SCHOOL OF SCIENCE AND TECHNOLOGY
PAN-ATLANTIC UNIVERSITY

Programme Manual

B.Eng. Electrical/Electronic Engineering

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

SCHOOL OF SCIENCE AND TECHNOLOGY
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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".*

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

In order to achieve the above mission, the School seeks to:

- *Provide hands-on, 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.*

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 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:

At graduation, our students are expected to know and able to do the following:

Engineering knowledge	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of developmental and complex engineering problems.
Problem Analysis	Identify, formulate, research literature, and analyse developmental and complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
Design and development of solutions	Proffer solutions for developmental or complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

Investigation	Conduct investigation into developmental or complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
Modern Tool Usage	Create, select, and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modelling and optimization to developmental and complex engineering activities, with an understanding of the limitations.
The Engineer and Society	Apply reasoning informed by contextual knowledge including Humanities and Social Sciences to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to professional engineering practice.
Environment & Sustainability	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice, including adherence to the COREN Engineers Code of Conducts.
Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
Communication	Communicate effectively on developmental or complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management and Finance	Demonstrate knowledge and understanding of engineering, management and financial principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
Lifelong learning	Recognize the need for and have the preparations and ability to engage in independent and lifelong learning in the broadest context of technological and social changes.

2.3 Mapping of Student Outcomes to Programme Educational Objectives

Student Outcomes	Programme Educational Objectives			
	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 general philosophy of the Electrical/Electronic Engineering programme is to produce graduates with high academic standard and adequate practical background for self-employment as well as being of immediate value to industry and the community in general.

The Degree programme in Electrical/Electronic Engineering of the Pan-Atlantic University is intended to provide a solid foundation in the principles and practices of engineering for young people who look forward to a career in engineering. It is also a preparation for those young people interested in an academic career and entrepreneurship in the area of engineering.

Emphasis will be given to the knowledge of problem solving approaches, critical thinking about, and in-depth analysis of, engineering issues and problems, and the acquisition of a capacity for ethical and competent professional performance.

Furthermore the programme is informed by the aspiration to train electrical/electronic engineering professionals in the areas of design, building and maintenance of electrical control systems, electric power, electronic devices, power electronics, microcomputers, digital electronics, electrical machines, instrumentation, communication networks, etc., and who would uphold the highest intellectual, ethical and professional values that promote creativity, social responsibility, and the spirit of enterprise.

The programme will prepare students for careers in the vast areas where electrical/electronic engineering is applied such as in telecommunications, power generation and distribution, renewable energy, manufacturing, aviation/aerospace, automotive, information technology, lighting, heating, ventilation and air-conditioning (HVAC) systems, military hardware, utilities, consultancy, general maintenance and construction industries, etc. With the skills students will acquire in this programme, they will be better equipped to contribute to improving national productivity and economic growth in general while earning a decent living.

Electrical/Electronic Engineering is a dynamic, fascinating and rapidly growing area that has become an integral part of the world that we live in today. It occupies a central position in our daily life, both in homes and in the workplace. The need for individuals with good electrical/electronic engineering skills and competencies will continue to grow.

5.0. Objectives

The fundamental aim of the Electrical/Electronic Engineering programme is tied to that of the University through the School of Science and Technology. It is *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*. The programme further aims to produce engineering manpower with the adequate knowledge and skills to

handle engineering situations/problems competently and ethically. To achieve this, the programme will prepare the graduates:

(i) To design engineering projects and supervise their implementation.
(ii) To design and make components, machines, equipment and systems.
(iii) To design and develop new products and production techniques in industries.
(iv) To install and maintain complex engineering systems so that they can perform optimally in our environment.
(v) To adapt and adopt exogenous technology in order to solve local engineering problems.
(vi) To be able to exercise original thought, have good professional judgment and be able to take responsibility for the direction of important tasks.
(vii) To develop appropriate leadership, interpersonal, organizational and entrepreneurial skills.
(viii) To improve on indigenous technology to enhance local problems solving capability
(ix) To be conversant with all the materials, components, machines, equipment, production techniques and systems in Electrical/Electronic Engineering.
(x) To man and maintain the specific production equipment in Electrical/Electronic Engineering.
(xi) To plan, manage and be responsible for quality control of the products and processes in the plant/factory.
(xii) To be able to manage people, funds, materials and equipment.

Other specific objectives of the programme are:

- Provide a high quality Bachelors programme in the area of Electrical/Electronic Engineering comparable to the best in the world.
- To prepare high calibre of electrical/electronic engineering graduates who are well equipped with requisite knowledge, skills, competencies and practices of electrical/electronic engineering in order to serve the needs of local and international industries in the private and public sectors.
- To involve the students in an intellectually stimulating and satisfying experience of engaged learning through continuous professional development activities that adapts to changes in the work environment.
- To prepare the students to play key roles in the professional engineering bodies.
- To provide students with knowledge and skills base for further studies in electrical/electronic engineering or multi-disciplinary studies in science and technology.

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, as 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%), Class participation (5%), End-of-Semester Examinations (65%). For the purely practical/workshop courses, Continuous Assessment will carry 100 marks.

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 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 224.

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

To qualify for the award of a degree of Pan-Atlantic University, a student is required to have:

(i) Completed and passed the prescribed number of units including all compulsory courses of the programme as specified by the University.
(ii) Completed and met the standards for all required and elective courses.
(iii) Obtained the prescribed minimum CGPA.

12.0 CURRICULUM FOR B.Eng. DEGREE IN ELECTRICAL/ELECTRONIC ENGINEERING IN AGREEMENT WITH THE NUC MINIMUM STANDARDS (2018) & COREN OBE BMAS 2019

NOTE the following legend for the list of courses below:
C = Compulsory Course – A course which every student must compulsorily take and pass in any particular programme at a particular level of study.

E = Elective Course – A course that students take within or outside the faculty (school). Students may graduate without passing the course provided the minimum credit unit for the course had been attained.

R = Required Course – A course that you take at a level of study and must be passed before graduation

LH = Lecture Hours per semester
PH = Practical Hours per semester

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Course Structure at 100-Level Engineering Degree Programme

Course Code	Course Description Semester I	Units	Status	PREQ	LH	PH
GET 111	Basic Engineering Drawing	2	C	-	15	45
CHM 101	General Chemistry I (Physical)	3	C	-	45	
CHM 107	General Practical Chemistry I	1	C	-		45
MTH 101	Elementary Mathematics I	3	C	-	45	
MTH 103	Elementary Mathematics II	3	C	-	45	
PHY 101	General Physics I	3	C	-	45	
PHY 106	General Physics III	3	C	-	45	
PHY 107	General Practical Physics I	1	C	-		45
STA 101	Statistics for physical science and engineering	3	C	-	45	
GST 101	Communication in English I	2	C	-	30	
GST 103	Use of Library, Study Skills and Information Communication Technology	2	C	-	30	
	TOTAL UNITS	**26**				

Course Code	Course Description Semester II	Units	Status	Pre requisite	LH	PH
CHM 102	General Chemistry II (Inorganic)	3	R	-	45	
CHM 106	General Chemistry III (Organic)	2	C	-	30	
CHM 108	General Practical Chemistry II	1	R	-		45
MTH 102	Elementary Mathematics III (Differential & Integral Calculus)	3	R	MTH 101	45	
MTH 104	Elementary Mathematics IV (Vectors, Geometry & Dynamics)	3	C	MTH 101	45	
PHY 102	General Physics II (Electricity, Magnetism & Modern Physics)	3	R	PHY 107	45	
PHY 108	General Physics Practical II	1	R	-		45
GST 104	Logic, Philosophy and Human Existence	2	R	-	30	
GST 105	Communication in English II	2	C	-	30	
GST 125	Contemporary Health Issues	2	R	-	30	
GST 102	Introduction to Christian Theology	3	C	-	45	
	TOTAL UNITS	**25**				

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Course Structure at 200-Level Engineering Degree Programme

Course Code	Course Description Semester I	Units	Status	Pre-requisite	LH	PH
GET 201	Fundamentals of Electrical Engineering I	3	C	-	30	45
GET 203	Engineering Drawing I	2	C	-	15	45
GET 205	Workshop Practice	1	C	-		45
GET 207	Engineering Mechanics	3	C	-	45	
GET 209	Engineering Mathematics I	3	R	-	45	
GET 211	Engineering Materials	3	R	-	45	
GET 213	Fundamentals of Thermodynamics	3	C	-	45	
ENT 201	Entrepreneurship I	2	C	-	15	45
GST 202	Philosophical Anthropology	2	C	-	30	
GST 211	Environment and Sustainable Development	2	R	-	30	
	TOTAL UNITS	**24**				
Course Code	**Course Description Semester II**	**Units**	**Status**	**Pre-requisite**	**LH**	**PH**
GET 203	Fundamentals of Electrical Engineering II	3	C	GET 201	30	45
GET 206	Fundamentals of Fluid Mechanics	3	C	-	30	45
GET 208	Strength of Materials	3	C	-	30	45
GET 210	Engineering Mathematics II	3	R	GET 209	45	
GET 212	Fundamentals of Computer Aided Engineering	3	R	-	30	45
GET 222	Engineering Drawing II	2	C	GET 203	15	45
GET 224	Engineering Communication	2	C	-	30	
ENT 202	Entrepreneurship II	2	C	ENT 201	15	45
GST 204	Peace studies, Conflict Resolution & Ethics	3	R	-	45	
	TOTAL UNITS	**24**				
GET 299	SIWES I	6	C	-	12 weeks	

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Course structure at 300-Level Electrical/Electronic Engineering

Course Code	Course Description Semester I	Units	Status	Pre-requisite	LH	PH
EEE 301	Electronic Circuits I (Analogue)	3	C	-	30	45
EEE 303	Electric Circuit Theory I	3	C	-	45	
EEE 305	Electromagnetic Fields and Waves I	3	C	-	45	-
EEE 307	Data Communications and Networks	3	C	-	45	
EEE 309	Physical Electronics	3	C	-	45	-
EEE 320	Laboratory Practicals I	2	C	-		90
GET 301	Engineering Mathematics III	3	R	GET 210	45	
GET 303	Engineer in Society & Professional Ethics	2	R	-	30	
GST 303	Nigerian Peoples and Culture	2	R	-	30	
	TOTAL UNITS	**24**				
Course Code	**Course Description Semester II**	**Units**	**Status**	**Pre-requisite**	**LH**	**PH**
EEE 302	Electronic Circuits II (Digital)	3	C	-	30	45
EEE 304	Measurements and Instrumentation	3	C	-	45	
EEE 306	Electrical Machines I	2	R	-	30	
EEE 308	Applied Computer Programming	2	C	-	30	
EEE 310	Linear Systems	3	C	-	45	
EEE 312	Electric Circuit Theory II	3	C	EEE 303	45	
EEE 314	Electromechanical System	3	C		45	
EEE 316	Laboratory Practicals II	2	C	-		90
GET 302	Engineering Mathematics IV	3	R	GET 301	45	
	TOTAL UNITS	**24**				
GET 399	SIWES II	6	C	-	12wks	

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Course structure at 400-Level Electrical/Electronic Engineering

Course Code	Course Description Semester I	Units	Status	Pre-requisite	LH	PH
EEE 401	Electromagnetic Fields and Waves II	3	R	EEE 305	45	-
EEE 403	Principles of Communication Engineering	3	C	-	45	
EEE 405	Electric Power Principles	3	R	-	45	-
EEE 407	Advanced Electronics Circuits	2	C	-	30	
EEE 409	Control Theory	3	C	-	45	-
EEE 411	Electrical Machines II	2	R		30	
EEE 413	Laboratory Practicals III (EEE 403, EEE 407 & EEE 411)	2				90
CPE 404	Assembly Language Programming	2	C	-	30	
GET 401	Cost Engineering	2	C	-	30	
GET 403	Engineering Economics	3	C	-	45	
	TOTAL UNITS	**25**				
Course Code	**Course Description Semester II**	**Units**	**Status**		**LH**	**PH**
GET 499	SIWES III (4th year)	6	C	-	24wks	

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Course structure at 500-Level Electrical/Electronic Engineering

Course Code	Course Description Semester I	Units	Status	Pre-requisite	LH	PH
EEE 501	Reliability Engineering	2	C	-	30	
EEE 505	Advanced Circuit Techniques	3	C	-	30	45
EEE 507	Electromechanical Devices	2	R	-	30	
EEE 509	Design of Electrical & ICT Services	3	C	-	45	
EEE 511	Advanced Computer Programming and Statistics	2	R	-	15	45
EEE 513	Use of Engineering Software Packages	2	C	-	30	
MCT 501	Automation and Robotics	3	E	-	30	45
GET 501	Engineering Management	3	R	-	45	
	TOTAL UNITS	**20**				
Course Code	**Course Description Semester II**	**Units**	**Status**	**Pre-requisite**	**LH**	**PH**
EEE 502	Power Electronics	3	R	-	45	-
EEE 504	Control Engineering	3	C	-	45	
EEE 506	Digital Signal Processing	3	E	-	45	
EEE 599	Final Year Project*	6	C	-		270
GET 502	Engineering Law	3	R	-	45	
GET 504	Engineering Valuation/Appraisal	2	C	-	30	
	TOTAL UNITS	**20**				
	GROUPS OF ELECTIVES (Up to 5 credits)					
	COMPUTER & CONTROL ENGINEERING OPTION					
EEE 516	System Design and VHDL Programming	2	E	-	30	
EEE 518	Digital Computer Networks	2	E	-	30	
EEE 504	Modern Control Engineering (Control Engineering II)	3	E	-	45	
	POWER AND MACHINES OPTION					
EEE 530	Electric Power System Engineering	3	E	-	45	45
EEE 532	Switchgear and High Voltage Engineering	2	E	-	30	-
EEE 504	Modern Control Engineering (Control Engineering II)	3	E	-	45	

(*) The Project load is divided between the first and the second semester.
The estimated load of the first semester is 1/3 of the total year load for the project.

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DETAILED COURSE DESCRIPTIONS

FIRST YEAR, SEMESTER I

GET 111: Basic Engineering Drawing (2 Units: LH15 PH 45)
Introduction of Engineering Drawing as means of communication. Drawing paper format. Use of drawing instruments. Type of lines and their use in Engineering Drawing. Circles and tangents. Plane geometry. Circles to satisfied conditions involving other circles, lines and points. Conic sections, various methods of their construction. Cycloid, epicycloids, and hypocycloids, involute. Archimedes spiral. Helix (cylindrical and conical) single and multi-start threads. Coiling of compression and tension springs. Loci- Paths of points on moving link work. The theory of projection. Perspective (briefly), parallel projections (oblique – general, cavalier, cabinet). (Orthographic – Multi-view, two views, three views, auxiliary views). (Axonometric – Isometric, Diametric, Trimetric). Multiview representation. 1st and 3rd angle projections. Isometric drawings. Oblique drawings. Freehand sketching.

CHM 101: General Chemistry I (Physical) (3 Units, LH 45)
Atoms, molecules and chemical reactions (types and properties). Modern electronic theory of atoms: atomic Spectra – the Bohr atom and extension of Bohr theory. Electronic configuration, periodicity and building up of the periodic table. Hybridisation, molecular orbital theory, the LCAO method, homo- and heteronuclear diatomic molecule, and shape of simple covalent molecules. Valence forces; Structure of Solids. Chemical equations and stoichiometry (Balancing of equation by electron transfer method, mole concepts and calculations involving titrimetry). Chemical bonding and intermolecular forces (van der Waals, hydrogen bonding, dipole-dipole interaction). Kinetic theory of matter: Properties of gases - ideal and non-ideal behaviour. Elementary Thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 107: General Practical Chemistry I (1 Unit, PH 45)
Laboratory experiments designed to reflect the topics taught in CHM 101 such as qualitative and quantitative chemical analysis, acid-base titrations. Gravimetric analysis. Calculation, data analysis and presentation. Functional group analysis.

MTH 101 Elementary Mathematics I: (3 Units, LH 45)
(Algebra and Trigonometry)
Indices and logarithms, Inequalities, and polynomials (including factor and remainder theorems), Theory of equations, Theory of quadratic, cubic and quartic equations, Binomial theorem, Partial fractions, Complex numbers, Circular measure, Trigonometric functions of angles of any magnitude, addition and factor formulae, expansion of sin nØ, cos nØ, tan nØ.

MTH 103 Elementary Mathematics II: (3 Units, LH 45)
(Set Theory and Numbers)
Elementary set theory, subsets, union, intersection, complements and Venn diagrams, Real numbers: integers, rational and irrational numbers, Surds, Mathematical induction, Real sequences and series, Complex numbers: algebra of complex numbers, the Argand Diagram, De-Moiré's theorem nth roots of unity.

PHY 101: General Physics I (3 Units, LH 45)
(*Mechanics & Properties of Matter*)
Space and Time, Units and dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems. Elasticity; Hooke´s law, Young´s shear and bulk moduli. Hydrostatics; Pressure; buoyance, Archimedes' principle; Surface tension: adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases; Sound: Types and properties of Waves as applied to sound and light energies; Superposition of waves. Propagation of sound in gases, solids and liquids and their properties.

PHY 106: General Physics III (3 units, LH 45)
(Heat, Sound and Optics)
Temperature, thermometers, heat transfer, PVT –surfaces, Kinetic theory, first and second laws of thermodynamic, transverse and longitudinal waves, standing waves, intensity, beats. Doppler Effect, Electromagnetic spectrum. Huygen's principle, images formed by a single surface thin lenses, aberrations, the eye, optical instruments, interface, single slit, diffraction grating, polarization, Malus' law.

PHY 107: General Practical Physics I (1 Unit, PH 45)
This introductory practical part of course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction. A selection of experiments such as: use of measuring instruments, viscosity, surface tension oscillations about an equilibrium position, Hooke's law, moment of inertia, focal lengths of lenses, refractive index, volume expansion and latent heat, etc.

STA 101: Statistics for Physical Sciences and Engineering (3 Units LH 45)
Descriptive Statistics, frequency distribution, population and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, Poison hyper-geometric, Normal distributions, etc. Statistical interference intervals, test hypothesis and significance. Regression and correlation.

GST 101: Communication in English I **(2 Units: LH 30)**

Effective communication and writing in English Language skills, essay writing skills (organization and logical presentation of ideas, grammar and style), comprehension, sentence construction, outlines and paragraphs. This course is an overview of grammatical structure. Attention will be paid to the parts of speech (nouns, pronouns, verbs, prepositions, adjectives, adverbs, conjunctions, and interjections) as well as markers of noun (articles, quantifiers predetermines, demonstratives) and modality in verb use. The course will also study phrases and clauses, sentence structure, the sentence in use, punctuation, capitalization and spelling. It will provide an introduction to paragraph structure, critical thinking in writing, speech planning and organization.

GST 103: Use of Library, Study Skills and ICT **(2 Units: LH 30)**

Brief history of libraries; Library and education; University libraries and other types of libraries; Study skills (reference services); reading and comprehension; listening and comprehension; note-taking and note-making; word processing. The use of dictionaries, encyclopaedia and other reference materials; the library and learning; organization of the library system; finding information in a library; Types of library materials, using library resources including e-learning, e-materials, etc.; Understanding library catalogues (card, OPAC, etc.) and classification; Copyright and its implications; Database resources; Bibliographic citations and referencing. Development of modern ICT; Hardware technology; Software technology; Input devices; Storage devices; Output devices; Communication and internet services; Identification of PC parts and peripheral devices: functions, applications, and how to use them. Safety precautions. Procedure for booting a PC. Filing system: directory, sub-directory, file, path, and how to locate them. Word processing skills (typing, etc.), Spreadsheet, Database management, Presentation software. Exercises.

FIRST YEAR, SEMESTER II

CHM 102: General Chemistry II (*inorganic*) **(3 Units: LH 45)**

Solutions Chemistry: types of solutions, solubility, vapour pressure, solubility product and pH determination. Origin of quantum theory. Stereochemistry. Electrode potential and non-aqueous solvent. The chemistry of selected metals and non-metals: comparative Chemistry of groups IA, IIA, IVA elements. The chemistry of non-metallic elements: hydrogen and hydrides, main group elements of 2nd and 3rd periods and their compounds, oxygen and oxides, chalcogen and chalcogenides, halogens and halides, rare gases and their compounds. Introduction to transition metal chemistry. Coordination compounds (structure of complexes, coordination number and geometry), Nomenclature, Isomerism, Simple treatment of Crystal Field Theory, Splitting of D-orbitals into octahedral, square-planar, and tetrahedral. Inorganic Chemicals: Application in Chemistry, Agriculture, Medicine and Industry.

CHM 106: General Chemistry III (*Organic*) (3 Units: LH 45)
Historical survey of the development and importance of Organic Chemistry. Electron theory in organic chemistry; saturated hydrocarbons, unsaturated hydrocarbons. Isolation and Purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional groups classes of organic compounds. Introductory reaction mechanism and kinetics. Carbon hybridization, Homologous series, functional group chemistry. The Chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, ketones, carboxylic acids and derivatives.

CHM 108: General Practical Chemistry II (1 Unit PH 45)
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 102: Elementary Mathematics III (3 units LH 45)
(*Differential and Integral Calculus)*
Functions of a real variable, graphs, limits and idea of continuity. The derivative as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, Definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson´s rule.

MTH 104: Elementary Mathematics IV (3 units LH 45)
(*Vectors, Geometry & Dynamics)*
3-Dimensional Cartesian Coordinate Systems. Definition and Representation of Vectors, Algebra of Vectors, Multiplication of a Vector by a Scalar, Addition of Vectors, Scalar Products of two Vectors, Direction Cosines, Calculus of Vector Functions, Differentiation of Vector Function, Integration of Vector Function. Conic: Circles, Parabola, Ellipse and Hyperbola

PHY 102: General Physics II (3 units, LH 45)
(Electricity, Magnetism and Modern Physics)
Electrostatics; conductors and currents; dielectrics; magnetic fields and electromagnetic induction, Maxwell's equations; electromagnetic oscillations and waves; Coulomb's laws; method of charging; Ohm's law and analysis of DC circuits; AC Voltages applied to Inductors, Capacitors and resistances; Applications.

PHY 108: General Practical Physics II (1 unit, PH 45)
This is a continuation of the experiments designed for PHY 101 and PHY 102 some of which have been covered under PHY 107.

GST 102: Introduction to Christian Theology (3 Units, LH 45)
The Existence of God; Revelation; Supernatural Faith; God's Nature and Action; The Holy Trinity; Creation; Elevation to the Supernatural Order and original Sin; Jesus Christ, True God and True Man; The Incarnation ; The Passion and Death on the Cross; Resurrection,

Ascension and Second Coming; The Holy Spirit, the Holy Catholic Church; The Communion of Saints and the Forgiveness of Sin; History of the Church; The Church and the State; The Resurrection of the Body and Life Everlasting; Introduction to the Liturgy and the Sacraments; Baptism and Confirmation; The Eucharist; Penance; Anointing of the Sick; Holy Orders; Marriage; Freedom, Law and Conscience; Morality of Human Acts; Grace and the Virtues; The Person and Society; Personal Sin; The Ten Commandments; Prayer.

GST 104: Logic, Philosophy and Human Existence (2 Units: LH 30)

A brief survey of the main branches of Philosophy; Rudiments and dynamics of critical thinking as a major component of knowledge production. Such forms of knowledge as good and bad arguments, the capacity to think clearly and rationally, to engage in reflective and independent thinking and to reason logically, coherently and purposefully towards a particular end. Topics include: logic and logical reasoning: the nature of reasoning: deduction and induction; the structure of argumentation; forms of fallacies; types of discourse; techniques for evaluating arguments; symbolic logic; Special symbols in Symbolic logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements, law of tort. The method of deduction using rules of interference and bi-conditional, qualification theory. Types of discourse, nature or arguments, validity and soundness, techniques for evaluating arguments, distinction between inductive and deductive inferences; etc. (Illustrations will be taken from familiar texts, including literature materials, novels, law reports and newspaper publications.

GST 105: Communication in English II (2 Units: LH 30)

Communication in English II builds on the foundation laid by the first part of the course. It aims to strengthen the foundation and further understanding of the grammatical elements through increased writing and reading exercises. The course reviews the use of the parts of speech in writing as well as sentence construction, but it focuses in particular on difficult verbs, the gerund, voice, mood, agreement, high frequency spelling, punctuation, and the rules governing the use of capital letters. It will also provide guidelines on critical reading, summary writing, and speech writing while reviewing argument and paragraph structures. Logical presentation of papers; Phonetics; Instruction on lexis; Art of public speaking and oral communication; Figures of speech; Précis; Report writing.

GST 125: Contemporary Health Issues (2 Units: LH 30)

Diet, exercise and health, nutritional deficiency diseases, malaria, other infections, hypertension, organ failure, air-borne diseases, sexually transmitted diseases, cancer and its prevention, sickle cell disease. HIV/AIDS & COVID-19: Introduction, epidemiology, natural history of infection, transmission of predisposing factors, Impact on the society, management of infection, prevention. Drugs and Society: sources of drugs, classification of drugs, dosage forms and routes of drug administration, adverse drug reactions, drug abuse and misuse, rational drug use and irrational drug use. Human kinetics and health education: personal care and appearance, exercise and health, personality and relationship, health emotions, stress, mood modifiers, refusal to tobacco, alcohol and other psychoactive drugs.

SECOND YEAR, SEMESTER I

GET 201: Fundamentals of Electrical Engineering I (3 Units: LH 30 PH 45)
Fundamental Concepts-Electric Fields, charges, magnetic fields. Current, B-H curves. Kirchhoff´s laws, superposition. Thevenin's and Norton's Theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurements, Transducers, Single phase circuits. Complex J- notion, AC circuits, Impedance, Admittance, susceptance.

GET 203: Engineering Drawing I (2 Units: LH 15; PH 45)
Revision of multi-view representation. Harder examples of two and three view representation (1st and 3rd angles). Harder examples on isometric drawing to include simple pictorial assembly drawing in isometric. Harder examples on oblique drawing (Cavalier, Cabinet and Angles other than 45 degrees). Dimensioning. Sections and Conventions. Auxiliary views. Representation and specifications of threads. Bolted joints. Keys and cotter-joints. Conventional representations. Engineering drawing techniques: Geometrical Constructions, Principles of Tangency. Orthographic Projections: Auxiliary views, Interpenetration & Development. Sectional Views and Dimensioning. Isometric Projection. (See BS 308/8888).

GET 205: *Workshop Practice* (1 Unit: PH 45)
Introduction to basic equipment in wood, machine, fitting and welding workshops. Element of safety practice with the various tools used in the workshops. Discussion on general safety precautions. General principles governing the various workshop machines. Selection and use of tools for specific operations in the various workshops. Practical demonstration of use of tools and machines in performing basic workshop processes. Introduction to practices and skills in general engineering through instruction in operation of hand and powered tools for wood and metal cutting and fabrication. Supervised hand-on experience in safe usage of tools and machines for selected tasks.

GET 207: *Engineering* Mechanics I (3 Units: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machines parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton´s laws of motion. Kinetic energies and momentum analysis.

GET 209: Engineering Mathematics I (3 Units: LH 45)
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions- matrices and determinants, vector Algebra, Vector Calculus, Directional derivatives.

GET 211: Engineering Materials (3 Units: LH 45)

Introduction to electronic configuration, atomic structures, inter atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramic and plastics. Principles of the behaviour in common environments. Fabrication processes and applications. Fundamentals of structure, energetics, and bonding that underpin materials science. Topics include: an Introduction to thermodynamic functions and laws governing equilibrium properties, relating macroscopic behaviour to atoms and molecules of materials; the role of electronic bonding in determining the energy, structure, and stability of materials; quantum mechanical descriptions of interacting electrons and atoms; materials phenomena, such as heat capacities, phase transformations, and multiphase equilibrium to chemical reactions and magnetism; symmetry properties of molecules and solids; structure of complex, disordered, and amorphous materials; tensors and constraints on physical properties imposed by symmetry; and determination of structure through diffraction. Real-world applications include engineered alloys, electronic and magnetic materials, ionic and network solids, polymers, and biomaterials.

GET 213: Fundamentals of Thermodynamics (3 Units: LH 30, PH 45)

Introductory survey of thermodynamics. What is Thermodynamics? Historical background, scope of thermodynamics, dimensions and units. Fundamental concepts: systems, control volume, properties and states, processes, heat and work, pressure, temperature and the zeroth law. Elementary form of the continuity equation. The first law of thermodynamics and its corollaries: conservation of energy, internal energy, and enthalpy, thermodynamic properties of pure substances: P-V-T relations and diagrams, the ideal gas property tables and charts. The second law of thermodynamics and its corollaries: Reversibility, Irreversibility, Efficiency and thermodynamic temperature scale. Entropy. Clausius inequality, heat engines and heat pumps. Basic concepts, quantitative relationship of Zeroth, first, second and third laws of thermodynamics. Behaviour of pure substances and perfect gases. Ideal gas cycles.

ENT 201: Entrepreneurship I (2 Units: LH 15 PH 45)

1. Mapping the Journey - This module introduces the basics of starting a business by explaining different types of business structures, legal and tax considerations, and how to test your idea. a) Introduction to Entrepreneurship/Finding the right idea; b) Types of Entrepreneurship; c) How to set up the business; d) Value Proposition; e) Product Development.
2. Model - how to organize your business, protect your ideas, and communicate them to others. a) IP Management; b) Business Model Canvas.
3. Market - This module defines the process of identifying your target market, preparing to enter the marketplace and how to communicate value to your customers. a) Analysing the Market; b) Market Communication; c) Idea to Market; d) Sales; e) Negotiation.
4. Management - This module outlines a company's organizational structure, how to recruit and manage talent, and organize your finances. a) Budgeting/Financial Planning; b) Recruiting; c) Boot strapping.

5. Money - This module addresses various financing methods available to start-ups, including how to prepare a good investor pitch. a) Raising Funds; b) The Pitch.

GST 202: Philosophical Anthropology (2 Units: LH 30)
An introduction to the philosophical basis of considerations about the human person. The course seeks to establish what the human person is. With the aim of bringing the students to a due appreciation of the human reality, a study will be made of the human potencies and faculties, such as the understanding, the imagination, and the will. Particular attention will be paid to human rationality and freedom, qualities which, among others, set the human person apart from other material beings. Fundamental questions about the relations between human nature, religion and culture, as well as the basis of the dignity of the human person will also be dealt with. A study will also be made of various conceptions of the person which are based on ideology.

GST 211: Environment and Sustainable Development (2 Units: LH 30)
Man- his origin and nature; Man and his cosmic environment; scientific methodology, Science and Technology in the society and service of man. Renewable and non-renewable resources –man and his energy resources. Environmental effects of chemical plastic, textiles, Wastes and other materials. Chemical and radiochemical hazards. Introduction to the various areas of science and technology. Elements of environmental studies.

SECOND YEAR, SEMESTER II

GET 203: Fundamentals of Electrical Engineering II (3 Units: LH 30 PH 45)
Basic machines- DC, synchronous alternators, transformers, equivalent circuits. Three phase balanced circuits, PMN junction diode, Transistors, Thyristors, FETs, Zener, and Rectifiers. Basic control systems, open/close loop systems. Communication fundamentals, introduction to TV, Radio, Telephone systems.

GET 206: Fundamentals of Fluid Mechanics I (3 Units. LH 30, PH 45)
Properties of Fluids, Fluid statics, Basic conservation laws, friction effects and losses in laminar and turbulent flows in ducts and pipes. Dimensional analysis and dynamic similitude, principles of construction and operation of selected hydraulic machinery, Hydropower systems.

GET 208: Strength of Materials (3 Units: LH 30, PH 45)
Consideration of equilibrium; composite members, stress-strain relation. Generalized Hooke´s Law. Stresses and strains due to lodging and temperature changes. Torsion of circular members. Shear forces, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr´s circle. Elastic buckling of columns. Force equilibrium – free body diagrams. Concept of stress, strain; tensile test. Young's moduli and other strength factors. Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems. Hoop

stresses in cylinders and rings. Bending moment, shear force and axial force diagrams for simple cases, Simple torsion and application.

GET 210: Engineering Mathematics II (3 Units: LH 45)
Second order differential equations, line integral, multiple integral and their applications, differentiation of integral. Analytical functions of complex variables. Transformations and mapping, special functions-

GET 212: Fundamentals of Computer Aided Engineering I (3 Units: LH 30, PH45)
Introduction to computers and computing. Problem solving on Computer algorithms design using flowchart and pseudo-code. Introduction to high level programming languages, C syntax, and flow of control, input/outputs constructs, data types. Programming in C. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

GET 222: Engineering Drawing II (2 Units: LH 15, PH 45)
Cams. Interpretation of solids. Development of surfaces. Detail drawing, Belts, Chain, gears. Bearing and lubrication arrangements, Coupling breaks, Flexibles shafts, Universal joints, etc. Assembly drawings. Revisions.

GET 224: Engineering Communication (2 Units: LH 30)
Professional use of English language for letters, specification descriptions, presentation of charts, graph tables, writing of proposals in reports. Case studies of major engineering designs and construction/fabrication as well as industrial failures; professional presentation of reports and proposals.

ENT 202: Entrepreneurship II (2 Units: LH 15, PH 45)
The work in this course is fully practical. Each group, made up of between six and ten students will be given as seed capital the naira equivalent of $250. Each group will register their business, open a bank account, mobilise additional funds and run the business throughout the semester. At the end of the semester, the business will be officially liquidated, the seed capital returned to EDC and the profit donated to a charity of their choice or used to improve the community around the University. At the very least, each group MUST break even and return the seed capital. A report will be submitted by each group focusing on how they have been able to use entrepreneurial principles learnt in ENT 201 and, more importantly, what they have learnt during their entrepreneurial journey.

GST 204: Peace studies, Conflict Resolution & Ethics (3 Units: LH 30)
Basic Concepts in peace studies and conflict resolution; Peace as vehicle of unity and development; Conflict issues; Types of conflict, e. g. Ethnic/religious/political/ economic conflicts; Root causes of conflicts and violence in Africa; Indigene/settler phenomenon; Peace – building; Management of conflict and security. Elements of peace studies and conflict resolution; Developing a culture of peace; Peace mediation and peace-keeping; Alternative Dispute Resolution (ADR). Dialogue/arbitration in conflict resolution; Role of

international organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

GET 299: Students Industrial Work Experience I (6 Units: 12 weeks)
On the job experience in industry chosen for practical working experience but not necessarily limited to the student´s major (8 weeks during the long vacation following 200 levels). In view of the problems being experienced in the operation of SIWES arising from limited places for meaningful industrial attachment outside the universities, PAU will have to run SWEP I (Students' Work Experience Programme I), involving the in-house exposure of 200-Level students to the use of various workshop tools and machines, electrical works, maintenance and repair of electrical equipment, woodwork, welding practice, etc.

THIRD YEAR, SEMESTER I

EEE 301: Electronic Circuits I (Analogue) (3 Units: LH 30 PH 45)
Semiconductor devices – models, characteristics and applications, small signal amplifiers, Audio amplifiers, class A, AB, B, C, and push-pull design. Operational amplifiers, Feedback amplifiers. Oscillators, power amplifiers, tuned amplifier. Wave shaping sequential circuits, definition, and characteristics and design. Flip flops, memory circuits, and logic families-TTL, ECL, RTL, DTL, LSI, and VLSI digital systems design
Review of single-stage transistor amplifiers using BJTS and EETs Equivalent circuit and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Parameters and applications. Feedback, Broadband and narrowed band amplifies. Power amplifiers. Voltage and current stabilizing circuit. Voltage amplifiers, multi storage amplifier. Using BJTs and FETs

EEE 303: Electric Circuit Theory I (3 Units: LH 45)
Circuit elements, sources, circuit theorems, applications. Network response to steps, ramp, impulse, Network functions, response to exponential, sinusoidal sources. Laplace transform, pole- zero analysis, network synthesis, resonance, two-point analysis, ladder network, Star-Delta transformation.

EEE 305: Electromagnetic Fields and Waves I (3 Units: LH 45)
Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell's equation (in rectangular co-ordinates and vector-calculus notation): Derivation of Maxwell's equations; electromagnetic potential and waves; Poynting vector; Boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media, Fundamentals of transmission lines, wave-guides and antennae.

EEE 307: Data Communication and Computer Networking (3 Units: LH 45)
Introduction to Data communications. LAN topology, access methods, signalling methods. WAN systems. Protocols: Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Peer-to-peer, Client Server. Client-Server Requirements. Information Network Software. Features and benefits of major recovery mechanisms. Network Operating Systems. Internet protocol, IPv4, IPv6.Internet programming, Intranet. System administration, and security issues.

EEE 309: Physical Electronics (3 Units: LH 45)
Free electron motion in static electric and magnetic fields, electronic structure of matter. Conductivity in crystalline solids. Theory of energy bands in conductors, insulators and semiconductors. Electron in metals; carriers and transport phenomenon in semi-conductors. Characteristics of some electron and photo-devices, junction diodes, transistors, FETs and SCR, vacuum tubes, photo resistors, diodes, transistors, photo-cell and light emitting diode. Elementary discrete devices and fabrication techniques and technology.

EEE 320: Laboratory Practicals I (2 Units: PH 90)
Laboratory investigations and report submission for selected experiments and prescribed project drawnfrom first semester courses.

GET 301: Engineering Mathematics III (3 Units: LH 45)
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 integral of Vectors, The gradient of Scalar quantities. Flux of Vectors, The curl of a Vector Fields. Gauss, Greens and Stokes' Theorems an 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 303: Engineer in Society & Professional Ethics (2 Units: LH 30)
Philosophy of Science and Engineering. History of Engineering and Technology. The engineering profession – engineering - engineering literacy professional bodies and engineering societies. Engineers' conduct and ethics. Engineers and nation building – economics, politics, business, safety in Engineering and introduction in Risk analysis. Invited lectures of professionals.

GST 303: Nigerian Peoples and Culture (2 Units, LH 30)
Study of Nigerian history, culture and arts in pre-colonial times; Nigerian's perception of his world; Culture areas of Nigeria and their characteristics; Evolution of Nigeria as a political unit; Indigene/settler phenomenon; Culture is a way of life and persons are defined by the cultures within which they live. An understanding of persons thus requires a

knowledge of their culture. The course studies the ways of life of people in Nigeria. It examines the customs, traditions, beliefs, and values of various groups. While particular emphasis shall be placed on the various cultures found within Nigeria, a survey of the history and culture of people of the great empires of ancient and pre-colonial Africa will be made, together with a study of Africa today and the African image in the contemporary world. Concepts of trade; Economic self-reliance; Social justice; Individual and national development; Norms and values; Negative attitudes and conducts (cultism and related vices); Re-orientation of moral; Environmental problems.

THIRD YEAR, SEMESTER II

EEE 302: Electronic Circuits II (Digital) (3 Units: LH 30 PH 45)
Number Systems and Codes. Boolean algebra and truth table. Switching circuits. Electronic logic gates, basic functional components. Analysis of combinational circuits. Synthesis of combinational logic circuit. Karnaugh maps. K-maps of four or more variables. Simplification of switching functions. Computer-aided minimization of switching functions. Algebraic methods for determining prime implicants. Digital vs. analog systems. Mixed signal design, analogue and digital grounding. Digital system design hierarchy. Logic devices: TTL and CMOS families, technology, applications. Memory devices. Latches, Flip- flops. Modular Design. Decoders. Implementing Logic Functions Using Decoder. Encoder Circuit Structures. Multiplexer circuits. Computer-aided Design of Modular Systems.

EEE 304: Measurements and Instrumentation (3 Units: LH 45)
General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impedance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital volumeters; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generators, function generators, wave

EEE 306: Electrical Machines I (2 Units: LH 30)
Electromechanical energy conversion; emf equations, Synchronous machines, 3-phase alternator, instability, mathematical representation of characteristics, polar diagram. Synchronous motor: construction, characteristics, circuit diagram. Induction motor: construction, characteristics, torque/slip relation, speed control, induction generator, single phase induction motor application.

EEE 308: Applied Computer Programming (2 Units: LH 30)
Software development life cycle. Top-down design. Programme design using pseudo-code, flowchart ANSI symbols and usage. Programming using a structured language such as C:

Symbols keywords, identifiers, data types, operators, various statements, operator precedence, type conversion, conditional and control structures, array, function, recursive functions parameter passing, pointers,structure, and union. File Handling. Software development in C in MS Windows, UNIX/LINUX environments

EEE 310: Linear Systems (3 Units: LH 45)
Mathematical models of physical system. Analogous concepts in electrical, mechanical and thermal systems. Transfer functions. Block diagrams and signal flow graphs. Feedback control system: advantages. Transient response of systems. The root-locus methods. Frequency response of systems. Bode and polar plots. System stability. Bouth and Nyquist criteria. Introduction to analogue computer simulation

EEE 312: Electric Circuit Theory II (3 Units: LH 45)
Networks, Node, Loop Analysis. Non-linear circuit analysis. Network functions, Locus diagrams. Filters; design, operation, low, high, band pass. Butterworth, Chebychev filters. Active network synthesis and analysis.

EEE 314: Electromechanical Systems (3 Units: LH 45)
Magnetic circuits. Basic principles of relays and activators; Ideal transformer. Equivalent circuits and basic analysis of practical transformers. D.C. machine contraction, characteristics of D.C. generators. Excitation of D.C. machines. Torque-speed characteristics of D.C. motors. A.C. machines; production of rotating magnetic fields. Simple theory of three-phase induction motors; torque speed characteristics, three-phase induction motors Single-phase motors-applications. Selection of motors, for practical applications. Synchronous machines

EEE 316: Laboratory Practicals II (2 Units: PH 90)
Laboratory investigations and report submission for selected experiments and prescribed project drawnfrom second semester courses.

GET 302: Engineering Mathematics IV (3 Units: LH 45)
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equation 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 and Mellin and Handel Transforms. Convolution Integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. Runge-Kutta and other methods in the solution of ODE and PDEs. Numerical integration and differentiation.

GET 399: Students Industrial Work Experiences II (SIWES II) (6 Units: 12 weeks)
On the job experience in industry chosen for practical working experience but not necessarily limited to the student´s major (12 weeks during the long vacation following 300 levels)

FOURTH YEAR, SEMESTER I

EEE 401: Electromagnetic Fields and Waves II (3 Units: LH 45)
Propagation of electromagnetic waves in free space and in material media. Dielectric, conductors and ionised media. Transmission line theory including wave-guides and resonator, the Smith charts. Radiating elements and antenna theory.

EEE 403: Principles of Communication Engineering (3 Units: LH 45)
Brief historical development on communications. Block diagram of a communication system. The frequency spectrum. Modulation: Reasons for, types of(analogue/digital). AM systems: DSB, BSBSC, SSB, ISB, VSB and their generation, detection, spectrum, power, applications. FM systems: frequency deviation, modulation index, significant sideband criteria, bandwidth of a sinusoidally modulated FM signal, power of an FM signal, narrowband FM, direct and indirect FM generation, various methods ofFM demodulation: discriminator, phase-locked loop, limiter, pre-emphasis and de-emphasis. Noise waveforms and characteristics. Effect of noise on AM and FM systems. Pulse modulation systems: PAM, PWM, PPM and their generation, detection and applications. Multiplexing techniques: FDM and TDM. Pulse code modulation (PCM). Antenna principle and design. Block diagram of a super heterodyne radio receiver, broadcast band and specification. TV broadcast band and specification. Signal format, transmitter and receiver block diagrams of Black and White TV and Color TV. Introduction to digital broadcasting

EEE 405: Electric Power Principles (3 Units: LH 45)
Types of power station, operation, auxiliaries, economics of operation - stations, substations power supply economics, tariffs, Power factor correction. Polyphase theory. DC, AC power distribution, network calculations. Overhead line conductors. Corona effect, voltage control, circuit breakers, load forecast, sitting of generating plants.
Second phase of investigations involving the implementation of the designed model, debugging, calibration, testing, data collection and analysis, and presentation of a comprehensive written report of the investigations.

EEE 407: Advanced Electronics Circuits (2 Units: LH 30)
Linear I.C. op-amp, linear and non-linear operations, logarithmic amplifiers, A/D and D/A converters, gyrators and negative impedance converters, the 555 timer structure and applications; four-quadrant multipliers, dynamic logic systems and RAM memory circuits, application of digital circuits to instrumentation.

EEE 409: Control Theory **(3 Units: LH 45)**

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

EEE 411: Electrical Machines II **(2 Units: LH 30)**

Energy conversion concepts, DC machines: generators, motors, shunt and series characteristics, design, construction. Transformer: equivalent circuits, design, construction, characteristics, open/short circuit tests, polarity tests. Regulation: Auto-transformers, three-phase transformers. Connections.

EEE 413: Laboratory Practicals III (EEE 403, EEE 407 & EEE 411) **(2 Units: PH 90)**

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

CPE 404: Assembly Language Programming **(2 Units: LH 30)**

Introduction**:** Language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: Programming model as resources available to programmer, addressing modes, instruction format, instruction set-arithmetic directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C. Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola

GET 401: Cost Engineering **(2 Units LH 30)**

Cost and schedule management- an engineering function. Supporting skills and knowledge. Role of cost engineer during evaluation phase. Role of cost engineer during the basic design phase. Role of cost engineer in contractor selection. Role of cost engineer during detailed engineering design phase. Role of cost engineer during construction. Cost engineering function as distinct from Design engineering function. Canon of ethics for cost engineers. Basic capital cost estimating. Basic operating cost estimating. Basic project planning and scheduling. Cost engineering terminology. Cost engineering standards.

GET 403: Engineering Economics **(3 Units: LH 45)**

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. Minimum acceptable rate of return. Judging attractiveness of proposed investment

FOURTH YEAR, SEMESTER II

GET 499: SIWES III (6 Units 24 weeks)
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 First semester at 400 levels to the beginning of the First Semester of the following session. Thus the second semester at 400-level is spent in industry.)

FIFTH YEAR, SEMESTER I

EEE 501: Reliability Engineering (2 Units: LH 30)
Introduction to reliability, maintainability and metrics. Application to computer hardware systems, communication equipment, power systems, electronic components. Basic maintenance types. Fault troubleshooting techniques. QoS and time of availability of data communication. Quality control techniques. Design for higher reliability, fault tolerance. Software Reliability: specification, and metrics. Programming for reliability, software safety and hazard analysis. Comparison of hardware and software reliability. Software Quality and Assurance. Software quality metrics. Ensuring Quality and Reliability: verification and validation, measurement tracking and feedback mechanism, total quality management, risk management

EEE 505: Advanced Circuit Techniques (3 Units: LH 30 PH 45)
Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops, Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g. PSPICE, Electronic workbench, Visio technical etc. should be encouraged.

EEE 507: Electromechanical Devices Design (2 Units: LH 30)
Design of transformers, principles of AC and DC machine design, introduction to parks equations

EEE 509: Design of Electrical & ICT Services (3 Units: LH 45)
Basic electrical installations. Distribution system. Regulation-IEE, NSE, Nigeria standard. Illumination. Cables-types, ratings, wiring systems, earth protection. Auxiliary electrical system-fire alarm, telephone, elevator circuit. Design of electrical Installation-Domestic, industrial, commercial air-conditioning. Telecommunication Design & Installation: Telephone, PABX, cables, cablings, trucking, calculations, etc. Computer Networking: Design, Calculations, topology, cables, cabling, etc. Satellite and VSAT installation. Surge and lighting protections. Earthing: earth resistivity measurement, surge and lighting equipment selection and installation. Contract proposal and document preparation. Costing and preparation of BEME. Basic Law of Contract. Commissioning.Environmental Impact Assessment (EIA)

EEE 511: Advanced Computer Programming and Statistics (2 Units: LH 15; PH 45)
Elements of statistics; Distribution and experiments; law of large number, numerical iteration procedures; revision of FORTRAN IV and BASIC Application program in computer aided design of Electrical systems.

EEE 513: Use of Engineering Software Packages (2 Units: LH 30)
Introduction to MATLAB and their engineering applications. Introduction to AUTOCAD and their engineering applications. Introduction to simulation packages

MCT 501: Automation and Robotics - *Process Automation* (3 Units: LH 30 PH 45)
Introduction to automation: Economics of Automation, Flow Lines, Mathematical Models, Storage Buffers, Partial Automation, Balancing, Group Technology and Flexible Manufacturing. Programmable Logic Controllers Introduction to PLCs, Advantages of PLCs, Ladder Logic Diagrams, Switching Logic. Components of PLC, PLC Operating Cycle, Additional Capabilities of a PLC, Latches, Design Cases (Deadman Switches, Conveyor, Accept/Reject Sorting), Addressing. PLC connection, PLC operation, Numbering, Event based logic, sequential logic design, Advanced ladder logic functions. PLC Programming, Structured text programming, Instruction list programming, Function block programming, Continuous control, PLC data communication, Human Machine Interfaces (HMI). Selecting a PLC.

GET 501: Engineering Management (3 Units: LH 45)
Principles of Organization; 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.

FIFTH YEAR, SEMESTER II

EEE 502: Power Electronics (3 Units: LH 45)
Rectification and smoothing techniques. Voltage and current regulation, regulator circuits, the thyristor or SCR and its applications, timing circuits, motor speed control, power translator and integrated circuits, welding and heating.

EEE 504: Control Engineering (3 Units: LH45)
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realization of systems having specified transfer function, applications to circuit synthesis and signal processing.

EEE 506: Digital Signal Processing (3 Units: LH 45)
Overview of signals, systems and signal processing; concepts of discrete-time signal processing and systems necessary for the design and analysis of advanced signal processing technology. Types and selection of ADC/DAC, sampling theorem, aliasing, quantization, noise and coding. Analysis and application of discrete-time signals and systems in transform z-domain: z-transform, properties, transfer stability, causality and difference equations. Discrete Fourier analysis and FFT. Digital time signals and systems, DTFT and IDTFT. Digital filters: definitions and types, structure and design, FIR and HR filters. Software implementation of DSP algorithms. DSP microprocessors: architecture, fixed point and floating point DSP; signal segmentation effect, DSP chips. Practical application of DSP in audio and video.

EEE 599: Final Year Project (6 Units: LH 270)
This course lasts for one academic session. 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.

GET 502: Engineering Law (3 Units: LH 45)
Common law: Its history, definition, nature and division. Legislation, codification, interpretation. Equity: Definition and its main spheres. Law of contracts for Engineers: offer, acceptance, communication, termination. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents, requirements, application and infringements. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law.

GET 504: Engineering Valuation/Appraisal (2 Units: LH 30)
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.

GROUPS OF ELECTIVES (up to 5 credits)

A. COMPUTING & CONTROL ENGINEERING OPTION

EEE 516: Digital System Design & VHDL Programming (2 Units: LH 30)
Finite State Machine. Sequential circuits design. Structured Design: Design constructs, Design levels, Geometry-based interchange formats, Computer aided electronic system design tools, Schematic circuit capture, Hardware description languages, Design process. Introduction to VHDL: language, design. Concurrent VHDL, Sequential VHDL, Advanced features of VHDL. Structural level modeling, Register-Transfer level modeling, FSM with datapath level modeling, Algorithmic level modeling. Introduction of ASIC, FPGA Design. Paradigm, FPGA synthesis, FPGA/CPLD Architectures. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer-aided design of logic circuits.

EEE 518: Digital Computer Networks (2 Units: LH 30)
Communication within computer systems: addressing and databases. CPU - memory - I/O device communications. Communication between systems: host/host versus host/slave relationships, handshaking protocols and synchronization. Serial versus parallel communications. Hardware elements of network design - terminals, modems, multiplexors, and concentrators. Message and control processors. Communication equipment and carriers. Software elements of computer networks: host operating systems. Message and packet switching. Structure of computer networks: star, ring, and hierarchical networks. Decentralized networks.

EEE 504: Modern Control Engineering (3 Units: LH 45)
Digital control; concept of sampling, Z-transform, inverse zero-order- hold, stability analysis. State variables of dynamic system, formulation of state vector differential equation, solution state equation, transition matrix, eigenvalues and eigenvectors. System response and stability. Finite word length effect. Digital 3-term PID design. Introduction to Neural Network. Introduction to fuzzy control system. Introduction to mechatronics and robotics

B. POWER & MACHINES OPTION

EEE 530: Electric Power Systems Engineering (3 Units: LH 45)
Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

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EEE 532: Switchgear and High Voltage Engineering (2 Units: LH 30)
Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightening protection, Electric cables and condensers.

EEE 504: Modern Control Engineering (3 Units: LH 45)
Digital control; concept of sampling, Z-transform, inverse zero-order- hold, stability analysis. State variables of dynamic system, formulation of state vector differential equation, solution state equation, transition matrix, eigenvalues and eigenvectors. System response and stability. Finite word length effect. Digital 3-term PID design. Introduction to Neural Network. Introduction to fuzzy control system. Introduction to mechatronics and robotics.