mechanisms, Actuators and Drive Systems, Differential Motion, Statics and dynamics, Force and Compliance Controls, Realistic and Safe Use of Robots.

200 Level

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

Learning Outcomes

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

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character 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 E: LH 45)

Learning Outcomes

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

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

Course Contents

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

GET 203: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)

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 multi-physical, multidisciplinary design.

Course Contents

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

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;

2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

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

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

GET 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 instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and

8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

Students will acquire the ability to:

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

Course Contents

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

GET 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, etc. (8-10 weeks during the long vacation following 200 level).

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

300 Level

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

Learning Outcomes

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

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

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

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

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
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 using examples that depicts students possess the breadth of knowledge in the area covered.
2. Demonstrate using clear example to depict in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. Create at least two (2) simple algorithms that use computational proficiency.
4. Write at least two (2) simple proofs for theorems and their applications; and
5. Communicate the acquired mathematical knowledge effectively in at least three (3) approaches such as in speech, writing and collaborative groups.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;

3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

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

Practical Contents

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

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

Learning Outcomes

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

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;

6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

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

MCE 321: Design of Mechatronic Engineering& Robotics Systems I (2 Units C: LH 30)

Learning Outcomes

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

1. ability to utilise a systems approach to complex problems and to design an operational performance;
2. proficiency in engineering design;
3. capacity for creativity and innovation;
4. ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member; and
5. ability to apply systems engineering perspective in designing mechatronics systems.

Course Contents

Integrated design process of mechatronics systems; components of mechatronics systems, sensors and actuators, fundamental principal of operation for components, strengths and weaknesses, and operational characteristics. The design process; integrated iterative design, sub-systems, component selection and sizing, design considerations, state-of-the-arts and challenges. Design exercises with increasing degrees of complexity. Others are mechatronics design concepts: integrative design, concepts analogies between electrical and mechanical systems, appreciation of components of mechatronics systems, formulation of design requirements, design exercise and justifications, optimal division into sub systems component, selection and sizing prototype development, appraisal of benefit and cost evolution of mechatronics design and challenges. case studies.

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

Course Contents

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

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

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS. A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

1. design of machine components;
2. product design and innovation;
3. part modelling and drafting in solidworks; and
4. technical report writing.

400 Level

MCE 401: Computer Vision and Image Processing (2 Units E: PH 30)

Learning Outcomes

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

1. explain the basic algorithms, tools and systems for the management, processing and analysis of digital images;
2. identify basic concepts, terminology, theories, models and methods in the field of computer vision;
3. describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition;
4. assess which methods to use for solving a given problem, and analyse the accuracy of the methods;
5. develop and apply computer vision techniques for solving practical problems;
6. choose appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation;l
7. acquire good and practical skills in computer vision; and
8. design and develop simple systems oriented to real-world computer vision applications such as those requiring segmentation and classification of objects in digital images.

Course Contents

Computer vision and image processing are important and fast evolving areas of Mechatronics and Robotics. Student will get familiar with both established and emergent methods, algorithms and architectures. The course will enable students to apply computer vision and image processing techniques to solving various real-world mechatronics and robotics problems, and develop skills for research in the fields. Image formation, image filtering, edge detection and segmentation, morphological processing, registration, object recognition, object detection and tracking 3D vision.

The topics may include but are not limited to:

1. Image formation and perception, image representation.
2. Image filtering: space- and frequency- domain filtering, linear and non-linear filters.
3. Morphological image processing.
4. Image geometric transformations, image registration.

5. Edge detection, image segmentation, active contours, and level set methods.
6. Object recognition, template matching, and classification.
7. Object detection and tracking: background modeling, kernel-based tracking, particle filters.
8. Camera models, stereo vision.

MCE 403: Microcontroller and Embedded Systems (2 Units E: PH 30)

Learning Outcomes

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

1. provide examples of existing embedded systems-based products and describe the special requirements placed in developing such systems;
2. use modern integrated development environments for microcontroller/processor programming and their features for testing and debugging;
3. develop microcontroller programs for mechatronic applications, including the usage of I/O and communication peripherals;
4. describe, explain, and apply some of the basic concepts of communication protocols, particularly the Controller Area Network (CAN);
5. explain basic real-time resource management theory;
6. discuss and communicate intelligently about OS primitives for concurrency, timeouts, scheduling, communication, and synchronisation; and
7. discuss I/O and device driver interfaces to embedded processors with networks, multimedia cards, and disk drives.

Course Contents

Introduction to embedded systems, history, design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols like SPI, I2C, CAN etc. RISC Design Philosophy, comparison between CISC and RISC; PIC/AVR/ARM Design Philosophy; Embedded System hardware, Embedded System software. PIC/AVR/ARM Processor fundamentals – PIC/AVR/ARM core architecture, data flow model, Register, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, PIC/AVR/ARM Processor families. PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 processors Block diagram and pin diagram, operating modes: Study of on-chip peripherals like I/O ports, timers, counters, interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM and USB. Hardware interfacing of PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 using CCS C Compiler/Flowcode/Embedded C language: LED, Switches, LCD Display & stepper motor. On-chip programming: UART, Timer, Real-Time Clock & ADC. Others include Architecture of kernel, task and task scheduler, ISR, Mutex, Semaphores, mailbox, message queues, pipes, events, timers, Priority inversion problem, priority Inheritance, RTOS services in contrast with traditional OS. Introduction to µcos II RTOS and its features, study of kernel structure of µcos II. Case study of digital camera and automatic chocolate vending machine (without codes).

MCE 405: Control Engineering (2 Units E: LH 15; PH 45)

Learning Outcomes

1. At the end of this course, the students should be able to:
2. develop the mathematical model of the physical systems;
3. analyse the response of the closed and open loop systems;
4. analyse the stability of the closed and open loop systems;
5. design the various kinds of compensator;
6. explain alternate representations of dynamic systems (time domain, frequency domain, state space);
7. define and explain feedback and feed-forward control architecture and discuss the importance of performance, robustness and stability in control design;
8. interpret and apply block diagram representations of control systems and design PID controllers based on empirical tuning rules;
9. compute stability of linear systems using the Routh array test and use this to generate control design constraints;
10. employ Evans root locus techniques in control design for real world systems;
11. compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability;
12. design Lead-Lag compensators based on frequency data for an open-loop linear system;
13. analyse the stability of systems by root locus and frequency response methods;
14. draw Bode diagrams, root locus graphs and Nyquist plots for the analysis of control systems solve numerical problems on control systems; and
15. utilise MATLAB/Simulink to analyse open and closed loop performance and design linear feedback controllers.

Course Contents

Introduction to control system: Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function. Mathematical modelling of dynamic systems: Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring– Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Time domain analysis: Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants. Stability Analysis: Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichol's chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichol's chart. M-circle and M-Contours in Nichols chart. Control System performance measures: Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD and PID control.

MCE 407: Industrial Automation and Control (2 Units E: PH 30)

Learning Outcomes

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

1. describe working of various blocks of basic industrial automation systems;
2. demonstrate proficiency in automation programming/troubleshooting related to programmable logic controllers;
3. connect the peripherals with the PLC.
4. utilise various PLC functions and develop small PLC programs;
5. Summarize distributed control system and SCADA system;
6. demonstrate an understanding of the core hardware and theory related to programmable automation controllers;
7. employ various industrial motor drives for the Industrial Automation; and
8. design, install and maintain automation and control systems.

Course Contents

This course will provide an overall exposure to the Technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course covers a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC machines. More specifically, the course covers:

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems Measurement Systems: Pressure and Force Measurement, Temperature measurement, Displacement and Speed Measurement, Flow Measurement, Measurement of Level, Humidity and pH, Signal Conditioning Circuits, Errors and Calibrations. Process Control: Introduction to Process Control, PID, PID Controller Tuning, PID Controller Implementation Programmable Logic Control: The Software Environment and Programming of PLC, Sequence Control and Structured RLL Programming, Programming of PLCs Sequential Function Chart. CNC Machines: Introduction to CNC Machines, CNC Machines Interpolation, Control and Drive. Actuators: Control Valves, Directional Control Valves, Switches and Gauges, Industrial Hydraulic Circuits, Pneumatic Control Components, Pneumatic Control Systems,

Electric Machines Drive: Energy Savings with Variable Speed Drives, Step Motors - Principles, Construction and Drives, DC Motors Drives, Induction Motor Drives, BLDC Motor Drives. Industrial Embedded and Communication System: Introduction to Real-time Embedded Systems, Real-Time Operating Systems, Networking of Field Devices via Fieldbus, Higher Levels of Industrial Automation.

MCE 409: Sensor and Actuators for Embedded Systems (2 Units E: LH 30)

Learning Outcomes

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

1. itemise and discuss the characteristics and the components of mechatronic systems;
2. discuss recent trends in Mechatronics;
3. describe active & passive electrical circuits;
4. describe the techniques used to design a mechatronics process; and
5. suggest possible design solutions.

Course Contents

This course provides an introduction to sensors and actuators in mechatronics systems. The topics include sensing principles for measuring motion, force, torque, pressure, flow, and temperature using analogue and digital transducers; actuating principles for continuous drive actuators and stepper motors; power transmission systems; and methods for signal collection, conditioning and analysis. Various components will be experimentally tested and analysed. Others are basics of Energy Transformation: Transducers, Sensors and Actuators.

Understanding of Sensor Interfacing with Microprocessor to build electronic system Week Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor-based electronics systems. Sensor performance criteria and selection, including: (a) Thermocouples (b) Resistive sensors (c) Inductive sensors (d) Capacitive sensors (e) Piezoelectric sensors (f) Encoders and tachometers. Actuator performance criteria and selection, including: (a) Fluidic actuators (b) Solenoids and voice coil motors (c) Stepper motors (d) DC motors (e) Piezoelectric actuators (f) Shape memory alloy actuators (g) MEMS sensors and actuators. Merits of Fluid power & its utility for increasing productivity through Low-Cost

Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, Signalling & control system. Introduction to Industrial Hydraulics, Hydraulics Power System elements and standard symbolic Representation (CETOP symbols). Pneumatic & hydraulic control elements (control valves & hydraulic pumps, accessories), Basic circuits for controlling single & double-acting cylinder, Basic circuits, Advantages of Hydro-Pneumatics and its applications, Hydraulics system and their Classification. Hydraulics circuits Hydraulic Motors, Hydraulic Fluids and effective contamination control. Advanced pneumatic circuits for controlling multi-cylinders (operable & inoperable circuits), Electro pneumatics with relay logic, Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

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 device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

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

500 Level

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;

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

Course Contents

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

MCE 501: Design of Mechatronic Engineering & Robotics Systems II (2 Units C: PH 90)

Learning Outcomes

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

1. ability to practicalise the systems approach to complex problems learned MCE 321;
2. practicalise the design of an assigned device for operational performance;
3. dexterity in engineering design and implementation;
4. evaluation of designed mechantronic systems; and
5. ability to partake in design and innovation competitions.

Course Contents

This is essentially the practical implementation of the content of MCE 321, with students working independently and in focus groups. See content of MCE 321 for more details.

MCE 599: Final Year Project **(6 Units C: LH 270)**

Learning Outcomes

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

1. prepare for real-life postgraduation experience in project implementation and report writing skills. The course lasts for one academic session.

Course Contents

Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars. This course lasts for one academic session.

Staffing

PAN-ATLANTIC UNIVERSITY
B.Eng. MECHATRONICS ENGINEERING PROGRAMME
30% ADDITIONAL COURSES TO CCMAS

SUMMARY

100 LEVEL					
Course Code	Course Title	Units	Status	LH	PH
PAU-MCE 102	General Physics II (Electricity, Magnetism and Modern Physics)	2	C	30	
PAU-MCE 104	General Physics IV (Vibration, Waves and Optics)	2	C	30	
PAU-MCE 112	Probability for Engineers	3	C	45	
PAU-MCE 191	Introduction to Christian Theology	2	R	30	
Total: 9					

200 LEVEL					
Course Code	Course Title	Units	Status	LH	PH
PAU-MCE 202	Applied Electricity II	3	C	30	45
PAU-MCE 203	Engineering Graphics and Solid Modelling II	2	C	15	45
PAU-MCE 204	UNIX and Robot Operating System	2	C	15	45
PAU-MCE 207	Applied Mechanics I	3	C	30	45
PAU-MCE 292	The Nature of Human Beings	2	R	30	
Total: 9					

300 LEVEL					
Course Code	Course Title	Units	Status	LH	PH
PAU-MCE 306	Thermodynamics II	2	C	15	45
PAU-MCE 307	Theory of Machines I	2	C	15	45
PAU-MCE 310	Fluid Mechanics II	2	C	15	45
PAU-MCE 312	Analogue Electronic Circuits	2	C	15	45
PAU-MCE 313	Manufacturing and Engineering Technology	2	C	15	45
PAU-MCE 315	Control Systems Engineering I	3	C	30	45
PAU-MCE 322	Digital Electronics	2	C	15	45
PAU-MCE 331	Engineering Graphics and Solid Modelling III	2	C	15	45
PAU-MCE 392	Professional and Personal Skills	2	R	30	
Total: 18					

400 LEVEL					
Course Code	Course Title	Units	Status	LH	PH
PAU-MCE 401	Professional Ethics for Engineers	2	C	30	
PAU-MCE 403	Engineering Economics	3	C	45	
PAU-MCE 413	Research Methods	1	C	15	
Total: 5					

500 LEVEL					
Course Code	Course Title	Units	Status	LH	PH
PAU-MCE 503	Applied Thermodynamics II	2	C	30	
PAU-MCE 504	Mechanical (Machine) Design Engineering III	2	C	30	
PAU-MCE 507	Signals and Systems	2	E	45	
PAU-MCE 509	Hardware Design Techniques and Verification	2	E	30	
PAU-MCE 510	Engineering Management	2	E	30	
PAU-MCE 511	Mobile Robotics and Community Manufacturing	2	E	15	45
PAU-MCE 512	Turbomachinery	2	E	30	
PAU-MCE 515	Engineering Valuation and Appraisal	2	E	30	
PAU-MCE 518	Industrial Automation and Control	2	E	15	45
PAU-MCE 521	Design of Mechatronics Engineering and Robotics Systems	2	E	30	
PAU-MCE 522	Automotive System Design	2	E	30	

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 102 General Physics II (Electricity, Magnetism and Modern Physics) (2 Units, Core, LH=30)

Senate-approved relevance

Electromagnetic fields play important roles and are fundamental to electronic and electrsystems. motors, generators, speakers, microphones, computer storage devices like hard drives and many other devices are based upon electromagnetic principles. This course will equip students with a variety of skills required for the design and development of electromagnetic systems, devices, and components. These skills will be needed to attain the mission of the Pan-Atlantic university to “form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large.”

Overview

Electricity and magnetism are separate, yet interconnected phenomena associated with the electromagnetic force. Together, they form the basis for electromagnetism, a key physics discipline. It is possible to have an electric field without a magnetic field, and vice versa. However, a moving electrical charge always has an associated magnetic field. Asides behaviour due to the force of gravity, nearly every occurrence in daily life stems from the electromagnetic force. It is responsible for the interactions between atoms and the flow between matter and energy.

The course familiarises students with the fundamental concepts and laws in electricity and magnetism and establish a good grounding in electromagnetism in preparation for more advanced electronic engineering courses. Also, it provides students with analytical tools to understand and analyse the interactions between time-varying electric and magnetic fields.

Objectives

The objectives of the course are to:

- Describe the electric field and potential, and related concepts, for stationary charges.
- Calculate electrostatic properties of simple charge distributions using Coulomb’s law, Gauss’s law, and electric potential.
- Describe and determine the magnetic field for steady and moving charges.
- Determine the magnetic properties of simple current distributions using Biot-Savart and Ampere’s law.

- Describe electromagnetic induction and related concepts and make calculations using Faraday and Lenz's laws.
- Explain the basic physical of Maxwell's equations in integral form.
- Evaluate DC circuits to determine the electrical parameters.
- Determine the characteristics of ac voltages and currents in resistors, capacitors, and Inductors.

Learning Outcomes

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

- Describe the at least five (5) field types emanating from different geometric arrangement of stationary charges.
- Solve simple charge distributions using the equation dq= λdl to calculate electrostatic properties
- Describe the magnetic field in two types of wires: long wire and short wires.
- Determine the magnetic properties of simple current distributions in at least three (3) engineering materials such as such as straight wire, circular loop, and solenoid.
- Calculate change in flux linkages using Faraday's first and second laws.
- State Gauss's law, Faraday's law, and Ampere-Maxwell's laws in integral forms
- Solve for electric voltage, current, resistance, electric power and energy, and difference between conventional and electron current flow for two types of simple DC circuits.
- Differentiate among three electronic components such as resistors, capacitors, and Inductors in terms of their voltages and currents.

Course contents

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step-down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

Minimum Academic Standards

Equipped laboratory as per NUC CCMAS

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 104 General Physics IV (Vibration, Waves and Optics) (2 Units, Core, LH=30)

Senate-approved relevance

Waves have many uses which are vital to our daily lives. For instance, visible light allows us to see, microwaves and radio waves allow for long-range communication via mobile phones, television and radio, infra-red waves are used in night-vision cameras and in many remote controls, x-rays are used in medical imaging; lasers (beams of concentrated light) are used for many precision tasks, such as cutting materials, reading and writing optical discs such as CDs and DVDs, and preforming delicate surgery. This course will equip students with a variety of skills required to unify physical phenomena as periodic motion, oscillations and waves in different parts of physics as in mechanics, acoustics, electricity and especially in optics. These skills will be needed in order to attain the mission of the Pan-Atlantic university to "form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large."

Overview

Waves and oscillations characterize many different physical systems, including vibrating strings, springs, water waves, sound waves, electromagnetic waves, and gravitational waves. Quantum mechanics even describes particles with wave functions. Despite these diverse settings, waves exhibit several common characteristics, so that the understanding of a few simple systems can provide insight into a wide array of phenomena.

The aim of this course is to introduce students to the fundamental concepts and mathematical treatment of mechanical vibrations and physical waves, to explore various phenomena arising from the superposition of two or more waves, and to outline some of the general principles governing the propagation of light. The course also aims to amplify and expand on the ideas of vibrations and resonance followed by the physics of wave motion since understanding wave motion is vital for several areas of advanced physics and, including optics and quantum mechanics.

Objectives

The objectives of the course are to:

- Outline a variety of physical phenomena, including mechanical and electrical oscillations, mechanical and electromagnetic waves and optics, at the level of the basic course of general physics

- Describe the wide applicability of vibration and wave concepts.
- State the general principles governing the propagation of light.
- Describe the physics of periodic oscillations, waves and optics and the related calculus
- Develop simple diffraction patterns and describe the limits imposed by diffraction to the performance of optical instruments

Learning Outcomes

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

- Describe the principles of polarization, diffraction, and interference.
- Discuss the motion of a mass on a spring and state the categories of waves.
- Explain transmission, reflection, and refraction of light.
- Explain reflection of a pulse, longitudinal waves, and standing waves on a string
- Explain reflection and refraction in mirrors and lenses.

Course contents

Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (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 wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens's principle (interference and diffraction).

Minimum Academic Standards

Equipped laboratory as per NUC CCMAS

SCHOOL OF SCIENCE AND TECHNOLOGY
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Pan-Atlantic University
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PAU-MCE 112 Probability for Engineers (3 Units, Core, LH=45)

Senate-approved relevance

Probability is the aspect of mathematics which enables us to measure the degree of certainty or uncertainty about a given random outcome. In engineering in particular, Probability theory provides us with a formal basis for quantifying risk or uncertainty in engineering problems. Probability Theory helps the engineer to evaluate whether a certain set of engineering data provides sufficient evidence to draw conclusions. This in turn will enable sound decision making which is in line with the mission of the university to produce highly competent individuals who can serve society with their knowledge and skills. Probability theory finds application in areas of engineering such as in reliability analysis and in engineering risk assessments etc.

Overview

In this course the focus will be on the study of some basic and essential concepts in Probability theory. These concepts include sample space, events, random variables, and simple concepts in probability such as addition and multiplication rule, probability distributions - discrete and continuous, axioms of probability, mathematical expectation, moments of random variables, Chebyshev's inequality, joint, marginal, and conditional distribution, and Bayes' theorem.

In this course, greater attention will be given to how these concepts apply in solving practical engineering problems.

Objectives

The objectives of the course are to:

- Describe the nature of probability of events in a sample space.
- Explain some special discrete and continuous univariate probability distributions.
- Explain moments, and mathematical expectations of random variables.
- Describe the idea behind joint, conditional and marginal distributions.
- Discuss the nature of Bayesian probability.

Learning outcomes

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

- Construct the probability of a sample space for two phenomena such as tossing a coin and/or rolling a die.
- Determine probability distributions using Pascal's triangle, Binomial expansion, Permutation, Combinations, Binomial theorem, and the Binomial probability distribution.
- State the five (5) properties of mathematical expectations.
- Solve probability problems in two distributions such as joint, conditional, and marginal distributions.
- Solve problems of conditional probability using Bayes' theorem.

Course content

Introduction to probability and its axioms. Mutually exclusive and independent events. Addition and multiplication rules of probability. Conditional probability and independence, Bayes' theorem. Random variables, mathematical expectations, and moments of random variables. Laws of large numbers. Chebyshev's inequality. Some special probability distributions: Bernoulli, binomial, geometric, negative binomial, Poisson, hypergeometric, normal and Weibull distributions.

Minimum Academic Standards

Classroom with screen and overhead projector

Pan-Atlantic University
School of Science and Technology
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B.Eng. Mechatronics Engineering

PAU-MCE 191 Introduction to Christian Theology (2 Units Required; LH= 30).

Senate-approved Relevance

Pan Atlantic University has a strong Christian identity which is shown in its openness to people of all races and religions. Its mission is "to form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large". One of the objectives of the university is to also give a well-rounded formation of the human person, which includes some courses in the humanities. The course intends to present the essentials of the Christian faith and morals that are related to contemporary issues that inform the identity of the school and will form the basis of other courses on humanities that the students will be taught. It will also help the students to learn to think deeply about contemporary societal issues.

Overview

Nigeria is a multicultural and multi-religious country. Christians make up roughly half of the population of the country. The purpose of the course is to provide essential background on key aspects of Christian faith and morals, related to contemporary issues, as a means of giving students basic criteria to analyze contemporary situations and form a basis for critical analysis from a Christian perspective.

The course will also help the non-Christians understand some aspects of the Christian faith which fosters societal integration of people of different religions. The purpose of the course is to aid the students to understand the human being in relation to God, the others and the world from a Christian perspective and apply that knowledge to modern-day issues.

Objectives

- The objectives of the course are to:
- State some basic philosophical concepts that are fundamental for theological discussion.
- Discuss some fundamental concepts and mysteries of the Christian faith.
- Explain the place of man in the modern world and correctly judge
- contemporary issues in the light of the Christian faith.
- Discuss the relationship between law and human conscience.
- Analyze human actions and determine their morality.
- Explain Christian morals and be able to judge situations with clear moral
- criteria.

- Discuss contemporary moral situations from a Christian perspective.

Learning Outcomes

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

- Discuss at least three philosophical arguments about the existence of God.
- Explain the relationship between science and faith using at least three concrete examples.
- Explain three modern theories about the relationship between creation and evolution.
- Analyze human actions to determine their morality based on the three criteria of action, circumstance, and intention.
- List and explain the Ten Commandments and their implications.
- Explain at least five consequences of mishandling the truth, detraction, and defamation.
- Explain five contemporary issues relating to human life and drug use.

Course contents

The Existence of God. Divine Revelation. Creation and Evolution. Jesus Christ: both man and God. Eschatology. Human Freedom and Natural Law. Moral Conscience. Factors that determine the Morality of Human Acts. Personal Sin and Responsibility. Influence of the Passions in Human Actions. The Virtues. Introduction to the Ten Commandments. Contemporary human Life issues. Contemporary sexual issues. The morality of Gambling. Contemporary issues regarding handling the truth. Christian Prayer.

Minimum Academic Standard

A classroom with a projector

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 202 Applied Electricity II (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Applied Electricity, is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Electrical and electronic engineers work at the forefront of practical technology, improving the devices and systems we use every day. From solar-energy systems to mobile phones, we innovate to meet society's communication, tech and energy needs. Electricity is integral to modern life - power generation, transport, medicine, quantum information, computing, artificial intelligence (AI), cryptography, communications, the list is endless. So, what distinguishes electrical from electronic? Put simply, electrical engineers deal with the supply and flow of power; electronic engineers create the electronic devices we use every day.

This course will cover Power factor, Power in AC circuit, Resonance in RLC series and parallel circuit, Three Phase Circuits: Voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. DC Machines: Construction, Basic concepts of winding (Lap and wave); DC generator: Principle of operation, EMF equation, characteristics (open circuit, load) DC motors: Principle of operation, Torque Equation, Speed Torque Characteristics (shunt and series machine); Single Phase Transformer: Constructional parts, Types of transformers, Emf equation, No Load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, regulation and efficiency calculation; Three Phase Induction Motor: Types, Construction, production of rotating field, principle of operation, Slip and Frequency, rotor emf and current, Equivalent circuit and phasor diagram, Torque Slip characteristics torque-speed characteristics; General Structure of Electrical Power System: Power generation to distribution through overhead lines and underground cables with single line diagram, Earthing of Electrical Equipment, Electrical Wiring Practice.

Objectives

The objectives of the course are to:

- Use computational tools and packages in the design of electric power systems, electronic, and digital equipment, and systems.
- Solve common, technical problems in the design of electronics and electrical circuits including electric power systems and seek specialist advice as needed for more complicated problems.
- Identify the process of innovation and the main factors of entrepreneurship and creative thinking and apply methods of product development.
- Apply project management methods to the planning of projects.
- plan, manage and analyse projects, using current best-practice methods; and
- Calculate cost estimate for a design solution, and understand the uncertainties associated with the cost estimation process.

Learning Outcomes

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

- Use computational tools and packages in the design of electric power systems, electronic, and digital equipment, and systems.
- Solve common, technical problems in the design of electronics and electrical circuits including electric power systems and seek specialist advice as needed for more complicated problems.
- Identify the process of innovation and the main factors of entrepreneurship and creative thinking and apply methods of product development.
- Apply project management methods to the planning of projects;
- Analyse projects, using current best-practice methods; and
- Calculate using a spreadsheet the cost estimate for a design solution, and understand the uncertainties associated with the cost estimation process.

Course contents

Power factor, Power in AC circuit, Resonance in RLC series and parallel circuit, Three Phase Circuits: Voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. DC Machines: Construction, Basic concepts of winding (Lap and wave); DC generator: Principle of operation, EMF equation, characteristics (open circuit, load) DC motors: Principle of operation, Torque Equation, Speed Torque Characteristics (shunt and series machine); Single Phase Transformer: Constructional parts, Types of transformers, Emf equation, No Load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, regulation and efficiency calculation; Three Phase Induction Motor: Types, Construction, production of rotating field, principle of operation, Slip and Frequency, rotor emf and current, Equivalent circuit and phasor diagram, Torque Slip characteristics torque-speed characteristics; General Structure of Electrical Power System: Power generation to distribution through overhead lines and underground cables with single line diagram, Earthing of Electrical Equipment, Electrical Wiring Practice.

Minimum Academic Standards Functional Electrical Machine laboratory.

SCHOOL OF SCIENCE AND TECHNOLOGY
PAN-ATLANTIC UNIVERSITY

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 203 Engineering Graphics and Solid Modelling II (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding engineering drawing and modelling is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Engineering graphics are useful in simulation of the following built environments: Determining origin of failure in components and systems Clarify accidents from misuse of products or negligent behaviour. in Engineering Profession, it is very essential that the Engineers and Craftsmen are able to communicate their ideas and facts with each other clearly and without ambiguity. The verbal communication may be hopelessly inadequate. The written communication, on the other hand may be very inefficient, lengthy and boring to create accurate mental and physical impression of an item in the mind of the reader.

The Engineering Drawing, which is a Graphical Communication of an accurate and unambiguous description of an object, has proved to be an efficient communication method. It is a means of organizing and presenting precise technical directions for items to be produced for the consumers. Engineering Drawing can supply all the information needed with the exactness and details required. It is therefore, one of the principal functions of drawing to convey ideas from the design engineer to the fabricator. Hence, the skill to interpret and construct engineering sketches and drawings is of paramount importance. The engineer may convey his ideas by one or more of the three basic types of projections namely; Orthographic Projection, Oblique Projection or Perspective Projection, depending upon the purpose of the drawing and the person to whom he wishes to convey his ideas. Certain professional areas have different nomenclature such as Machine Drawing, Architectural Drawing, and Structural Drawing.

Objectives

The objectives of the course are to:

- Use projections to prepare a detailed working drawing of objects and designs.

- Design in parametric design to aid their ability to see the design in the optimal specification of materials and systems to meet needs.
- Analyse designs based on strength and material minimization appraoches.
- Identify the need for the theoretical perspectives that create the basis for the analyses that are possible in design and optimisation, and recognize the practical link to excite their creativity and ability to innovate; and
- Translate to produce shop drawings for multi-physical, multidisciplinary design.

Learning Outcomes

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

- Use projections to prepare at least two (2) detailed working drawings of objects and designs.
- Use parametric design to produce an BSI or DIN complaint design in the optimal specification of materials and systems to meet needs;
- Analyse at least three (3) designs using strength and material minimization approaches.
- Identify the need for the theoretical perspectives that create the basis for the analyses that are possible in design and optimisation and recognize the practical link to excite their creativity and ability to innovate.
- Translate to working shop floor drawings for multi-physical, multidisciplinary design.

Course contents

Projection of lines, auxiliary views, and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface, and shell modeling. Faces, bodies, and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries, and Schematic design. Parametric modeling 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).

Minimum Academic Standards

Equipped Engineering drawing facility.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 204 UNIX and Robot Operating System (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with strong capacity for robotics for community manufacturing is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Robots increase speed for manufacturing processes. The speed and dependability of robots ultimately reduces cycle time and maximises throughput. For small and medium scale community manufacturing outfits, the need for cost-effective implementation and sustainability are critical for remaining competitive.

This course provides object-oriented theory and practice for the development and application of robot technology in small and medium enterprises (SME) but very cost-effective production processes in a manufacturing community such as the upcoming manufacturing clusters in the Lagos Free Zone.

Objectives

The objectives of the course are to:

- Understand the Fundamentals of UNIX and LINUX Operating System
- Managing, Securing, Automating and Trouble Shooting the UNIX/Linux Operating System
- Describe robotic systems used in manufacturing.
- Teach the application of Free and Open-Source Software (FOSS) to design robot manufacturing system.
- Describe Robot Operating System (ROS) programming for ROS robot simulation hardware prototyping.
- Perform troubleshooting procedures for robotic systems.
- Analyse robot system using kinematics of serial and parallel Robots.
- Demonstrate robots path planning procedure.

- Explain actuators and drive systems for manufacturing robots.
- Describe the characteristics of sensors for image processing and analysis of vision systems.

Learning Outcomes

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

- Install and use at least three (3) UNIX/Linus Operating Systems
- Use at least twenty (20) UNIX and LINUX Commands
- Managing, Securing, Automating and Trouble Shooting at least three (3) UNIX/Linux Operating Systems
- List at least four (4) robot system used in manufacturing as defined by global robotics organisations.
- Install and use Free and Open-Source Software (FOSS) to design at least three systems for manufacturing.
- Apply Robot Operating System (ROS) programming for hardware prototyping.
- Troubleshoot faulty robotic system.
- Analyse at least two (2) robot systems using kinematics of serial and parallel Robots principles.
- Perform path planning of two robotics systems and motion control.
- Describe ten (10) actuators and drive systems for manufacturing robots.
- Describe the characteristics of at least seven (7) types of sensors used for image processing and analysis of vision systems.

Course contents

UNIX/Linux Fundamentals. Manage, Secure, Automate and Trouble Shoot UNIX/Linux Operating Systems. Robot Fundamentals. Free and Open-Source Software (FOSS). Introduction to Robot Operating System (ROS) programming. ROS Robot Simulation. ROS Robot hardware Prototyping. Trouble shooting and best practices. Kinematics of Serial and parallel Robots. Differential motion and velocities. Path planning of robotics systems and motion control. Actuators and Drive systems. Sensors. Image processing and analysis of vision systems. Robot project management. Basic Artificial Intelligence for Robotics design.

Minimum Academic Standards

Computer teaching laboratory with Ubuntu Linux operating system and ROS software with at least one computer to 5 students. One Robot-arm running with FOSS and ROS Software.

SCHOOL OF SCIENCE AND TECHNOLOGY
PAN-ATLANTIC UNIVERSITY

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 207 Applied Mechanics I (3 Units, Core, LH=30 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Applied mechanics which is the "building blocks" of statics, dynamics, the strength of materials, and fluid dynamics. Engineering mechanics is the discipline devoted to the solution of mechanics problems through the integrated application of mathematical, scientific, and engineering principles is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Engineering Mechanics provides the "building blocks" of statics, dynamics, the strength of materials, and fluid dynamics. Engineering mechanics is the discipline devoted to the solution of mechanics problems through the integrated application of mathematical, scientific, and engineering principles.

The three subdivisions of Engineering Mechanics are statics, which deals with forces acting on and in a body at rest; kinematics, which describes the possible motions of a body or system of bodies; and kinetics, which attempts to explain or predict the motion that will occur in each situation. These divisions are so fundamental to a myriad of engineering applications to human comfort.

Objectives

The objectives of the course are to:

- Describe the statics of particles and determine the resultant of multiple forces acting on a particle.
- Discuss the resolution of forces into components and add forces that have been resolved into rectangular components.
- Introduce the concept of the free-body diagram and use free-body diagrams to assist in the analysis of planar and spatial particle equilibrium problems.

- Discuss the equilibrium of rigid bodies, equivalent systems of forces, and application of Varignon's theorem to simplify certain moment analyses.
- Discuss and analyze the static equilibrium of rigid bodies in two and three dimensions.
- Describe the centers of gravity of two- and three-dimensional bodies.
- Examine the laws of dry friction and the associated coefficients and angles of friction.
- Describe the basic kinematic relationships between position, velocity, acceleration, and time.
- Apply Newton's second law of motion to solve particle kinetics problems using different coordinates.
- Solve particle kinetics problems using the principle of work, energy, and momentum methods.

Learning Outcomes

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

- Resolve forces into components and determine the resultant of multiple forces acting on a particle.
- Analyze forces, moments, and couples applied to at least three (3) engineering structures.
- Determine the equilibrium at least two (2) simple structures and machine parts.
- Apply equilibrium to at least two (2) simple structures and machine parts.
- Describe and evaluate the friction phenomenon in at least four (4) machine components.
- Apply the first and second moments of the area, centroids.
- Apply kinematics in two (2) bodies such as particles and rigid bodies in plane motion.
- Evaluate the kinetics of particles using Newton's second law.
- Analyze the kinetics of particles using energy and momentum methods.
- Evaluate the dependent motion of particles.

Course contents

Forces, moments, and couples. Equilibrium of simple structures and machines parts. Rigid Bodies: equivalent systems of Forces. Equilibrium in two- and three-dimensions. Friction. Wedges and screws. Square-threaded screws. Belt friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Rectilinear motion of particles. The curvilinear motion of particles. Position, Velocity, and Acceleration. The projectile of a particle. Newton's Second Law of Motion. Linear Momentum of a particle and its rate of change.

Minimum Academic Standards

A well-equipped applied mechanics laboratory with NUC-MAS requirement facilities.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 292 The Nature of Human Beings (2 Units Required; LH 30).

Senate-approved relevance

The mission of Pan-Atlantic University is "to form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large". Thus, Pan-Atlantic University is committed to ensuring that its students devote time to courses in humanities and liberal arts that ensure their all-around formation as persons and foster in them the highest regard for human dignity albeit inculcating in them a sense of service for humanity.

Overview

An anthropological crisis is at the root of most of the social and moral problems confronting contemporary society due to a resurgence of doubts as regards the true nature of human beings. This situation calls for intervention in the form of philosophical anthropology to the nagging existential questions such as; Who is a human being? What kind of difference exists between human beings and animals? What is the meaning of life? What is the foundation of human dignity? What is human fulfilment? Is death the end of life? etc.

This course is designed to introduce the students to the philosophical basis of considerations about the human person. It seeks to establish what/who the human person is with the aim of bringing the students to a due appreciation of the human person and human dignity. The course exposes the students to human potencies and faculties, such as; rationality, understanding, imagination, freedom, Will, and emotions. The students will also be exposed to various conceptions of the human person across different epochs, the idea of death, immortality of the soul, and human destiny.

Objectives

The objectives of the course are to:

- Teach basic concepts in Philosophical Anthropology such as nature, truth, and reality.
- Describe what makes human beings' higher animals.
- Discuss human rationality and the process of conceptual knowledge, focusing on the intellect and will.
- Analyze the social nature of human beings and the consequences of relationality.
- Explain human freedom and responsibility.

- Discuss human existence, the meaning of life and human fulfilment.
- Discover the meaning of human dignity and its practical consequences.
- Evaluate ideas about human death, immortality, and the human soul.

Learning Outcomes

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

- Explain at least seven basic concepts in Philosophical Anthropology.
- Give at least five aspects of the human person that reflect the difference between human beings and lower animals.
- Explain at least three different operations of the human intellect and will.
- Enumerate at least four institutions that develop the social nature of human beings.
- Give at least five consequences of good and bad uses of freedom.
- Explain at least four practical consequences of understanding human dignity in each of socio-political, economic, cultural, and technological development.
- Demonstrate knowledge of the four cardinal virtues and their relation to the development of the human person.
- Discuss at least three reasons why the idea of death shapes one's sense of meaning and human existence.

Course Content

Introduction and conceptual clarifications. Human beings as higher animals. Human emotions and emotional Intelligence. The rationality of human beings – intelligence and will. The unity of the human person. Human sexuality. The nature of Human Freedom. Freedom and truth. Freedom and Evil. Human beings as social beings. Expanded view of the social environment – virtual world and meta-verse. Human beings as working beings – the objective and subjective dimensions of human work. Human development – the virtues. The dignity of human beings and its practical consequences. Human fulfilment. Existence and the meaning of Life. The phenomenon of Human death.

Minimum Academic Standard

A classroom with projector

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 306 Thermodynamics II (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Thermodynamics especially in manufacturing refrigeration systems and heat pumps is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Thermodynamics is the science of energy. It is the is the study of the relations between heat, work, temperature, and energy, All activities in nature involve some interaction between energy and matter; thus, it is hard to imagine an area that does not relate to thermodynamics in some manner. Therefore, developing a good understanding of basic principles of thermodynamics has long been an essential part of engineering education.

Thermodynamics is commonly encountered in many engineering. This course is a follow up course of the introductory course on Fundamentals of Thermodynamics. The course discusses evaporation, dehydration, psychometry, surface phenomena, refrigeration and air conditioning as well as heat and mass transfer. It discusses heat penetration within containers, factors affecting heat penetration with cans, death order of microorganisms with cans. Material and energy balance calculations, steady and unsteady conduction, free convection, forced convection and heat transfer with change of phase are presented. Radiation heat transfer and its applications in industry as well as steady and non-steady diffusion in liquids. Mass transfer with convection and its applications in industries are explored as practical examples.

Objectives

The objectives of the course are to:

- Explain the ideal air cycles
- Discuss thermodynamic principles of operation of Internal Combustion Engines and solve related problems following examples.

- Distinguish the working principles of Reciprocating air compressors with other positive displacement compressors.
- Relate the Gas and vapour power cycles with their significance in operation of the requisite heat engines.
- Relate the refrigeration cycles with their areas of application.
- Study vapour compression units and their related specificities
- Discuss the principles of absorption refrigeration.
- State process operations in food processing such as evaporation, dehydration, psychometry, surface phenomena, refrigeration and freezing and explain their applications.
- Demonstrate material and energy balance calculations for thermodynamic systems.
- Discuss steady and non-steady diffusion, heat and mass transfer.

Learning Outcomes

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

- Explain using practical examples, the ideal air cycles.
- Discuss thermodynamic using examples principles of operation of Internal Combustion Engines and solve related problems.
- Compare the working principles of reciprocating air compressors with, at least, two positive displacement compressors.
- Relate the Gas and vapour power cycles with at least two significances in operation of the requisite heat engines.
- Relate the refrigeration cycles with at least two (2) areas of application.
- Study vapour compression units and their related specificities
- Discuss the principles of absorption refrigeration.
- State at least four (4) of the following process operations in food processing such as evaporation, dehydration, psychometry, surface phenomena, refrigeration and freezing and explain their applications.
- Demonstrate material and energy balance calculations for at least two (2) thermodynamic systems.
- Discuss using at least two (2) industries, steady and non-steady diffusion, heat and mass transfer.

Course contents

Ideal air cycles. Introduction of Internal Combustion Engines; Reciprocating air compressors and other positive displacement compressors. Gas and vapour power cycles, refrigeration cycles, vapour compression units, principles of absorption refrigeration. Testing of various heat engine plants. Evaporation, dehydration, psychometry, surface phenomena, refrigeration and freezing. Heat and mass transfer, Heat penetration within cans; factors affecting heat penetration with cans; death order of microorganisms with cans. Material and energy balance calculations, steady and unsteady conduction, free convection, forced convection and heat transfer with change of phase. Radiation heat transfer and its applications in food industry. Steady and non-steady diffusion in liquids. Mass transfer with convection and its applications in beverage industries.

Minimum Academic Standards

An equipped Thermodynamics laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 307 Theory of Machines I (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Theory of machines especially in manufacturing industries is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

The general philosophy of the mechanical engineering programme of Pan-Atlantic University is to prepare competent professionals with high academic standards and adequate practical background of the programme geared towards self-employment. In line with this aforementioned philosophy and vision of PAU, it is necessary to provide a solid foundation to the students in the area of design engineering projects and supervision of their implementation, design and manufacture of components, machines, equipment and systems, design and development of new products and production techniques in industries, installation and maintaining of complex engineering system that can perform optimally in our environment, improving indigenous technology to enhance local problems solving capability in Mechanical Engineering. All the aforementioned are areas and facilities that determine the technological advancement and growth of a nation.

To guarantee a sound formation of professionals in mechanical engineering, Theory of Machines 1 is a core course to be focused, dealing with teaching of the fundamentals of theory and operating principles of mechanisms and members of machines. It is the bedrock on which to teach design to students and without this prerequisite knowledge it is not feasible to design components of machines and machines in general.

Objectives

The objectives of the course are to:

- Analyse simple mechanisms
- Categorise vector diagrams, simple Harmonic motion, and applications.
- Evaluate the Newton’s Laws of motion and the relative motion of machines and their units.

- Apply the force analysis of mechanisms.
- Assess the friction effect relative to mechanisms and machines.
- Outline the analysis of machines and illustrate their possible applications.
- Categorise the theory of structures and its relationship to machines and mechanisms.
- Demonstrate the Dynamics of linear systems and the concept of Balancing.
- Describe the gear systems and gear trains.
- Justify the significance of the Rigid body in Theory of machines.
- Describe tribology.

Learning Outcomes

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

- Illustrate at least 10 simple mechanisms and their analysis.
- Outline 4 cases using vector diagrams, simple Harmonic motion and applications.
- re-assess the Newton's Laws of motion, relative motion of machines and their units on the example of at least 4 basic mechanisms.
- Demonstrate the force analysis of at least 10 mechanisms.
- Evaluate the friction effect relative to 4 mechanisms and 2 machines.
- Analyse at least 5 machines and their possible applications.
- Analyse the theory of structures and its relationship to machines and mechanisms using 2 case studies.
- Outline the dynamics of linear systems and the concept of balancing using al least 2 examples.
- Analyse the gear systems and gear trains using the example of at least 1 spur gear drive, 1 helical gear,1 bevel gear drive, 1worm gear and 1 planetary gear system.
- Evaluate the significance of the rigid body in Theory of Machines using 2 applications.
- Explain tribology with at least 3 examples of machines.

Course contents

Simple mechanisms and their analysis. Vector diagrams. Simple harmonic motion. Newton's Laws of motion. Force analysis of mechanism. friction effect. analysis and applications. Theory of Structures. Dynamics of linear systems. Balancing. Gear systems and Gear trains. Rigid body. Introduction to tribology.

Minimum Academic Standards

Standard Mechanics of Machine Laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 310 Fluid Mechanics II (2 Units, Core, LH=15 PH=45)

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Fluid Mechanics especially in manufacturing industries is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

The general philosophy of the mechanical engineering programme of Pan-Atlantic University is to prepare competent professionals with high academic standards and adequate practical background of the programme geared towards self-employment.Thus in order to guarantee a sound formation of professionals in mechanical engineering, Fluid Mechanics is a core course to be focused on. Its applications can be found in Thermal Power plants, Fluids as a renewable energy source, Operation of various instruments, Heat engines, Design of Heating and Airconditioning systems and Automotive engineering system to mention but a few.

Also to be in line with this vision of PAU, it is necessary to provide a solid foundation to the students in the area of design engineering projects and supervision of their implementation, design and manufacture of components, machines, equipment and systems, design and development of new products and production techniques in industries, installation and maintaining of complex engineering system that can perform optimally in our environment, improving indigenous technology to enhance local problems solving capability in Mechanical Engineering.

All are areas and facilities that determine the technological advancement and growth of a nation. Fluid Mechanics is an advanced course and has a prerequisite course “Fundamentals of Fluid Mechanics which must be covered before attempting it.

Objectives

The objectives of the course are to:

- Evaluate the properties of fluids and their domain of application.
- Analyze the elements of hydrostatics and its areas of application.

- Outline fluid motion and momentum equations and their areas of application in engineering and science.
- Differentiate boundary Layer flow and Flow measurements.
- Assess fluid operated machines and Rotodynamic machines and their areas of application.
- Demonstrate a sound knowledge of the Fluid Power transmission principle and systems.
- Categorize pumps and their characteristic.
- Evaluate pumps.

Learning Outcomes

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

- Outline the properties of fluids and their domain of application using at least 2 cases.
- Analyse the concept of hydrostatics and their areas of application using 2 examples.
- Generate fluid motion and momentum equation and their areas of application in engineering and science.
- Analyse Boundary Layer flow and Flow measurements using at least 1 example each.
- evaluate fluid operated machines and Rotodynamic machines and their areas of application based on at least 1 example each.
- Develop a sound knowledge of Fluid Power transmission using the example of a pump or compressor.
- Select pumps, and their characteristic- 3 examples.
- Design 3 different types of pumps

Course Contents

Properties of fluids. Hydrostatics. Fluid motion. Momentum equation; Boundary Layer flow. Flow measurements. Fluid operated machines. Rotodynamic machines. Fluid Power transmission. Pumps. Pump design. Rotodynamic.machines. Layer Flow. Boundary layers. Industrial examples. Maintenance management. Cost Optimisation.

Minimum Academic Standards

Standard Fluid Mechanics Laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 312 Analogue Electronic Circuits (2 Units, Core, LH=15, PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of analogue electronic circuits is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Analogue electronics (American English: analog electronics) are electronic systems with a continuously variable signal, in contrast to digital electronics where signals usually take only two levels. The term "analogue" describes the proportional relationship between a signal and a voltage or current that represents the signal. The word analogue is derived from the Greek: word ανάλογος pronounced [n](analogos) meaning "proportional"

An analogue signal uses some attribute of the medium to convey the signal's information. For example, an aneroid barometer uses the angular position of a needle as the signal to convey the information of changes in atmospheric pressure. Electrical signals may represent information by changing their voltage, current, frequency, or total charge. Information is converted from some other physical form (such as sound, light, temperature, pressure, position) to an electrical signal by a transducer which converts one type of energy into another (e.g. a microphone)

Objectives

The objectives of the course are to:

- analyse single-stage amplifiers with BJTs and MOSFETs;
- identify and analyse negative-feedback circuits;
- analyse single- and second-order passive filters;
- analyse single-, second-, and higher-order active filters;
- analyse rectifiers, peak detectors, and oscillators; and

- use pSpice to simulate circuits..

Learning Outcomes

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

- analyse single-stage amplifiers using BJTs and MOSFETs;
- identify using analog circuits the negative-feedback circuitry;
- analyse using three (3) examples single- and second-order passive filters;
- analyse using two (2) examples single-, second-, and higher-order active filters;
- analyse using two (2) engineering examples rectifiers, peak detectors, and oscillators;
- use pSpice to simulate at least three (3) circuits.

Course contents

Review of Microelectronic Devices: Diode, BJT, JFET, and MOSFET; Large-signal behaviour and Small-signal models; Single-Transistor Amplifiers: Common-emitter/source, common base/gate, and common-collector/drain; Biasing, small-signal gain, input resistance, and output resistance; Circuit simulation using pSpice; Multi-Transistor Amplifiers: Cascade, differential, and cascade; Biasing, small-signal gain, input resistance, and output resistance; Frequency Response, Gain/phase plots and Analysis; Negative Feedback: Effects on gain, input resistance, output resistance, noise, distortion, and bandwidth; Inverting and non-inverting inverting op amps; Passive Filters and Active Filters: Low-pass, high-pass, band-pass, and Engineering and Technology 368 New band-reject, First-, second-, and higher-order; Non-linear Circuits: Rectifiers and peak detectors, Sinusoidal oscillators, Mono and bi-stable multivibrators, Waveform generators

Minimum Academic Standards

Standard Electronic Laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 313 Manufacturing and Engineering Technology (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Graduates with high academic standard and adequate knowledge in engineering practice. Manufacturing and Engineering Technology is in accord with the PAU's vision to form competent and socially responsible engineering professionals who are committed to the promotion of the common good of society and the advancement of the engineering profession. On its relevance, the Mechanical Engineering students from PAU will be able to use manufacturing and engineering technology tools including CAE, CAD and CAM to further develop engineering practice in the industries in Nigeria and Africa.

Overview

Manufacturing and Engineering Technology is a key for high industrial productivity towards sustainable economic growth of a nation. It has been playing a major role in creation of wealth and self-reliance of people in a community. This emphasizes the importance of providing students in mechanical engineering with knowledge and skills on manufacturing and engineering technology to prepare them to participate actively in the production of goods and services in the community.

One of the difficulties in understanding manufacturing and engineering technology has been students' inadequate practical exposure in the industry. This course is designed to overcome the difficulty and importantly, it is to meet the need of the students towards industrialization of Lagos, having been the economic hub of the nation.

Objectives

The objectives of the course are to:

- State the fundamentals of manufacturing and engineering technology in the production of goods and services.
- Discuss manufacturing processes in a typical workshop.
- Discuss engineering technology in industrial setting.
- Explain the operations and capabilities of machine tools used in manufacturing.
- Explain maintenance management, work study and safety precautions in a workshop.

Learning Outcomes

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

- Describe at least 3 fundamentals of manufacturing and engineering technology.
- Describe the various types of manufacturing processes and their uses.
- Compare the working principles of at least 3 machine tools used in engineering technology.
- Analyse the operations and capabilities of machine tools including application of CAE, CAD and CAM designs in manufacturing process.
- Evaluate the principles of maintenance management, work study and safety precautions in a manufacturing industry.

Course contents

Fundamentals of manufacturing and engineering technology. Plant organization, administration and management. Production planning and control in workshops. Casting, welding and metal forming manufacturing processes. Processing of ceramics, plastics, composite materials and powder metallurgy. Working principles of lathe, milling, planer, shaper and drilling machines amongst others. Machine tools operations, classifications, and machining processes. Applications of CNC machines in CAE, CAD, and CAM designs. Types of chips and methods of metal cutting. Classifications and properties of cutting tools. Analysis of force of a single point tool and cutting tool ratio. Cutting speed, feed, and depth of machining. Cutting tool life, materials, and properties. Machining of gears and threads in a workshop. Maintenance management, work study, job evaluation, wages and incentives. Inventory control and financial budgeting. Industrial safety procedures.

Minimum Academic Standards

Functional central workshop with Projector and Smart screen. A computer simulation laboratory with one computer to not more than four students.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 315 Control Systems Engineering I (3 Units, Core, LH=30, PH=45)

Senate-approved relevance

Control engineering is the field of engineering that deals with designing, implementing, and managing systems that control physical processes, machines, or devices. Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ.

Overview

Control engineering or control systems engineering is an engineering discipline that deals with control systems, applying control theory to design equipment and systems with desired behaviors in control environments. The discipline of controls overlaps and is usually taught along with electrical engineering and mechanical engineering at many institutions around the world.

The practice uses sensors and detectors to measure the output performance of the process being controlled; these measurements are used to provide corrective feedback helping to achieve the desired performance. Systems designed to perform without requiring human input are called automatic control systems (such as cruise control for regulating the speed of a car). Multi-disciplinary in nature, control systems engineering activities focus on implementation of control systems mainly derived by mathematical modeling of a diverse range of systems.

Objectives

The objectives of the course are to:

1. Develop the mathematical model of the physical systems.

2. Analyse the response and stability of the closed and open loop systems.

4. Design the various kinds of compensator.

5. Explain alternate representations of dynamic systems (time domain, frequency domain, state space).

6. Define and explain feedback and feed-forward control architecture and discuss the importance of performance, robustness, and stability in control design.

7. Interpret and apply block diagram representations of control systems and design PID controllers based on empirical tuning rules.

8. Compute stability of linear systems using the Routh array test and use this to generate control design constraints.

9. Design Evans root locus techniques in control design for real world systems.

10. Compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability.

11. Design Lead-Lag compensators based on frequency data for an open-loop linear System.

12. Analyse the stability of systems by root locus and frequency response methods.

Learning Outcomes

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

1. Develop at least one mathematical model of the physical systems.

2. Analyse the response and stability for two (2) closed and open loop systems.

4. Design at least three (3) kinds of compensator.

5. Differentiate alternate representations of dynamic systems (time domain, frequency domain, state space).

6. Define at least two (2) feedback and feed-forward control architecture and discuss the importance of performance, robustness, and stability in control design.

7. Interpret at least five (5) block diagram representations of control systems and design PID controllers based on empirical tuning rules.

8. Compute stability of linear systems using the Routh array test and use this to generate control design constraints.

9. Design using Evans root locus techniques in control design for real world systems.

10. Compute gain and phase margins using Bode diagrams and Nyquist plots and understand their implications in terms of robust stability.

11. Design at least two (2) Lead-Lag compensators based on frequency data for an open-loop linear System.

12. Analyse the stability of systems using root locus and frequency response methods.

Course contents

Concept of Control Engineering. Open and Close Loop Systems. Control System Classification. Basic Terminologies in Control System. Control System Design. History of Automatic Control. Systems Mathematical Modeling. Differential Equations of Physical Systems. Through and Across Variables. First-Order ODE Models. Linear Approximations of Physical Systems. Laplace Transform. Transfer Functions. Block Diagram Fundamentals and Reduction Techniques. Superposition of Multiple Inputs. Signal-Flow Graphs. Conversion of Block Diagrams into Signal Flow Graphs. Mason's Rule. Mechanical Measurements. Transducer and Sensors. Controllers. Basics of PID Control. PID Controller Structure.

Minimum Academic Standards.

A functional Control laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 322 Digital Electronics (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery, the world's biggest single-train facility, and several other manufacturing enterprises are already springing up in the LFZ. Digital electronics is a field of electronics involving the study of digital signals and the engineering of devices that use or produce them. Practical digital electronics knowledge aligns with the Pan-Atlantic strategic positioning statement for her School of Science and Technology to become Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Digital electronics are electronic systems that use a digital signal instead of an analogue one. It is the most common representation of Boolean algebra and is the basis for all digital circuits for computers and consumer products like cell phones. The most critical and standard unit of digital electronics is the logic gate. Several logic gates, up to tens of thousands, are linked together so that more complex systems than are known can be created. The intricate digital design of this type of electronics is called a digital circuit.

There are various fields of electrical engineering within the realm of computer science and engineering. It necessitates the need to create a digital frame. Computer engineers have extensive training in electronics, software design, and hardware and software integration rather than just the field of electricity. The scope of this course is enormous, as it includes the creation of microcontrollers, microprocessors, personal computers, and supercomputers.

The field of Digital Electronics uses the VLSI (Very Large-Scale Integration), which has reduced the size and total area of circuit boards. As a result, it improves the accuracy and performance of the system. Furthermore, digital systems have a significant advantage in data encryption for communication purposes. As a result, data transmission remains safe and secure. These are the dominant factors that signify the importance of the flow of digital electronics. They also have an excellent projection of the future.

Objectives

The objectives of the course are to:

- perform base 2, 8, 16 and BCD-code (binary-coded decimal) calculations.
- design a minimal combinatorial logic circuit that solves binary logical tasks.
- design a minimal sequential circuit that solves binary logical tasks;
- describe the structure of a logic gate;
- explain the principles of programmable circuits;
- explain the principles of analog-to-digital (AD) - and digital-to-analog (DA) conversion;
- design synchronous networks with sequential flow charts;
- design sequential circuits for programmable logic device (PLD) circuits.
- programme a PLD type Field-Programmable Gate Array (FPGA).

Learning Outcomes

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

1. Calculate using base 2, 8, 16 and BCD-code (binary-coded decimal).
2. solves binary logical tasks using minimal combinatorial logic circuit.
3. solves binary logical tasks using minimal sequential circuit.
4. describe the structure of at least two (2) logic gates.
5. explain using examples the principles of programmable circuits;
6. explain using examples the principles of analog-to-digital (AD) - and digital-to-analog (DA) conversion;
7. design at least two (2) synchronous networks using sequential flow charts;
8. design at least two (2) sequential circuits for programmable logic device (PLD) circuits.
9. programme using a simple project a PLD type Field-Programmable Gate Array (FPGA).

Course contents

Introduction to Computing Systems; Switch Design; Boolean Algebra; Gate Design and Simplification; Building Blocks; Number Systems and Arithmetic; Latches and Registers; Counters; State Machines; Memory; Datapaths; Introductory Assembly Programming. Laboratory projects will include use of PC-based CAD environment that supports schematic capture, logic simulation, and HDL-based logic synthesis on FPGAs (field-programmable gate arrays). Small-scale integrated circuits will be used for early labs; HDL-based logic synthesis on FPGA-based design boards will be used for more advanced design implementations.

Minimum Academic Standards

A well-equipped laboratory with NUC-MAS requirement facilities.

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Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering
PAU-MCE 331 Engineering Graphics and Solid Modelling III (2 Units, Core, LH=15 PH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Engineering Graphics and Solid Modelling is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Engineering graphics are useful in simulation of the following built environments: Determining origin of failure in components and systems Clarify accidents from misuse of products or negligent behavior. n Engineering Profession, it is very essential that the Engineers and Craftsmen can communicate their ideas and facts with each other clearly and without ambiguity. The verbal communication may be hopelessly inadequate. The written communication, on the other hand may be very inefficient, lengthy, and boring to create accurate mental and physical impression of an item in the mind of the reader.

The Engineering Drawing, which is a Graphical Communication of an accurate and unambiguous description of an object, has proved to be an efficient communication method. It is a means of organizing and presenting precise technical directions for items to be produced for the consumers. Engineering Drawing can supply all the information needed with the exactness and details required. It is therefore, one of the principal functions of drawing to convey ideas from the design engineer to the fabricator. Hence, the skill to interpret and construct engineering sketches and drawings is of paramount importance. The engineer may convey his ideas by one or more of the three basic types of projections namely, Orthographic Projection, Oblique Projection or Perspective Projection, depending upon the purpose of the drawing and the person to whom he wishes to convey his ideas. Certain professional areas have different nomenclature such as Machine Drawing, Architectural Drawing, and Structural Drawing.

Objectives

The objectives of the course are to:

- Understand AutoCAD and its basic principle.
- Use AutoCAD to produce 2D and 3D drawings.
- Demonstrate a mastery of Descriptive Geometry.

- Study Limits and fits understand and master how they are represented in engineering drawing.
- Demonstrate a good knowledge of Geometric tolerances and its standard illustration on conventional drawings.
- Understand how to indicate Welding drawings and Design in standard welding practice.
- Apply standard convention in drawings when Redesigning components using welded joints.
- Draw Harder examples of exploded assembly drawings (e.g., a complete gear box in exploded assembly drawings) to demonstrate mastery of the AUTOCAD application.
- Practice the Arrangements of engineering components to form a working plant (Assembly drawing of a plant showing the layout of units and sub-assemblies).
- Describe the requisite Revision of all the areas covered above.

Learning Outcomes

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

- Discuss basic drawing principles using AutoCAD.
- Draw using AutoCAD to produce 2D and 3D drawings
- Demonstrate a mastery of Descriptive Geometry.
- Explain using charts the limits and fits and master how they are represented in engineering drawing.
- Demonstrate a good knowledge of Geometric tolerances and its standard illustration on conventional drawings.
- Understand how to indicate Welding drawings and Design in standard in at least three (3) welding practice scenarios.
- Apply the standard convention in drawings when Redesigning components using welded joints.
- Draw harder examples of exploded assembly drawings using a complete gear box in exploded assembly drawings to demonstrate mastery of the AUTOCAD application.
- Practice the arrangements of at least three (3) engineering components to form a working plant (Assembly drawing of a plant showing the layout of units and sub-assemblies).
- Demonstrate out the requisite revisions in three scenarios.

Course contents

Introduction to AutoCAD. Using AutoCAD to produce 2D and 3D drawings. Descriptive Geometry. Limits and fits. Geometric tolerances, Welding drawings and Design. Redesigning of casts components using welded joints. Harder examples on exploded assembly drawings (e.g., a complete gear box in exploded assembly drawings). Arrangements of engineering components to form a working plant (Assembly drawing of a plant). Revision.

Minimum Academic Standards

Standard Computer Engineering Graphics laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 392 Professional and Personal Skills (2 Units, Required, LH=30).

Senate-approved relevance

In order to appropriately resolve many challenges in Africa and the world, there is a need to have professionals who are not only competent but possess soft skills and other qualities which enrich interactions with their colleagues. The goal of our university education extends beyond obtaining technical skills and this course provides an opportunity for preparing students for personal and professional development and for service to the world. The course equips the students with a variety of skills that they need in order to attain the mission of the Pan-Atlantic university to provide holistic formation to students while preparing them for professional life.

Overview

Personal and professional skills contribute greatly to success. This course teaches the meaning of professionalism and its practical implications for the student's chosen career path while exposing the student to ways in which they can be of service to humanity. It teaches skills that lead to personal effectiveness in the professional context and provides practical strategies for improving self-management and interpersonal relations. It will dwell on a range of skills which are useful in managing ordinary situations and difficult ones in both personal and professional situations. It will teach how to maintain a sense of purpose and direction under pressure and develop the confidence to manage a variety of people and circumstances.

Through this course, the students will learn to make the most of all their capacities. They will be taught to harness their personal talents, energy, and time, relative to what is most important, and to channel their resources to achieve what is desirable.

Objectives

The objectives of the course are to:

- Describe the professional and personal skills needed to be effective in professional and personal relationships.
- Identify situations in which soft skills can be acquired for present and future employability.
- Evaluate the most effective practical ways to develop different personal and professional skills.
- Analyse real-life scenarios for applying professional and personal skills in today's world.

- Demonstrate the consequences of the absence or presence of certain skills in relation to personal budgeting and financial responsibility.
- Enumerate effective actions to take in different health emergencies.
- Illustrate what good leadership and teamwork entail.

Learning outcomes

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

- Describe at least five elements of professionalism and their manifestations within their chosen career path.
- Identify at least five ways in which their chosen career can be of service to communities.
- Identify at least three strengths and five weaknesses associated with each of the four classical types of temperaments.
- Describe five elements of good interpersonal communication differentiating between assertiveness and aggression.
- Describe at least five tips for financial responsibility and making good personal budgets.
- Describe appropriate actions and responses to at least four common medical emergencies.
- Describe two types of good leadership and describe at least five guidelines for good teamwork.

Course content

Professionalism. Job search: interviews, writing applications, CVs, resumes and professional profiles. Professional work as service to the community. Social responsibility. Self-knowledge. Self-esteem & assertiveness. Open-mindedness. Emotional intelligence. Temperaments, character development and personality. Interpersonal communications. Public speaking. Time management. Social etiquette. Cultivating optimal health: mental and physical. Personal budgets and financial responsibility. Leadership and Teamwork.

Minimum Academic Standard

A classroom with a projector.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 401 Professional Ethics for Engineers (2 Units, Core, LH=30)

Senate-approved relevance

Pan-Atlantic University's mission is "to form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large." This mission requires that students acquire a deep knowledge of the professional ethics of engineers, and for that purpose become familiar with the provisions of the COREN-approved Code of Conduct, and with the basic ethical concepts and principles, to be able to act responsibly, also in new and unexpected situations. Deep assimilation of professional ethics will also make students more employable and more useful to industry, in line with the Strategic Plan of the University.

Overview

Commitment to practicing one's profession ethically is a key aspect of the identity of a professional. This course provides a basic grounding in the fundamental concepts for ethical analysis and fundamental principles of ethics. Upon this base, it then explores the main responsibilities of engineering firms towards their customers and employees, and in relation to the environment, and the professional duties of individual engineers.

The course aims also at making students thoroughly familiar with the main provisions of COREN Engineering Practitioners' Code of Conduct 2022 and train them in their application to different practical situations.

Objectives

The objectives of the course are to:

- Describe the main provisions of the COREN Engineering Practitioners' Code of Conduct 2022.
- Explain the concept of human fulfillment and its main dimensions.
- Introduce the more commonly accepted ethical principles.
- Describe engineers' main responsibilities in relation to the environment.
- Identify the main professional responsibilities of individual engineers.
- Introduce the concept of fiduciary duties and its main implications for the relations of engineers towards their employers and clients.

- State the main responsibilities of engineers towards the profession and their fellow professionals.
- Conduct exercises in which students carry out an ethical analysis of real case studies

Learning Outcomes

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

1. List at least ten of the rules contained in the COREN Engineering Practitioners' Code of Conduct 2022.

2. Provide at least one justification for each of the more commonly accepted ethical principles (concern for others, rationality, fairness; effectiveness/dedication; role responsibility, life plan and no intentional infliction of harm).

3. Relate at least ten of the rules of the COREN Engineering Practitioners' Code of Conduct 2022 to the more commonly accepted ethical principles.

4. Analyse practical problems of engineering ethics by making use of the rules contained the COREN Engineering Practitioners' Code of Conduct 2022.

5. Explain the relationship between having internalised standards of professional ethics and being a more professional engineer.

6. Identify at least three practical ways in which their profession can be an avenue for rendering service to others.

Course contents

Professional ethics. Human fulfillment. Main ethical principles: rationality, concern for others, fairness, effectiveness/dedication, life plan, role responsibility, no intentional harm. Main duties of engineering firms by providing actual value to clients, stability of employment, protection from harm, job design and participation, payment of a living wage, privacy, fair hearing. Responsibilities in relation to the environment. Safety. Cost-benefit analysis. Life-cycle analysis. Environmental impact assessments. Duty of care. Professional competence. Obeying the law. Confidentiality, truthfulness, and appropriation of ideas. Duties to the profession. Duties to professional colleagues. Questionable payments. Fiduciary relationships/the duty of loyalty such as Accepting bribes, nepotism and cronyism, self-dealing, conflicts of interest. Whistleblowing.

Minimum Academic Standards

A classroom equipped with a computer and an overhead projector.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 403 Engineering Economics (3 Units, Core, LH=45)

Senate-approved relevance

Engineering economics will be increasingly valuable as students climb the career ladder in private industry, non-governmental organizations, public agencies, or in founding their own startups. Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of engineering economics is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Engineering economics, as a discipline, is focused on the branch of economics known as microeconomics in that it studies the behavior of individuals and firms in making decisions regarding the allocation of limited resources. Thus, it focuses on the decision-making process, its context and environment. It is pragmatic by nature, integrating economic theory with engineering practice. But it is also a simplified application of microeconomic theory in that it assumes elements such as price determination, competition and demand/supply to be fixed inputs from other sources. As a discipline though, it is closely related to others such statistics, mathematics, and cost accounting. It draws upon the logical framework of economics but adds to that the analytical power of mathematics and statistics.

Engineers seek solutions as to problems, and along with the technical aspects, the economic viability of each potential solution is normally considered from a specific viewpoint that reflects its economic utility to a constituency. Fundamentally, engineering economics involves formulating, estimating, and evaluating the economic outcomes when alternatives to accomplish a defined purpose are available.

Objectives

The objectives of the course are to:

- Outline and justify the nature and scope of economics.
- Evaluate the basic concepts of engineering economy.
- Differentiate between the Interest formulae, Discounted cash flow, present worth, equivalent annual growth, and rate of return comparisons.

- Compare and Contrast Replacement analysis, Breakdown analysis. Cost-Benefit Analysis.
- Evaluate the minimum acceptable rate of return.
- Analyze Judging the attractiveness of a proposed investment.

Learning Outcomes

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

- Outline three (3) reasons to justify the nature and scope of economics.
- Evaluate three (3) basic concepts of engineering economy.
- Differentiate between the interest formulae, discounted cash flow, present worth, equivalent annual growth, and rate of return comparisons.
- Contrast replacement analysis, breakdown analysis. cost-benefit analysis.
- Explain the minimum acceptable rate of return in three (3) engineering projects.
- Analyze three (3) approaches for judging the attractiveness of a proposed investment.

Course contents

The nature and scope of economics. Basic concepts of engineering economy. Interest formulae. Discounted cash flow, present worth, equivalent annual growth, and rate of return comparisons. Replacement analysis. Breakdown analysis. Cost-Benefit Analysis. The minimum acceptable rate of return. Judging the attractiveness of a proposed investment. The economics of the management, operation, and growth and profitability of engineering firms. Macro-level engineering economic trends and issues. Engineering product markets and demand influences. The development, marketing, and financing of new engineering technologies and products. Benefit–cost ratio

Minimum Academic Standards

A classroom equipped with a computer and an overhead projector.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MEE 413 Research Methods (1 Unit, Core, LH=15)

Senate-approved relevance

Engineering economics will be increasingly valuable as students climb the career ladder in private industry, non-governmental organizations, public agencies, or in founding their own startups. Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with research methods is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Research methods are specific procedures for collecting and analyzing data. Developing your research methods is an integral part of your research design. When planning your methods, there are two key decisions you will make. First, decide how you will collect data. Your methods depend on what type of data you need to answer your research question: Qualitative vs. quantitative: Will your data take the form of words or numbers? Primary vs. secondary: Will you collect original data yourself, or will you use data that has already been collected by someone else? Descriptive vs. experimental: Will you take measurements of something as it is, or will you perform an experiment? Second, decide how you will analyze the data.

For quantitative data, you can use statistical analysis methods to test relationships between variables. For qualitative data, you can use methods such as thematic analysis to interpret patterns and meanings in the data.

Objectives

The objectives of the course are to:

- Describe key research concepts, issues, types of research and the systematic process of research gap identification and documentation and use contexts.
- Analyse research articles, papers and reports and general literature.
- Evaluate research objectives, questions, and hypotheses.

- Create a research proposal or industry project plan.
- Identify and develop appropriate data acquisition and analysis methods and instrument.
- Design research process using appropriate research designs.
- Use appropriate tools/techniques, including computer soft- and hardware /technologies to interpret, discuss and report/present the result and conclusions derived from research data analysis in oral or written form; and
- Design research results/output for academic, journal articles, technical and other reports, and exhibitions/fairs (scientific, trade, etc.) as an individual or team/work group.

Learning Outcomes

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

- Describe at least three (3) key research concepts, issues, types of research and the systematic process of research gap identification and documentation and use contexts.
- Analyse at least four (4) research articles, papers and reports and general literature.
- Evaluate research objectives, questions, and hypotheses using at two research articles.
- Create at least two (2) research proposal or industry project plan.
- Identify two (2) appropriate data acquisition and analysis methods and instrument.
- Design research process using appropriate research designs.
- Use at least three (3) appropriate tools/techniques, including computer soft- and hardware /technologies to interpret, discuss and report/present the result and conclusions derived from research data analysis in oral or written form; and
- Design two (2) research results/output for academic, journal articles, technical and other reports, and exhibitions/fairs (scientific, trade, etc.) as an individual or team/work group.

Course contents

Origins and definitions of research; problem identification and formulation; research types/design; qualitative, quantitative and mixed methods of research; measurement; sampling; data analysis; interpretation of data and technical report writing; use of encyclopedia, research guides, handbooks, academic databases for computing and computer engineering discipline; use of tools/techniques for research production: referencing formats/styles and software; research management and reporting best practices; plagiarism definitions, types, detection software; basics of document analysis, systematic review and management methods; practical documentation/ presentation projects/seminars

Minimum Academic Standards

A classroom equipped with a computer and an overhead projector.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 503 Applied Thermodynamics II (2 Units, Core, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of applied thermodynamics is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

The Laws of Thermodynamics are the foundation of heat transfer and energy work. When any engineer is designing or implementing a system, the consideration of heat loss or energy produced is influenced by these fundamental principles. Thermodynamics teaches us that ideas and concepts can flow in either direction, between the basic and the applied. But we can see how a science evolves by asking new questions, in the case of thermodynamics, of asking how real systems behave and how they differ from those ideal but unreachable ideal limits. Thermodynamics gives the foundation for heat engines, power plants, chemical reactions, refrigerators, and many more important concepts that the world we live in today relies on. Beginning to understand thermodynamics requires knowledge of how the microscopic world operates.

This course will discuss General thermodynamics relations. Kinetic theory of gas. Mixture of gases, psychometry, air-conditioning and cooling towers. Introduction to Heat Transfer.

Objectives

The objectives of the course are to:

- Analyse general thermodynamics relation and Kinetic theory of gas.
- Explain mixture of gases and psychometry
- Analyse air-conditioning and cooling towers and heat transfer
- Apply the knowledge of mathematics, science, and engineering fundamentals to open system, closed systems and heat reservoirs.

- Apply the knowledge of mathematics, science and engineering fundamentals to chemical equations and chemical equilibrum
- Categorize centrifugal and axial flow compressors.
- Discuss the concepts of Turbine theory, velocity diagrams, degree of reaction, impulse efficiency, reheat factor to engineering.
- Evaluate the concepts of Combustion (engines) and product analysis and try to think beyond curriculum in alternative sources of energy.
- Assess the various concepts learnt in fundamental laws of thermodynamics from which ideas are generated on how to sustain energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.

Learning Outcomes

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

- Discuss general thermodynamics relation using Kinetic theory of gas.
- Explain using everyday examples mixture of gases and psychometry.
- Analyse at three (3) air-conditioning and cooling towers and heat transfer
- Apply the knowledge of mathematics, science and engineering fundamentals to three (3) open system, closed systems and heat reservoirs.
- Apply the knowledge of mathematics, science and engineering fundamentals to chemical equations and chemical equilibrium to three (3) engineering systems.
- Categorize three (3) centrifugal and axial flow compressors used in industries.
- Discuss using examples the concepts of Turbine theory, velocity diagrams, degree of reaction, impulse efficiency, reheat factor to engineering.
- Evaluate the concepts of Combustion (engines) and product analysis and try to think beyond curriculum in alternative sources of energy in Nigeria.
- Assess at least three (3) concepts learnt in fundamental laws of thermodynamics from which ideas are generated on how to sustain energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.

Course contents

General thermodynamics relations. Kinetic theory of gas. Mixture of gases, psychometry, air-conditioning and cooling towers. Introduction to Heat Transfer. Renewable sources of energy. Centrifugal and Axial compressors. Turbine theory. Velocity diagrams. Combustion engines. Industry examples. Complex engineering problems.

Minimum Academic Standards

Standard Thermodynamics Laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 504 Mechanical (Machine) Design Engineering III (2 Units, Core, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Mechanical (Machine) Design Engineering is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Machine design is the single most important activity in the mechanical industry. The success or failure of a company has its roots in product design, whether it is done in-house or contracted out. It is here that manufacturing costs and profits are determined. The knowledge of machine design helps the designers to select proper materials and best suited shapes, calculate the dimensions based on the loads on machines and strength of the material and specify the manufacturing process for the manufacture of the designed component of the machine or the whole machine.

This course creative application of the design process to engineering problems with emphasis of the manufacture of complete system to accomplish general objectives of minimum weight and high efficiency while satisfying the design constraints. The 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.

Objectives

The objectives of the course are to:

- Design and develop solutions to engineering problem that is related to manufacturing systems.
- Evaluate for a simulated factory floor, relevant key parameters and the effects on the system performance.
- Analyze the tradeoffs with different design alternatives using economic analysis functions as well as direct performance measures.

- Design computer algorithms for design using Fusion 360 and other CAD/CAM software packages to run a CNC machining.
- Design a product and program for an actual manufacturing project using the concept of Flow Line Assembly, Just-in-time and flexible manufacturing systems-JIT & FMS-, Job Shop details -storage of raw material, work-in-process inventory as well as finished product.

Learning Outcomes

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

- Apply the design process to at least 1 engineering problem with emphasis on the manufacture of complete systems.
- Select for a simulated factory floor, relevant key parameters with emphasis of the effects on the system performance.
- Evaluate the tradeoffs with at least 2 different design alternatives using economic analysis functions as well as direct performance measures- minimum weight and high efficiency.
- Generate computer algorithms – minimum 2- for design using Fusion 360 and other CAD/CAM software packages to run a CNC machine.
- Evaluate a product of an actual manufacturing project, using the concept of Flow Line Assembly, Just in time and flexible manufacturing systems-JIT & FMS-, Job Shop details -storage of raw material, work-in-process inventory as well as finished product,

Course contents

Creative application of the design process to engineering problems with emphasis of the manufacture of complete systems. General design objectives. Minimum weight and high efficiency satisfying the design constraints. Evaluation of several CAD/CAM software packages. CAD/CAM software. Design manufacturing design project. Compare software packages such as Fusion 360, CREO, and Inventor.

Minimum Academic Standards

Standard Mechanics of Machine Laboratory.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 507 Signals and Systems (2 Units, Elective, LH=45)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Signals and systems to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Signals and Systems focuses on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). Applications are drawn broadly from engineering and physics, including feedback and control, communications, and signal processing. The Signals and systems helps to predict with some certainty, behaviour of some system when they are subjected to different input signals. It also helps to design electrical circuits or algorithms that will operate on signals to get the desired output.

This course will discuss System modeling. Analog signals. Convolution and correlation. Fourier and Laplace Transforms. Random processes. Sampled signals and systems. Discrete Fourier transforms. Z transforms. Analog and Digital filters. Control strategies. Open-loop, feed forward and feedback control systems. Stability, performance and sensitivity analyses. Lag Engineering and Technology and Lead compensation, Frequency domain design, PID controllers. Elements of nonlinear control

Objectives

The objectives of the course are to:

- Identify the characteristics, properties and types of signals and systems.
- Describe their application in various engineering disciplines.
- Describe various system properties e.g., time invariance, linearity.
- Analyse systems and signals using Fourier, Laplace and Z-transforms.
- Identify effective control strategies towards effective sensitivity analysis.

Learning Outcomes

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

- Identify at least three (3) characteristics, properties and types of signals and systems.
- Describe their application in at least four (4) engineering disciplines.
- Describe three (3) system properties e.g., time invariance, linearity.
- Analyse systems and signals using Fourier, Laplace and Z-transforms.
- Identify two (2) effective control strategies towards effective sensitivity analysis.

Course contents

System modeling. Analog signals. Convolution and correlation. Fourier and Laplace Transforms. Random processes. Sampled signals and systems. Discrete Fourier transforms. Z transforms. Analog and Digital filters. Control strategies. Open-loop, feed forward and feedback control systems. Stability, performance and sensitivity analyses. Lag Engineering and Technology and Lead compensation, Frequency domain design, PID controllers. Elements of nonlinear control.

Minimum Academic Standards

Standard Signal and Systems laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 509 Hardware Design Techniques and Verification (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Hardware Design Techniques and Verification especially in tropics is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Hardware verification has been one of the biggest drivers of formal verification research, and has seen the greatest practical impact of its results. The use of formal techniques has not been uniformly successful here — with equivalence checking widely used, assertion-based verification seeing increased adoption, and general property checking and theorem proving seeing only limited use. I will first examine the reasons for this varied success and show that for efficient techniques to translate to solutions they must be part of an efficient methodology and be scalable.

This course will discuss elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes; micro-processors, system architecture, bus control, instruction execution and addressing modes; machine codes, assembly language and high-level language programming, micro-processors as state machines; microprocessor interfacing. input/output; technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters; system development tools. simulators, EPROM programming, assemblers and loaders, overview of available microprocessor application.

Objectives

The objectives of the course are to:

- Adequate knowledge in digital electronics and digital design concepts.
- Design digital circuits under realistic constraints and conditions.
- Debug, verify, simulate digital circuits.
- Select, and use modern techniques and tools needed for digital design; and

- Solve problems in a team.

Learning Outcomes

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

- Understand digital electronics in three (3) digital design concepts.
- Design digital circuits using realistic constraints and conditions.
- Design digital circuits using the debug, verify, simulate approach.
- Select digital designs using modern techniques and tools needed for digital design.
- Solve at least three (3) problems in a team.

Course contents

Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes; micro-processors, system architecture, bus control, instruction execution and addressing modes; machine codes, assembly language and high-level language programming, micro-processors as state machines; microprocessor interfacing. input/output; technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters; system development tools. simulators, EPROM programming, assemblers and loaders, overview of available microprocessor application.

Minimum Academic Standards

Standard Hardware Design Techniques and Verification Engineering Laboratory

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 510 Engineering Management (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery, the world's biggest single-train facility, and several other manufacturing enterprises are already springing up in the LFZ. Most of these companies need engineers who are versatile both in the technical and managerial requirements for their efficient and effective running. Training of engineers with understanding of managerial functions is also in line with Pan-Atlantic University's mission of forming competent professionals with a spirit of service. In addition, this course aligns with one of the Program Educational Objectives of the School of Science and Technology to develop entrepreneurial engineers, 3-5 years upon graduation.

Overview

With globalisation and the shifting of the economy towards services even in developing countries like Nigeria, the role of the engineer in organisations is fast changing. Engineers, who normally start their careers in technical areas involving design, quickly move into managerial or supervisory roles involving people. Within 5 years, their job function becomes that of managing others to achieve organizational goals. To remain relevant in the 21st-century economy, engineers must be acquainted with and seek to acquire managerial competencies that will be required of them to manage technical organisations now and in the future.

The engineering management course will expose the students to an overview of management, its relevance and principles, the functions of a manager, identify and explain the different management functions, describe the process of strategic management, understand basic accounting processes, highlight the challenges of managing as an engineer in the Nigerian context and help the students apply their learning to real-life scenarios.

Objectives

The objectives of the course are to:

- Discuss the relevance of Management to Engineers.
- Explain the different managerial functions, roles, and skills.
- Interpret the elements, principles, and management objectives of an organization.

- Select the most appropriate financial management methods in engineering situations.
- Analyse the principles and different methods of economic valuation, assets valuation and Depreciation accounting.
- Plan, direct and control the production operations - material supply and processing activities of an enterprise.
- Apply the concepts of work study, motion economy and ergonomics in the design of equipment and processes.
- Demonstrate the ability to understand, analyze, and improve organizational practices using current technology, analysis, to address evolving business and customer needs.
- Identify and articulate ethical issues while assessing occupational environmental factors like heat stress, noise, and vibration and Respirable Suspended Particulate Matter (RSPM) level in the industry.
- Analyze the annual financial statements/report of an engineering enterprise.

Learning Outcomes

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

- Discuss at least three (3) important relevance of Management to Engineers.
- Explain at least four (4) managerial functions, roles, and skills.
- Interpret using practical examples the elements, principles, and management objectives of an organization.
- Select four (4) most appropriate financial management method(s); Personnel management method(s); and Resource management method(s) in engineering situations.
- Analyse at least three (3) principles and different methods of economic valuation, assets valuation and Depreciation accounting.
- Describe the planning, directing and controlling of three (3) production operations
- Apply using the concepts of work study, motion economy and ergonomics in the design of equipment and processes.
- Demonstrate the ability to understand, analyze, and improve organizational practices using current technology, analysis, to address evolving business and customer needs in at least three (3) engineering outfits.
- Identify at least four (4) ethical issues while assessing occupational environmental factors like heat stress, noise, and vibration and Respirable Suspended Particulate Matter (RSPM) level in the industry.
- Analyze using the annual financial statements/report of an engineering enterprise.

Course contents

Elements of organization; management by objectives. Financial management, accounting methods, financial statements, cost planning and control, budget, and budgetary control. Depreciation accounting and valuation of assets. Personnel management, selection, recruitment and training, job evaluation and merit rating. Industrial Psychology. Resource management; contracts, interest formulae, rate of return. Methods of economic evaluation. Planning decision making; forecasting, scheduling. Production control. Gantt chart, CPM and PERT. Optimization linear, materials handling. Raw materials and equipment. Facility layout and location. Basic principles of work study. Principles of motion economy. Ergonomics in the design of equipment and process.

Minimum Academic Standards

A classroom with a multimedia projector.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 511 Mobile Robotics and Community Manufacturing (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with strong capacity for robotics for community manufacturing is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Robots increase speed for manufacturing processes. The speed and dependability of robots ultimately reduces cycle time and maximises throughput. For small and medium scale community manufacturing outfits, the need for cost-effective implementation and sustainability are critical for remaining competitive.

This course provides object-oriented theory and practice for the development and application of robot technology in small and medium enterprises (SME) but very cost-effective production processes in a manufacturing community such as the upcoming manufacturing clusters in the Lagos Free Zone.

Objectives

The objectives of the course are to:

- Describe robotic systems used in manufacturing.
- Teach the application of Free and Open-Source Software (FOSS) to design robot manufacturing system.
- Describe Robot Operating System (ROS) programming for ROS robot simulation hardware prototyping.
- Perform troubleshooting procedures for robotic systems.
- Analyse robot system using kinematics of serial and parallel Robots.
- Demonstrate robots path planning procedure.
- Explain actuators and drive systems for manufacturing robots.
- Describe the characteristics of sensors for image processing and analysis of vision systems.

- Teach cost minimisation methods in robot development in a development economy.
- Teach the Nigeria laws for Free Zones.

Learning Outcomes

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

- List at least four (4) robot system used in manufacturing as defined by global robotics organisations.
- Install and use Free and Open-Source Software (FOSS) to design at least three systems for manufacturing.
- Apply Robot Operating System (ROS) programming for hardware prototyping.
- Troubleshoot faulty robotic system.
- Analyse at least two (2) robot systems using kinematics of serial and parallel Robots principles.
- Perform path planning of two robotics systems and motion control.
- Describe ten (10) actuators and drive systems for manufacturing robots.
- Describe the characteristics of at least seven (7) types of sensors used for image processing and analysis of vision systems.
- State at least five (5) cost minimisation methods in robot development for SMEs.
- List at least five (5) Nigeria laws for Free Zones.

Course contents

Robot Fundamentals. Free and Open-Source Software (FOSS). Introduction to Robot Operating System (ROS) programming. ROS Robot Simulation. ROS Robot hardware Prototyping. Trouble shooting and best practices. Kinematics of Serial and parallel Robots. Differential motion and velocities. Path planning of robotics systems and motion control. Actuators and Drive systems. Sensors. Image processing and analysis of vision systems. Fuzzy logic controls. Cost minimisation procedures in robot development. Robot project management. Basic Artificial Intelligence for Robotics design. Solar systems for robot drive and control. Understanding laws to operate in Nigeria Free Zones.

Minimum Academic Standards

Computer teaching laboratory with Ubuntu Linux operating system and ROS software with at least one computer to 5 students. One Robot-arm running with FOSS and ROS Software.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 512 Turbomachinery (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of Turbomachinery is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Turbomachinery such as compressors and turbines consume and generate significant amounts of power. The optimal integration of turbomachines with SOFCs results in significant improvements in the overall energy conversion efficiency. Elaborating, a turbomachine is a power or head generating machine which employs the dynamic action of a rotating element, the rotor; the action of the rotor changes the energy level of the continuously flowing fluid through the machine. Turbines, compressors, and fans are all members of this family of machines.

Objectives

The objectives of the course are to:

- Demonstrate the principle of moment of momentum for different types of turbomachines.
- Resolve energy transfer in turbomachines of different designs.
- justify flow through two-dimensional turbine and compressor cascade using the cascade theory of Mach number effects.
- Assess flow through centrifugal compressor and its performance.
- Compare axial flow turbomachine with radial equilibrium.
- Demonstrate practical cases of fan.
- Analyse flow through radial flow turbine and wind turbine for a sustainable environment.
- Analyse future turbomachinery concepts based on physical principles.

Learning Outcomes

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

- Apply and the principle of moment of momentum for different three (3) turbomachines.
- Determine energy transfer in turbomachines of different designs using at least two (2) models.
- Evaluate for two examples flow through two-dimensional turbine and compressor cascade using the cascade theory of Mach number effects.
- Interpret flow through centrifugal compressor and its performance using 2 examples.
- Design axial flow turbomachine with radial equilibrium.
- Illustrate at least six (6) practical cases of fan.
- Assess flow through radial flow turbine and wind turbine for a sustainable environment based on a practical case.
- Analyse using charts future turbomachinery concepts of a machine based on physical principles.

Course contents

Introduction and Classification: Axial flow, radial flow and mixed flow machines, the equations of motion in rotating frame of reference, effects of Coriolis and Centrifugal forces, momentum and energy equation, Euler work, and illustrative examples. Gas Turbine Cycle: Brayton Cycle, regenerative cycle, reheat, inter-cooling, turboprop, turbojet, and turbofan engine, thrust augmentation, and illustrative examples. Similarity Analysis: Similarity rules, specific speed, Cordier diagram and illustrative examples. Cascade Analysis: Two-dimensional cascade theory, lift and drag, blade efficiency, estimation of loss, compressor and turbine cascade, blade geometry, and illustrative examples. Axial Flow Compressor: Two-dimensional pitch line design and analysis, h-s diagram, degree of reaction, the effect of Mach number, performance and efficiency, three-dimensional flow, tip clearance, losses, compressor performance, and illustrative examples. Centrifugal Pump and Compressor: Theoretical analysis and design, the effect of circulation and Coriolis forces, reversal eddies, slip factor, head and efficiency, diffuser, introduction to the combustion system, and illustrative examples. Axial Flow Turbine: Two-dimensional pitch line design, stage loading capacity, degree of reaction, stage efficiency, turbine performance, blade cooling, and illustrative examples. Applied to Turbomachinery Flows: Governing equations, numerical methods, and test cases illustrating flow and heat transfer related to turbomachines.

Minimum Academic Standards

Standard Fluid Mechanics Laboratory.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 515 Engineering Valuation and Appraisal (2 Units, Elective, LH=30)

Senate-approved relevance

Understanding engineering valuation and appraisal will help the graduates to use systematic method of improving the value of a product that a project produces as well as analyzing a service, system, or product to determine the best way to manage the important functions while reducing the cost. Graduates who understand and can apply the principles taught in the engineering and valuation course will have justified the mission of the Pan-Atlantic University which involves forming competent professionals that can help to build a better society in Nigeria and Africa at large.

Overview

Engineering Appraisal/Valuation is the art of estimating the value of specific properties where professional engineering knowledge and judgement are essential. Such properties include mines, factories, buildings, plant and machinery, industrial plants, public utilities, engineering constructions, etc.

The Council of Engineering and Regulation of Engineering in Nigeria COREN, argues that engineering students study engineering valuation, engineering economics, cost engineering courses in the engineering programme in the Nigerian Universities. The courses expose Engineering students to the economics sides of engineering and are therefore very compulsory for anyone passing through any engineering programme.

Due to the vastness of the engineering world, Engineers unlike other Professionals study engineering science in school, and specialize in practice at the workplace. Cost engineering, engineering valuation/appraisal and engineering economy are established fields of practice. Appraisal and Cost Engineering Professional Institutions belong to internationally recognised bodies like the International Cost Engineering Council (ICEC). The Institute of Appraisers and Cost Engineers (a Division of the Nigerian Society of Engineers) is a member of ICEC.

Objectives

The objectives of the course are to:

- Explain systematic valuation process, standards, and ethical values in engineering and environmental projects.
- Describe how risks and uncertainties affect evaluation outcomes and able to deal with uncertainties and risks in analysis.

- Explain the challenges of multi-attributed decision-making and able to apply an appropriate model to a given project for effective decision making.
- Outline valuation principles/process in real properties, personal properties, machinery and equipment, oil and gas, and mines and quarries
- Develop technical reports (using valuation methods and practices) that show critical analysis of information gathered from reliable sources to a specified audience.

Learning Outcomes

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

- Explain at least one systematic valuation process, standards, and ethical values in engineering and environmental projects.
- describe four (4) risks and uncertainties that affect evaluation outcomes and ways to deal with uncertainties and risks in analysis.
- describe at least five (5) the challenges of multi-attributed decision-making and apply an appropriate model to a given project for effective decision making.
- explain valuation principles/process in at least three (3) business domains such as real properties, personal properties, machinery and equipment, oil and gas, and mines and quarries.
- develop at least one professional technical report (using valuation methods and practices) that show critical analysis of information gathered from reliable sources to a specified audience.

Course contents

Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost, and value. Depreciation and obsolescence. Valuation terminology. Appraisal reporting and review. Real property valuation. Personal property valuation. Machinery and equipment valuation. Oil and gas valuation. Mines and quarries valuation.

Minimum Academic Standards

An internet smart board.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 518 Industrial Automation and Control (2 Units, Elective, LH=15 PH=45)

Senate-approved relevance

Automation of factory or manufacturing or process plant improves production rate through a better control of production. It helps to produce mass production by drastically reducing assembly time per product with a greater production quality. Therefore, for a given labor input it produces a large amount of output. Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding of industrial Automation and Control is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Industrial automation control systems are becoming increasingly crucial to manufacturing in a range of sectors. They are often viewed as technical solutions, however, they come under the remit of the senior engineering team at the coalface. The fact is, though, industrial automation control systems impact the wider enterprise, which means they can significantly improve business. These improvements centre around enhanced productivity both on the plant floor and in other areas of the organisation. This, in turn, makes business more competitive and flexible in fast-moving markets, as well as increasing profitability and ensuring your business is prepared for the future.

Importance of industrial automation and control system include eliminating the periodic or manual checking, it enhances productivity, reduces the production cost. Industrial automation reduces the human intervention to control the processes, enhances product quality, enhances the flexible features, and is operator friendly thus enhancing safety.

Objectives

The objectives of the course are to:

- Describe working of various blocks of basic industrial automation systems.
- Discuss automation programming and troubleshooting related to programmable logic controllers.
- Connect the peripherals with the PLC.

- Explain various PLC functions using small PLC programs.
- Demonstrate distributed control system and SCADA system.
- Demonstrate core hardware relating to programmable automation controllers.
- Explain various industrial motor drives for the Industrial Automation
- Design automation and control systems.

Learning Outcomes

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

- Describe working of at least two (2) blocks of basic industrial automation systems.
- Create automation programming for troubleshooting in at least three (3) programmable logic controllers.
- Design connection of the peripherals to at least two (2) programmable logic controllers.
- Explain the functioning of at least three (3) PLC functions using small PLC programs.
- Demonstrate distributed control system of one SCADA system.
- Explain core hardware relating to one programmable automation controllers.
- Describe three (3) industrial motor drives for the Industrial Automation
- Explain the automation and control systems of one industrial system in Nigeria.

Course contents

Introduction to industrial automation and control. Architecture of industrial automation systems measurement systems. Pressure and force measurement, temperature measurement, displacement, and speed measurement. Flow measurement including measurement of level, humidity and PH. Signal conditioning circuits, errors, and calibrations. Process control including introduction to process control such as PID, PID Controller Tuning, PID Controller. Implementation Programmable Logic Control including the software environment and programming of PLC. Sequence control and structured RLL programming. Programming of PLCs and Sequential Function Chart. CNC machines including introduction to CNC Machines, CNC machines interpolation, control, and drive. Actuators such as control valves, directional control valves, switches and gauges, Industrial hydraulic circuits. Pneumatic control components and pneumatic control systems. Electric machines drive including energy savings with variable speed drives. Step Motors including principles, construction and drives, DC motors drives, induction motor drives, BLDC Motor Drives. Industrial embedded and communication system including introduction to Real-time embedded systems, real-time operating systems. Networking of field devices via Fieldbus. Higher levels of industrial automation.

Minimum Academic Standards

A functional automation laboratory.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 521 Design of Mechatronics Engineering and Robotics Systems (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with strong capacity for robotics for community manufacturing is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Robots increase speed for manufacturing processes. The speed and dependability of robots ultimately reduces cycle time and maximises throughput. For small and medium scale community manufacturing outfits, the need for cost-effective implementation and sustainability are critical for remaining competitive.

This course provides object-oriented theory and practice for the development and application of robot technology in small and medium enterprises (SME) but very cost-effective production processes in a manufacturing community such as the upcoming manufacturing clusters in the Lagos Free Zone.

Objectives

The objectives of the course are to:

Describe robotic systems used in manufacturing.

- Explain the application of Free and Open-Source Software (FOSS) to design robot manufacturing system.
- Describe Robot Operating System (ROS) programming for ROS robot simulation hardware prototyping.
- Perform troubleshooting procedures for robotic systems.
- Analyse robot system using kinematics of serial and parallel Robots.
- Demonstrate robots path planning procedure.
- Explain actuators and drive systems for manufacturing robots.
- Describe the characteristics of sensors for image processing and analysis of vision systems.

Learning Outcomes

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

- List at least four (4) robot system used in manufacturing as defined by global robotics organisations.
- Install the Free and Open-Source Software (FOSS) to design at least three systems for manufacturing.
- Apply Robot Operating System (ROS) programming for hardware prototyping.
- Troubleshoot faulty robotic system.
- Analyse at least two (2) robot systems using kinematics of serial and parallel Robots principles.
- Perform path planning of two (2) robotics systems and motion control.
- Describe ten (10) actuators and drive systems for manufacturing robots.
- Describe the characteristics of at least seven (7) types of sensors used for image processing and analysis of vision systems.
- State at least five (5) cost minimisation methods in robot development for SMEs.

Course contents

Robot Fundamentals. Free and Open-Source Software (FOSS). Introduction to Robot Operating System (ROS) programming. ROS Robot Simulation. ROS Robot hardware Prototyping. Trouble shooting and best practices. Kinematics of Serial and parallel Robots. Differential motion and velocities. Path planning of robotics systems and motion control. Actuators and Drive systems. Sensors. Image processing and analysis of vision systems. Fuzzy logic controls. Basic Artificial Intelligence for Robotics design. Integrated design process of mechatronics systems. Components of mechatronics systems, sensors, and actuators. Fundamental principal of operation for components, strengths and weaknesses, and operational characteristics.

Minimum Academic Standards

Computer teaching laboratory with Ubuntu Linux operating system and ROS software with at least one computer to 5 students. One Robot-arm running with FOSS and ROS Software.

Pan-Atlantic University
School of Science and Technology
Mechatronics Engineering
B.Eng. Mechatronics Engineering

PAU-MCE 522 Automobile System Design (2 Units, Elective, LH=30)

Senate-approved relevance

Pan-Atlantic University is located near the Lagos Free Zone. The Lagos Free Zone (LFZ) is envisioned to become the preferred industrial hub and investment destination in West Africa. Several Companies such as the Dangote refinery, Africa's biggest oil refinery and the world's biggest single-train facility, as well as several other manufacturing enterprises are already springing up in the LFZ. Training of engineers with understanding Automotive design is in line with Pan-Atlantic strategic positioning statement for her School of Science and Technology to becoming Nigeria's research hub for smart and scalable inventions for transforming the manufacturing industry.

Overview

Automotive design is the process of developing the appearance (and to some extent the ergonomics) of motor vehicles - including automobiles, motorcycles, trucks, buses, coaches, and vans. The functional design and development of a modern motor vehicle is typically done by a large team from many different disciplines also included within automotive engineering, however, design roles are not associated with requirements for professional- or chartered-engineer qualifications.

Automotive design in this context focuses primarily on developing the visual appearance or aesthetics of vehicles, while also becoming involved in the creation of product concepts. Automotive design as a professional vocation is practiced by designers who may have an art background and a degree in industrial design or in transportation design. For the terminology used in the field, see the glossary of automotive design. This course covers auto engine design; design of steering systems; design of transmission systems.

Objectives

The objectives of the course are to:

- Describe the design of engine block.
- Describe various the chassis designs.
- Explain various steering system.
- Explain various mechanical transmission system designs.

Learning Outcomes

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

- Describe at least five (5) design of engine block designs.
- Describe at least five (5) contemporary chassis designs.
- Demonstrate using simulation five (5) types of steering system.
- Explain at five (5) mechanical transmission system designs of automobiles.

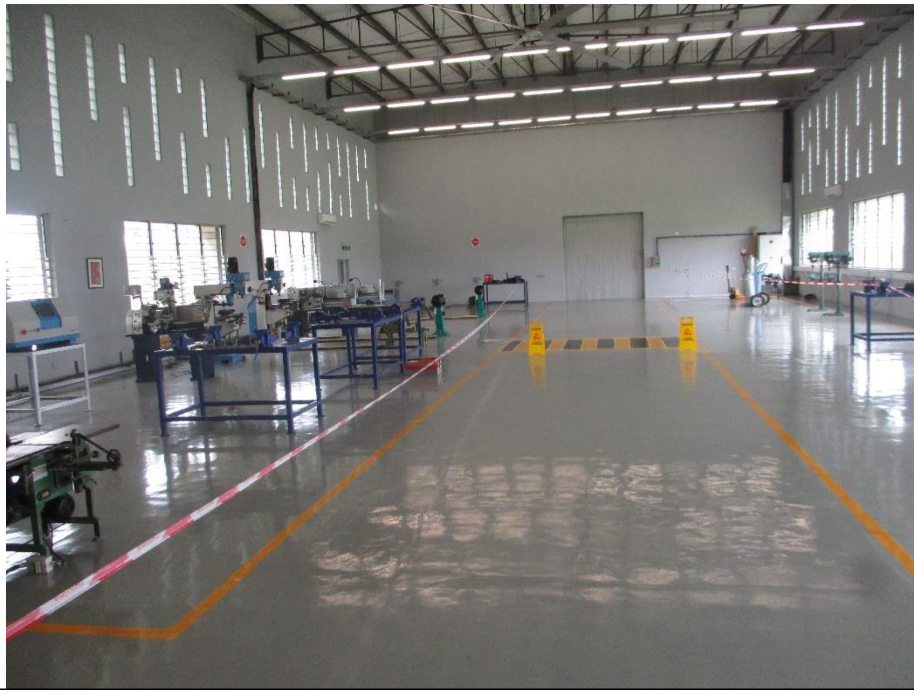
Course contents

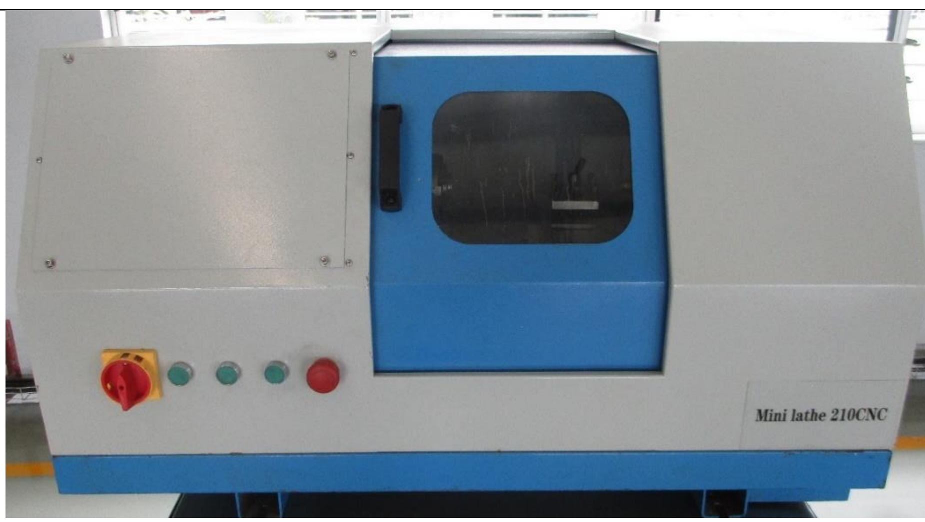
Auto engine design. Design of steering systems. Design of transmission systems. Overall process and workflow. Automotive design and styling. Ergonomic analyses and factors considered in establishing initial concept of passenger vehicles. Vehicle Architecture. Monocoque and Body on frame constructions. Types of suspension and factors in suspension configuration selection for vehicle. Modular platforms. Key characteristic of modular platforms and their benefits. System packaging design and importance of interfaces. Role of integration. Engineering bill of materials. Example of design of frame. Overview of performance domains and the systems.

Minimum Academic Standards

Standard automobile test engine platform.

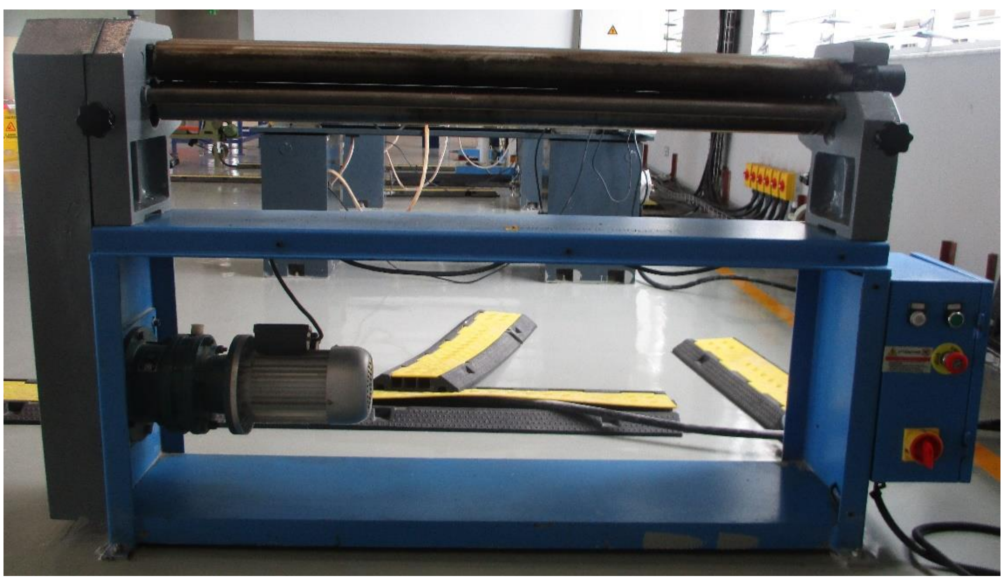
Laboratories and Workshop in Pictures - PAU

E.1.1 Central Workshop - Overview


E1.2 – Desktop CNC Machine Trainer


E.1.3 – Combined Lathe-Milling Machine

E.1.4 Roll Bending Machine

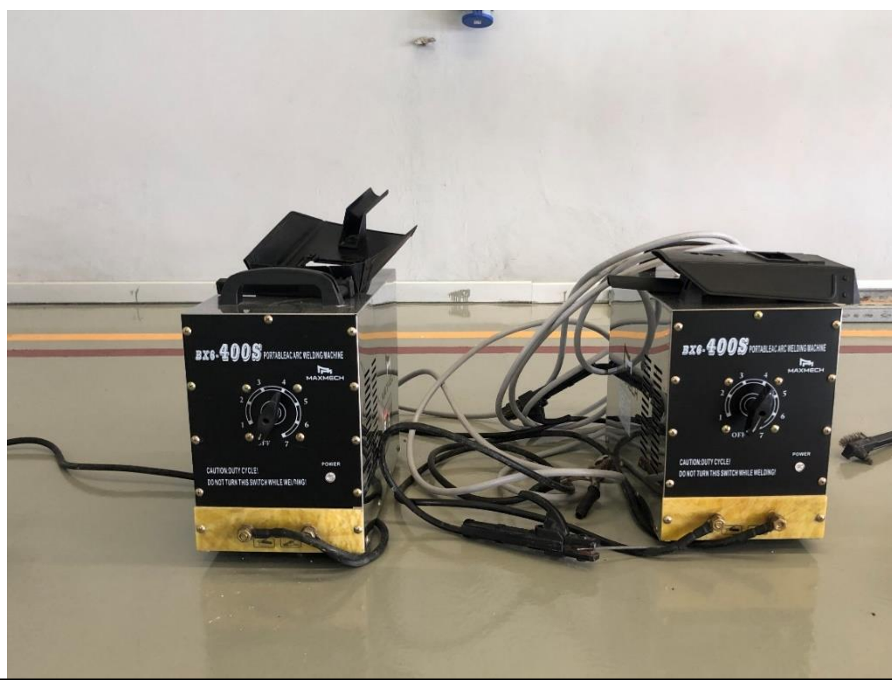


E.1.5 Milling Machine

E.1.6 Lathe Machine

E.1.7 Pillar Driling Maching

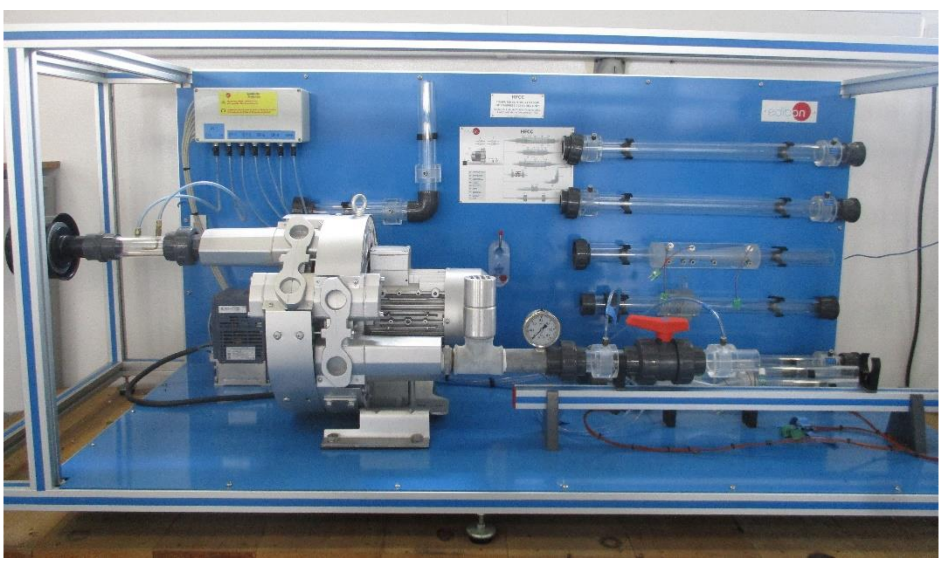
E.1.8 Arc Welding Machine



E.2.1 Thermodynamics Laboratory - Computer Controlled Gas Laws Unit

E.2.2 Computer Controlled Expansion Process of a Perfect Gas Unit

E.2.3 Oxygen Bomb Calorimeter


E.3.1 Fluid Mechanics Laboratory – Computer Controlled Flow of Compressible Fluid


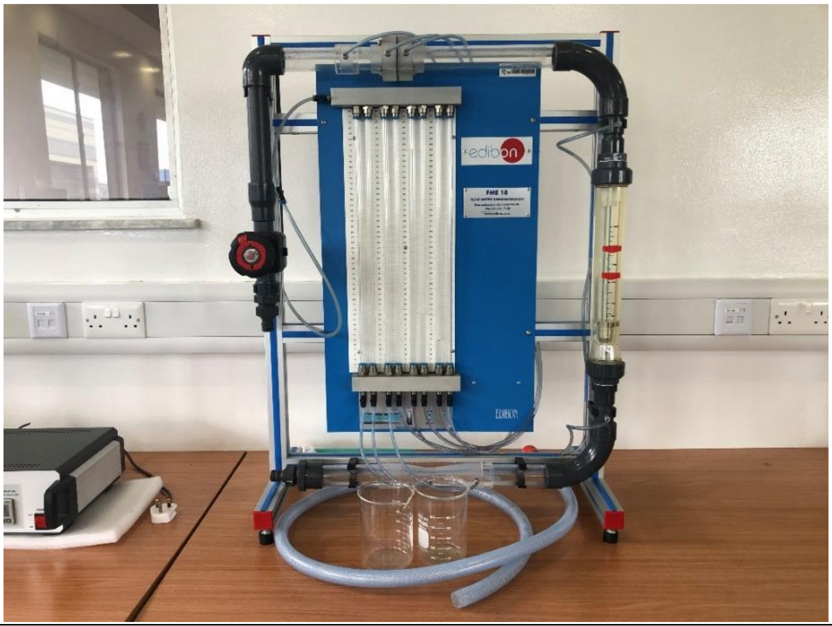
E.3.2 Fluid Mechanics Laboratory – Hydraulic Bench

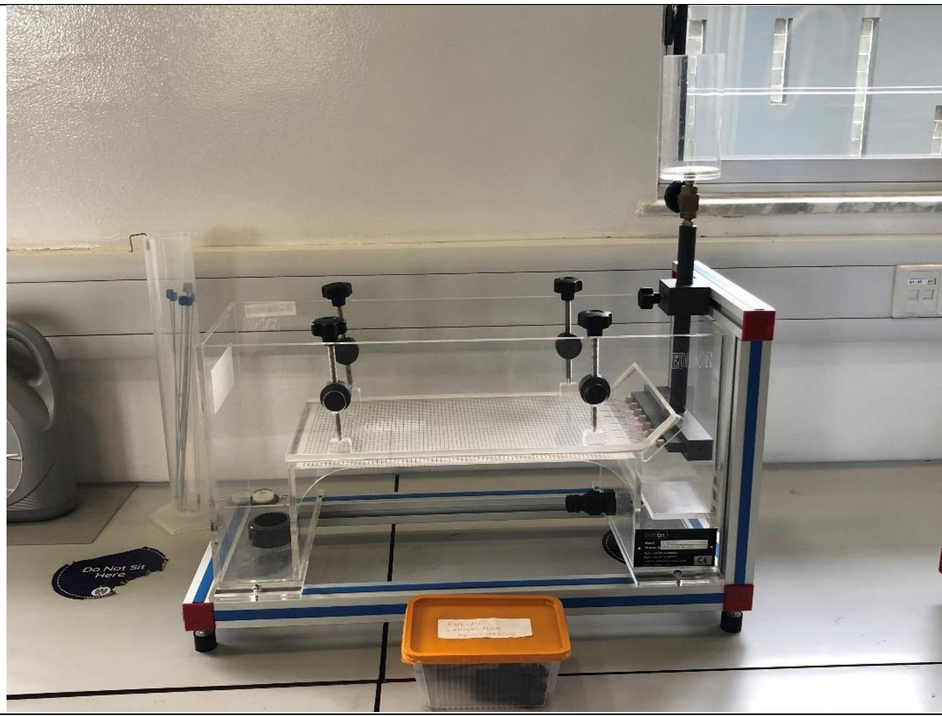
E.3.3 Fluid Mechanics Laboratory – Free and Forced Vortex Apparatus

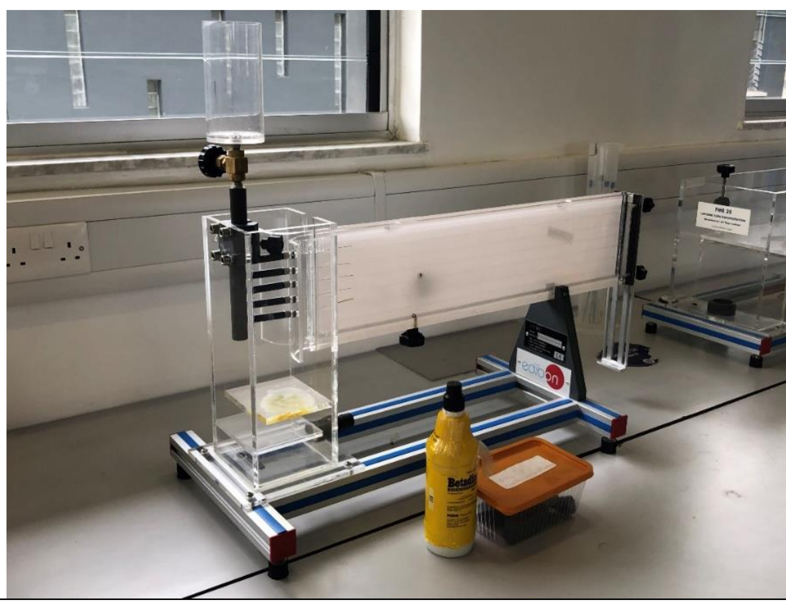
E.3.4 Fluid Mechanics Laboratory – Static and Manometry Apparatus

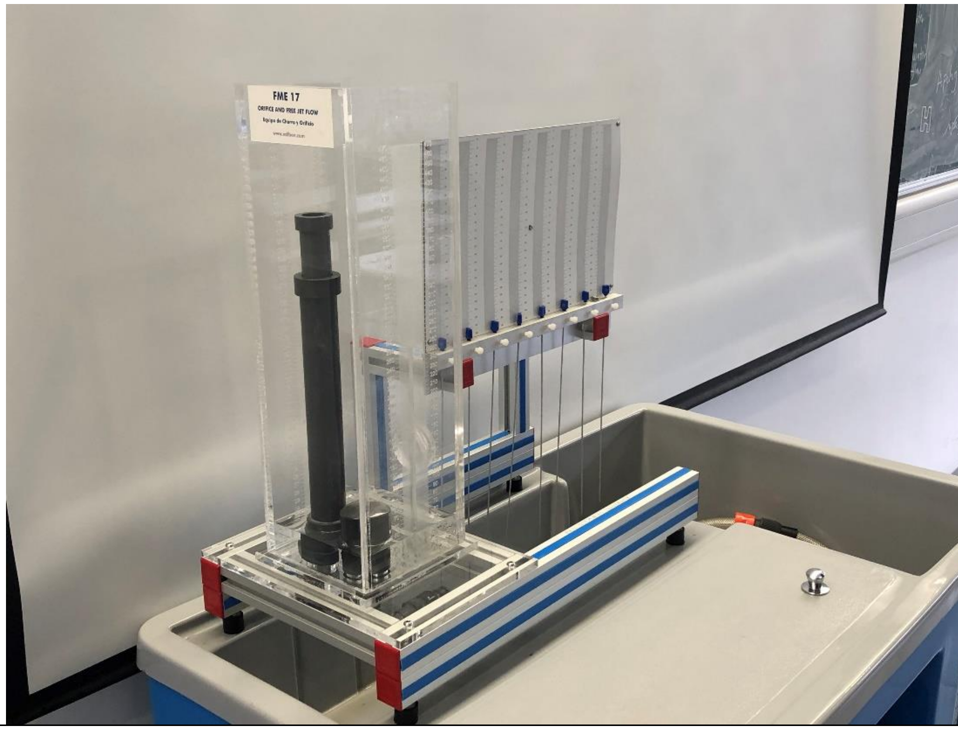
E.3.5 Fluid Mechanics Laboratory – Hydrostatic Pressure Machine

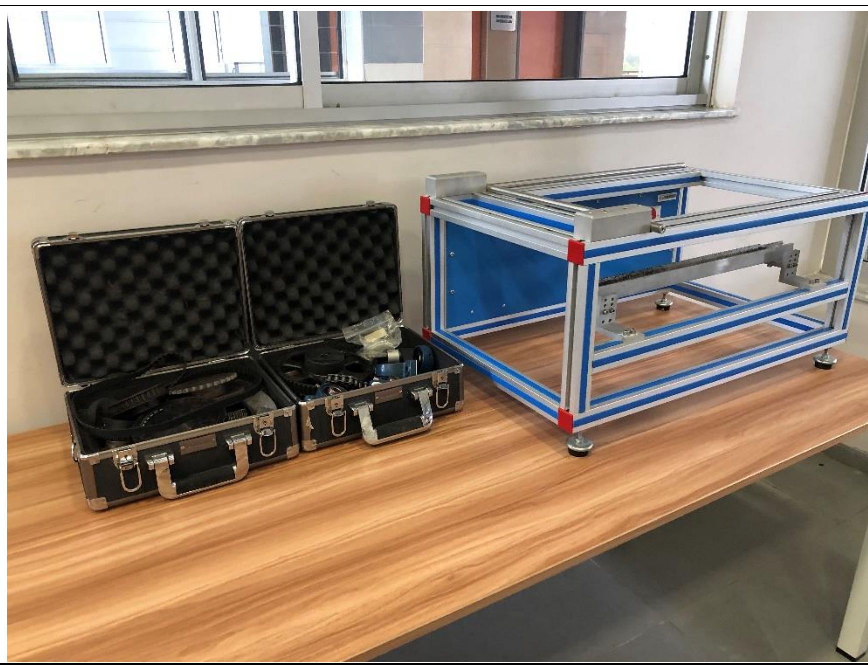
E.3.6 Fluid Mechanics Laboratory – Energy Losses in Pipes Apparatus


E.3.7 Fluid Mechanics Laboratory – Flow Meter Demonstration


E.3.8 Fluid Mechanics Laboratory – Laminar Demonstration


E.3.9 Fluid Mechanics Laboratory – Flow Visualisation Channel


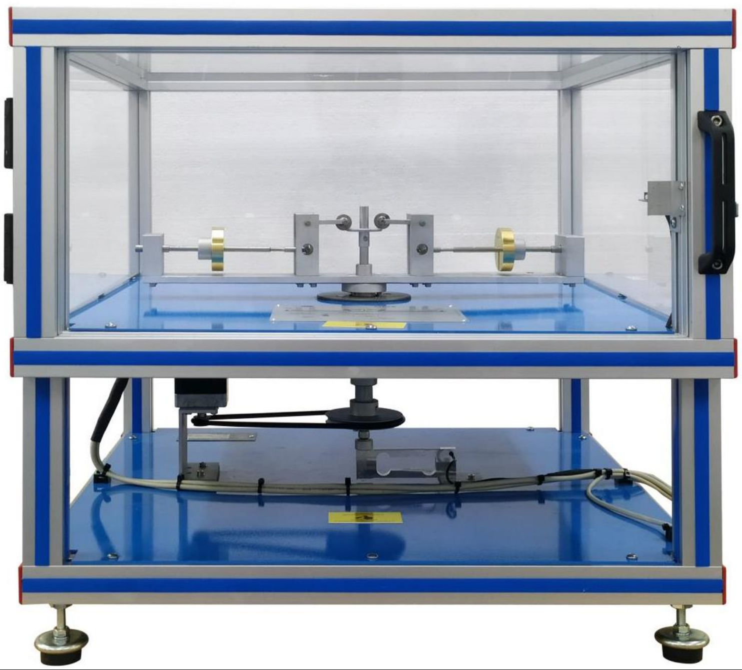
E.3.10 Fluid Mechanics Laboratory – Orifice and Free Jet Flow


E.4.1 Mechanics of Materials Laboratory – Study of Simple Drive Assembly


E.4.2 Mechanics of Materials Laboratory – Friction Study Unit


E.4.3 Mechanics of Materials Laboratory – Gyroscope

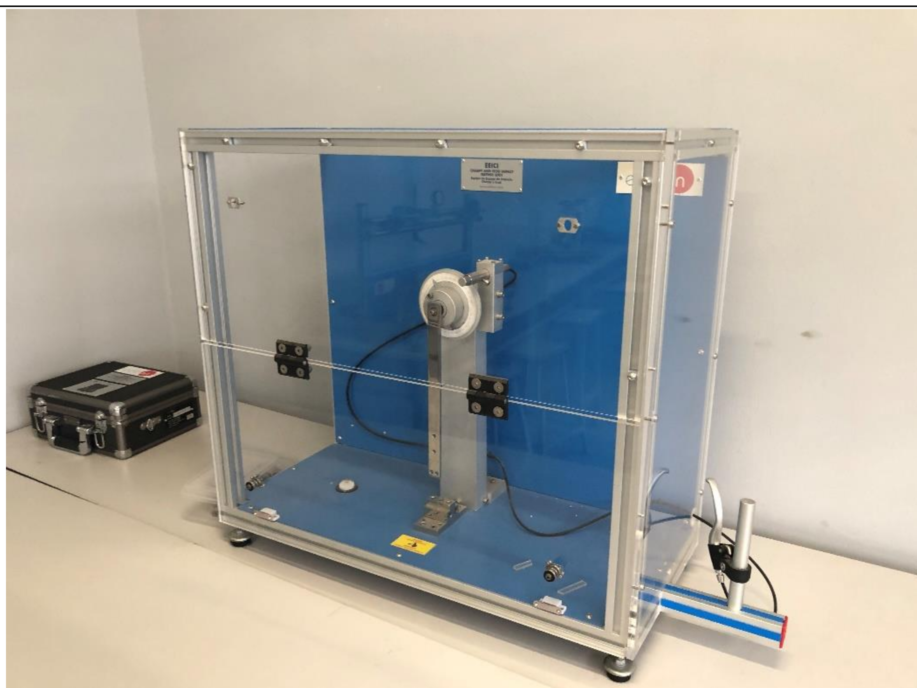

E.4.4 Mechanics of Materials Laboratory – Centrifugal Force Unit



E.5.1 Strength of Materials Laboratory – Hooke's Law Study

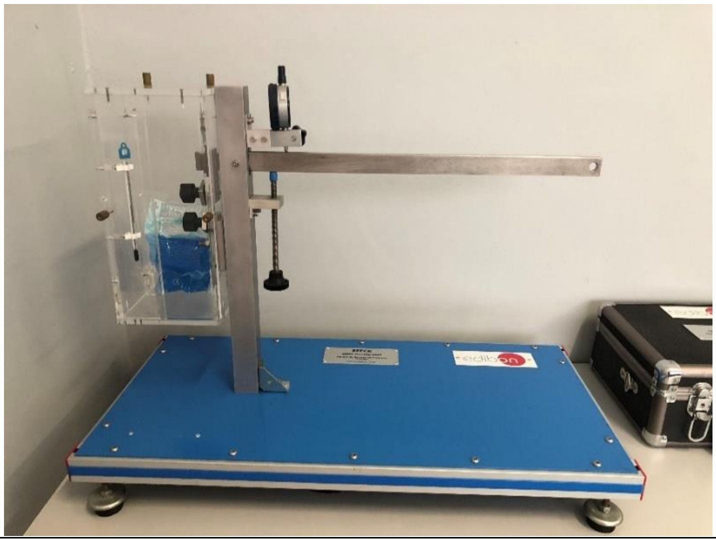
E.5.2 Strength of Materials Laboratory – Beam Deflection Unit

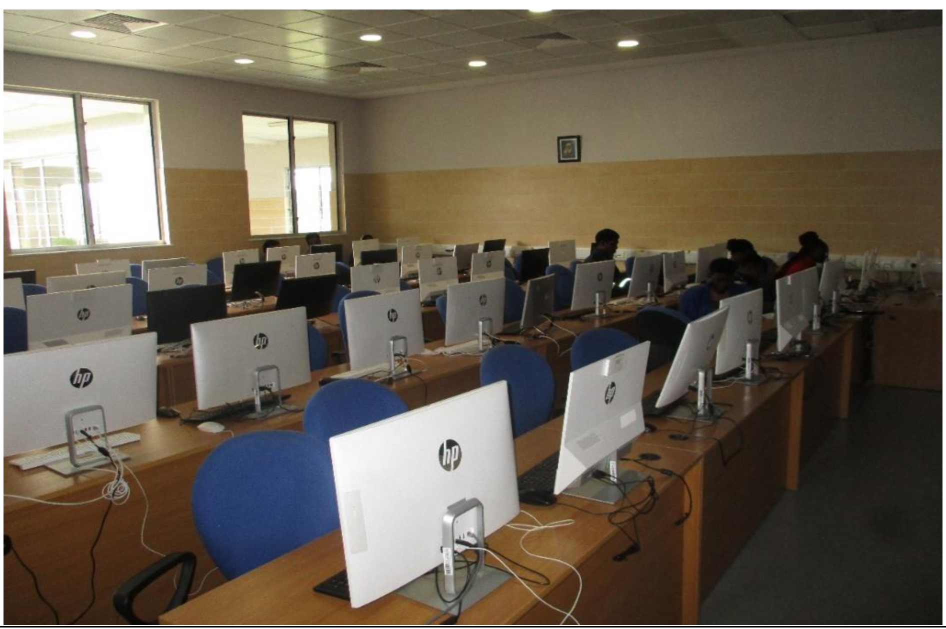
E.5.3 Strength of Materials Laboratory-Charpy & Izod Impact Testing



E.5.4 Strength of Materials Laboratory – Twist and Bend Machine


E.5.5 Strength of Materials Laboratory – Unsymmetrical Cantilever

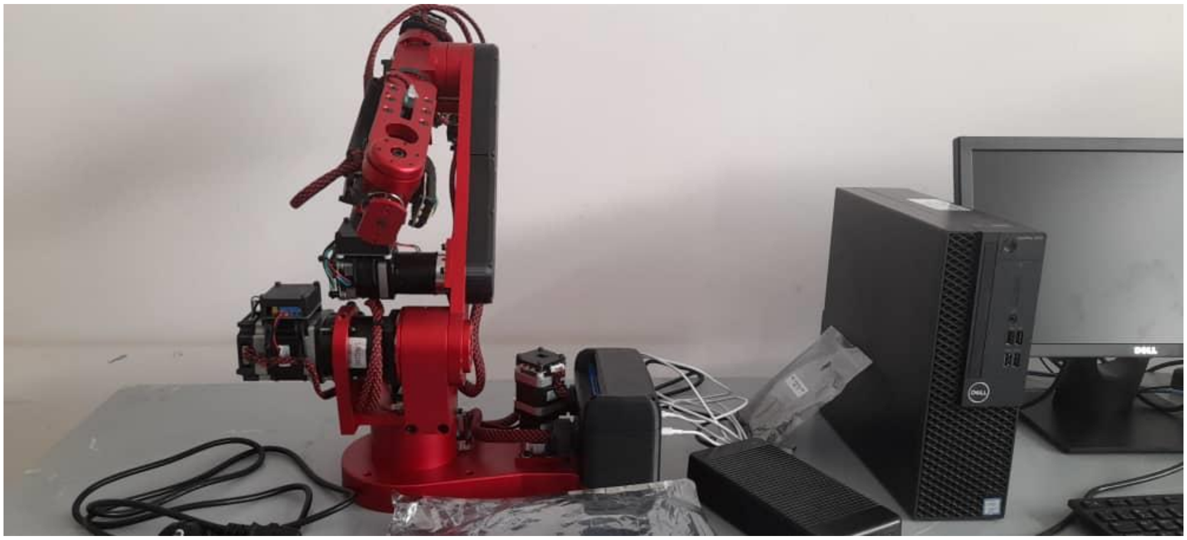

E.5.6 Strength of Materials Laboratory – Creep Testing Unit


E.5 CAD/CAD/Simulation Laboratory


F.1 Refrigeration and Air Conditioning Centre


F.2 Solar Power Training Centre


F.3 Robot Arm



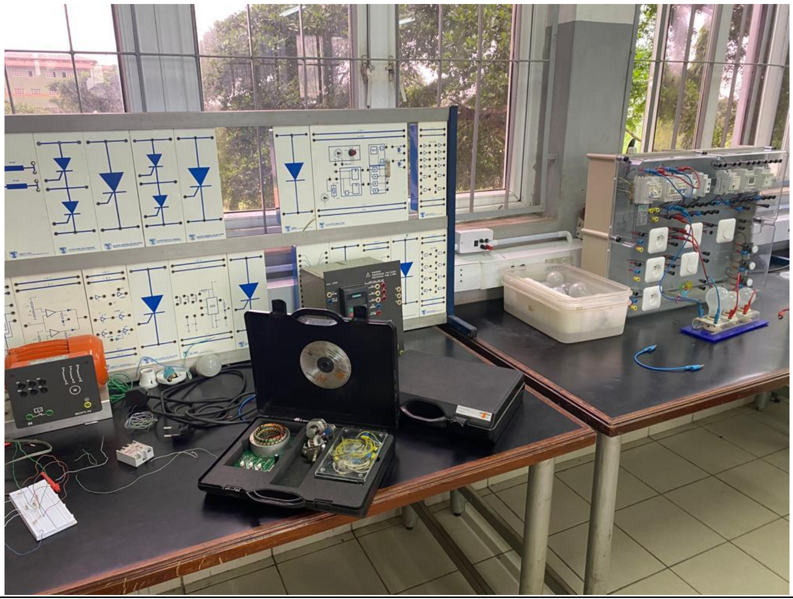
F.4 3D Printer

F.5 Desk-top CNC machine

E.5.8 Strength of Materials Laboratory – Universal Testing Machine

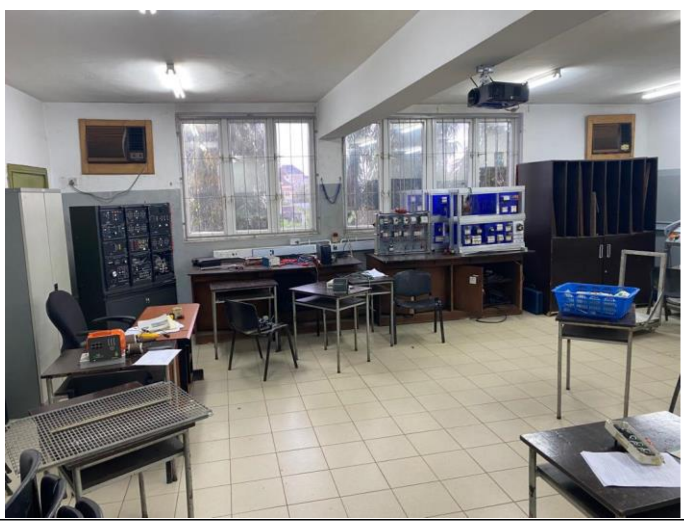

Laboratories and Workshop in Pictures – IIT

F.3 Mechatronics Engineering Laboratory



F.4 Mechatronics Engineering Laboratory

F.1 Control Laboratory


F.2 Automation Laboratory


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SST • School of Science and Technology • Pan-Atlantic University
52 km Lekki-Epe Expressway, Ibeju-Lekki, Lagos, Nigeria

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