

**GODFREY OKOYE UNIVERSITY
ENUGU, ENUGU STATE, NIGERIA**

www.gouni.edu.ng



B.SC. PHYSICS

Student Handbook

2023 – 2028

Course Contents

Overview

The B.Sc. Physics degree program is design to provide basic foundation of Physics in the first and second year through courses covering classical physics, electricity and magnetism, waves and optics, dynamics, thermodynamics, modern physics, computer literacy, and special theory of relativity, as well as underlining mathematical concepts that underpin a better understanding of the courses. The scope of energy and environment as well as weather and space science had been widened in line with the global concern on sustainable development. A new course on workshop practice had been introduced to provide the students with a flavour of engineering design and electronic instrumentation.

The third-year courses of the program build on the basic foundations and cover the transition between classical and quantum physics including electromagnetic waves, electromagnetism, statistical physics, and the student industrial work experience scheme design to compliment the theory learned in the classroom and practical applications and experience of the industries. The diverse topics covered as taught courses will be complimented during each year by laboratory practical's that enable the students understand and appreciate the principles, theorems, and laws in physics.

The fourth-year courses of the program are designed to provide further mathematical knowledge that buttress the applications of quantum mechanics, nuclear physics, and of special mathematical functions in physics. A range of diverse modern courses have been introduced to enable the students choose from various fields of specialization in physics as well as to carry out a scientific research project.

Philosophy

The philosophy of the programme is to provide supportive learning environment for the training of students in both theoretical knowledge and experimental skills in physics, ready and capable for further academic pursuit, research, or work in all relevant fields for human development.

Objectives

The objectives of the programme are to;

1. provide students with a broad and balanced foundation of physics knowledge and practical skills;
2. instil in students a sense of enthusiasm for physics, and appreciation of its applications in different contexts;
3. instil in students a culture of creativity and critical thinking that will enable them to seek solutions to problems;
4. involve the students in intellectually stimulating and satisfying experience in knowledge pursuit;
5. develop in students the ability to apply their knowledge and skills in Physics to the solution of theoretical and practical problems;

Course Contents

6. develop in students through an education in Physics a range of transferable skills of value in physics and other areas; and
7. provide students with a knowledge and skills base for further studies in Physics or multidisciplinary areas involving physics.

Unique Features of the Programme

The blend of courses in this revised curriculum are meant to provide:

1. topics that cover modern areas of research and developments in physics in tune with best practices of globally top rated universities;
2. course structures that are also designed in such a way to prepare the students towards multidisciplinary advanced studies.;
3. a course on workshop practices which is intended to expose the students to instrumentation and engineering design that will enable them produce simple instruments for either training and or research; and
4. a course on entrepreneurship for physicist which is also intended to provide the students with the required skills for innovation and job creation.

Employability Skills

The range of courses to be covered in the program are intended to prepare and equip the student's with the necessary and relevant theoretical knowledge and practical skills that are required of a physicist in;

1. Foresight
2. Resourcefulness
3. Planning
4. Organization
5. Time management
6. Design and execution of local and global challenges with solutions that are multidimensional and with professionalism.

21st Century Skills

1. Creativity
2. Communication and IT
3. Design and Construction
4. Planning and Experimentation
5. Innovation and Entrepreneurship

Admission and Graduation Requirements

Admission Requirements

Candidates can be admitted into the programme through either the indirect-entry mode or direct entry (DE).

Indirect -entry mode

The entry requirements shall be at least credit level passes in five subjects including English language, mathematics, physics and chemistry to form the core subjects with credit in one other relevant science subject at the senior secondary certificate

Course Contents

(SSC) or its equivalent. In addition, an acceptable pass in the unified tertiary matriculation examination (UTME) is required for admission into 100-level

Direct entry (DE)

Candidates with two passes (graded A-E) at the advanced level in physics and one of two relevant subjects (chemistry, and mathematics) may be admitted into 200-level.

Graduation Requirements

Candidates admitted into the 100 level of the 4-year program are required to pass a minimum of 120 prescribed credits (comprising of the faculty courses MTH 101, 102, and COS 101 and all core courses) to be eligible for graduation while candidates admitted into the 100 level of the 5-year program are required to pass a minimum of 150 prescribed credits. Direct entry candidates admitted into 200 level of the 4-year program are required to pass a minimum of 90 prescribed credits to be eligible for graduation. Candidates admitted into 200 level of the 5-year program are required to pass a minimum of 120 credits before graduation.

Global Course Structure

A: Four (4) Year B.Sc. Physics program

100 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
COS 101	Introduction to Computer Science	3	C	30	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 104	General Physics IV	2	C	30	-
PHY 107	General Physics Practical I	1	C	-	45
PHY 108	General Physics Practical II	1	C	-	45
GOU-PHY 161	MATHCAD	2	Compulsory	15	45
GOU-PHY 111	General Chemistry for Physics	2	Compulsory	30	0
GOU-PHY 131	General Biology for Physics	2	Compulsory	15	45
	TOTAL	27			

Course Contents

200 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	15	45
PHY 201	General Physics V (Modern Physics)	2	C	30	-
PHY 202	Introduction to Electric Circuits & Electronics	2	C	30	-
PHY 204	General Physics VI (Waves and Optics)	2	C	30	-
PHY 205	Thermal Physics	2	C	30	-
PHY 206	General Physics VII (Energy & Environment)	2	C	30	-
PHY 207	General Physics Practical	1	C	-	45
PHY 208	General Physics Practical	1	C	-	45
Course Code	Course Title	Unit(s)	Status	LH	PH
PHY 211	Workshop Practice	2	C	15	45
GOU-PHY 201	Principles of Meteorology and Climatology	2	Compulsory	15	45
GOU-PHY 203	Satellite Communications	2	Compulsory	15	45
GOU-PHY 223	Computer Programming for Physics I	3	Compulsory	30	45
GOU-PHY 225	Atmospheric Physics	2	Compulsory	15	45
GOU-PHY 231	Design Engines	2	Elective	15	45
GOU-PHY 235	Welding and Fabrication	2	Compulsory	15	45
GOU-PHY 251	Radar Physics	2	Compulsory	15	45
GOU-PHY 264	Semiconductor Technology	2	Compulsory	15	45
	TOTAL	35			

300 Level

Course Contents

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 312	Peace and Conflict Resolutions	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
PHY 301	Analytical Mechanics I	2	C	30	-
PHY 303	Electromagnetism	3	C	45	-
PHY 304	Electromagnetic Waves and Optics	3	C	45	-
PHY 305	Quantum Physics	3	C	45	-
PHY 306	Statistical and Thermal Physics	2	C	30	-
PHY 307	General Physics Practical V	1	C	-	45
PHY 308	General Physics Practical VI	1	C	-	45
PHY 318	Semiconductor Devices	3	C	45	-
PHY 399	Industrial Attachment II (12 Weeks)	3	C		
GOU-PHY 324	Computer Programming for Physics II	3	Compulsory	15	45
GOU-PHY 371	Robotic System	2	Compulsory	15	45
GOU-PHY 383	Applied Geophysics	2	Compulsory	15	45
	TOTAL	32			

400 Level

Course Code	Course Title	Units	Status	LH	PH
PHY 401	Quantum Mechanics I	3	C	45	-
PHY 402	Quantum Physics II	3	C	45	-
PHY 403	Mathematical Methods in Physics I	3	C	45	-
PHY 404	Mathematical Methods in Physics II	3	C	45	-
PHY 405	Physics Entrepreneurship	2	C	30	-
PHY 455	Research Project	6	C	-	270
GOU-PHY 416	Borehole Geophysics	2	Elective	15	45
GOU-PHY 434	Environmental Physics	2	Compulsory	15	45

Course Contents

GOU-PHY 496	Thin Film Technology	2	Compulsory	15	45
	TOTAL	26			

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

Sound patterns in English Language (vowels and consonants, phonetics, and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple, and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and critical thinking and reasoning methods (logic and syllogism, inductive and deductive argument and reasoning methods, analogy, generalisation and explanations). Ethical considerations, copyright rules, and infringements. Writing activities: (pre-writing, writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing). Types of writing: summary, essays, letter, curriculum vitae, report writing, note making etc. Mechanics of writing. Comprehension Strategies: (reading and types of reading, comprehension skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

GST 112: Nigerian peoples and culture

(2 Units C: LH 30)

Learning Outcomes

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

1. analyse the historical foundation of the Nigerian culture and arts in pre-colonial times;
2. list and identify the major linguistic groups in Nigeria;

Course Contents

3. explain the gradual evolution of Nigeria as a political unit;
4. analyse the concepts of Trade, Economic and Self-reliance status of the Nigerian peoples towards national development;
5. enumerate the challenges of the Nigerian State towards Nation building;
6. analyse the role of the Judiciary in upholding people's fundamental rights;
7. identify acceptable norms and values of the major ethnic groups in Nigeria; and
8. list and suggest 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 culture, peoples and culture of the ethnic minority 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). Concept of trade and economics of self-reliance (indigenous trade and market system, indigenous apprenticeship system among Nigeria people, trade, skill acquisition and selfreliance). Social justices and national development (law definition and classification). Judiciary and fundamental human rights. Individual, norms, and values (basic Nigeria 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 3R's – reconstruction, rehabilitation and re-orientation strategies, operation feed the nation (OFN), green revolution, austerity measures, war against indiscipline (WAI), 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).

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. explain the basic definition of set, subset, union, intersection, complements and use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify and use 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,

Course Contents

real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand diagram. De-Moivre'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 of differentiation and integration;
2. describe the meaning of function of a real variable, graphs, limits and continuity and their applications; and
3. solve some applications of definite integrals in areas and volumes.

Course Contents

Function of a real variable (graphs, limits, and idea of continuity). The derivative as limit of rate of change. Techniques of differentiation. Extreme curve sketching. Integration as an inverse of differentiation. Methods of integration. Definite integrals (application to areas and volumes).

COS 101: Introduction to Computing Sciences

(3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. explain basic components of computers and other computing devices;
2. describe the various applications of computers;
3. explain information processing and its roles in the society;
4. describe the Internet, its various applications and its impact;
5. explain the different areas of the computing discipline and its specializations; and
6. demonstrate practical skills on using computers and the internet.

Course Contents

Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

Lab Work: Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly

Course Contents

used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smartboards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

PHY 101: General Physics I (Mechanics)

(2 Units C: LH 30)

Learning Outcome

At the end of the course, 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 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). Coordinate systems. 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 (Electricity & Magnetism)

(2 Units C: LH 30)

Learning Outcomes

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

1. describe the electric field and potential, and related concepts, for stationary charges;
2. calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law, and electric potential;
3. describe and determine the magnetic field for steady and moving charges;

Course Contents

4. determine the magnetic properties of simple current distributions using Biot-Savart and Ampere's law;
5. describe electromagnetic induction and related concepts and make calculations using Faraday and Lenz's laws;
6. explain the basic physical of Maxwell's equations in integral form;
7. evaluate DC circuits to determine the electrical parameters; and
8. determine the characteristics of ac voltages and currents in resistors, capacitors, and Inductors.

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.

PHY 103: General physics III (Behaviour of Matter)

(2 Units C: LH 30)

Learning Outcomes

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

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

Course Contents

Heat and temperature (temperature scales). Gas laws. General gas equation. Thermal conductivity. First Law of thermodynamics (heat, work and internal energy, reversibility). Thermodynamic processes (adiabatic, isothermal, isobaric). Second law of thermodynamics (heat engines and entropy). Zero's law of thermodynamics. Kinetic theory of gases. Molecular collisions and mean free path. Elasticity (Hooke's law, Young's, shear and bulk moduli). Hydrostatics (Pressure, buoyancy, Archimedes' principles). Bernoulli's equation and incompressible fluid flow. Surface tension (adhesion, cohesion, viscosity, capillarity, drops and bubbles).

Course Contents

PHY 104: General Physics IV (Vibration Waves and Optics)

(2 Units C: LH 30)

Learning Outcomes

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

1. describe and quantitatively analyse the behaviour of vibrating systems and wave energy;
2. explain the propagation and properties of waves in sound and light;
3. identify and apply the wave equations; and
4. explain geometrical optics and principles of optical instruments.

Course Contents

Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. 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).

PHY 107: General Practical Physics I

(1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students 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.

Course Contents

PHY 108: General Practical Physics II

(1Unit C: PH 45)

Learning Outcomes

At the end of the course, students 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.

GOU-PHY 161: MATHCAD (2 Units; compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

MATHCAD is a software for the verification, validation, documentation and re-use of mathematical calculations in science and engineering. This course is developed to ensure solid educational experiences are encountered by the students in that the students will acquire in-depth knowledge and skill sets of MATHCAD for personal use, and training of others. The students will use MATHCAD software to do complex numerical calculation, modeling and visualization. This is in agreement with GOU's mission and vision to empower their graduates with skills to be outstandingly excellent in character and learning in order to be competitive for labour market. Furthermore, this course is fashioned in line with the philosophy of Godfrey Okoye University towards producing Physics graduates who will advance their career in mathematical design, modeling, simulation and programming of physical processes/mechanisms.

Overview

MATHCAD introduces live editing of typeset mathematical notation in an interactive notebook, combined with automatic computations. Physical equations and expressions are created and manipulated in the same graphical format in which they are presented. MATHCAD

Course Contents

helps Physicist to solve complex equations quickly and easily, built-in solvers that can handle systems of linear and nonlinear equations, as well as differential equations, handles numerical analysis tasks such as interpolation, differentiation, and integration.

Students would use their acquired knowledge and skillsets to solve and manipulate complex equations, do statistical analysis, such as regression analysis and curve fitting, data visualization, unit conversion and symbolic manipulation, as well as carryout mathematical modeling.

Objectives

The objectives of this course are to:

1. Define MATHCAD as a computational tool.
2. Describe the applications of MATHCAD in Physics.
3. Explain examples of simulations achieved by MATHCAD.
4. Explain the processes involved in installing MATHCAD software.
5. State the system requirements for MATHCAD software to function well.
6. State the advantages of using MATHCAD software above other mathematical analyzing tools.
7. Describe how to present a 3D simulation using MATHCAD.
8. Identify the processes involved in solving complex mathematical equations, using MATHCAD.
9. Perform calculations of both numerical and symbolic expressions using MATHCAD.

Learning outcomes

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

1. Discuss at least two innovative ideas and skills in representing physics equations.
2. Install MATHCAD software for their use and also install it for public use for a fee.
3. Identify and describe the sections and compositions of MATHCAD software and their uses.
4. Explain logically the existence of physical equations.
5. Skillfully manipulate scientific and engineering tools for analyzing difficult equations.
6. Analyze at least ten (10) complex physical equations in classical and quantum physics easily.
7. Plot graphs of advanced physical equations.

Course Contents

Course Contents

Introduction. MATHCAD basics. Getting started with MATHCAD. Online resources. Creating a MATHCAD worksheet. Working with Math graphics and other objects. Worksheet management. Computational features. Management and data array. 2-D and 3-D plots. Symbolic calculations. Programme advanced. Experiment on project motion. Application to statistical physics and thermal physics. Analysis of energy consumption in buildings and designing energy-efficient structures. Sustainable Cities and Communities. Design and optimization of sustainable transportation systems using MATHCAD. Mathematical modeling of ecosystem dynamics and conservation biology. Life below water and life on Land. Analysis of carbon capture and storage technologies for mitigating greenhouse gas emissions.

Minimum Academic Standards

Mathcad Software. Computer programming workshop with NUC-MAS requirements facilities. Mathcad Prime, maple and havac equipment.

Course Contents

GOU-PHY 111: General Chemistry for Physics (2 Units; Compulsory; LH = 30; PH= 0)

Senate -Approved Relevance

Knowledge of physical chemistry is very vital for Physics with Electronics students to hone their skill sets on chemical reactions involved in fabrication of electronic devices in micro- and nano-scales respectively. Chemistry is the fundamental knowledge of atoms, elements, compounds, and their interaction in an environment. Physics, Electronics, Micro-electronics, Nanoscience & Technology are the brain behind the disruptive technologies in the present state-of-art-facilities deployed in achieving high-level imaging in hospital, industries, space, and oil and gas sectors as well as other life science sectors. Therefore, fabrication/manufacturing of electronics devices/chips in micro- and nano-scales and gradually shifting to pico-scale are the new paradigm in the disruptive technologies deployed for diverse applications/usage. This aligns with Godfrey Okoye University's mission to empower their graduates with skills for the labour market.

Overview

GOU-PHY 111 intend to acquaint the Physics with Electronics students with basic knowledge of atom, element and compounds and their interactions via electrovalent, covalent, and other chemical bonding. GOU-PHY 111 utilize the Periodic Table to teach the students the arrangement of atoms and their valency electrons. Electronic configuration of elements in Periodic Table, and identification of characteristics of acids, bases, and salts and knowledge of chemicals reactions between these substances are prerequisites for Thin Film technology in micro-and nano-scales.

Chemistry is highly relevant in the study of physics because it provides a fundamental understanding of the behavior of matter and its interactions. Physicists use the knowledge of chemistry to explain the behavior of atoms and molecules, and to understand the chemical reactions that occur between them. Some specific areas where chemistry is relevant to physicists includes Atomic and molecular physics, Materials science, nuclear physics, etc. Overall, chemistry provides a crucial foundation for many areas of physics, and the two fields are closely intertwined. Many of the most important scientific discoveries in history have been the result of collaborations between physicists and chemists.

Course Contents

Objectives

The objectives of this course are to:

1. Explain chemical bonding between an atom/elements.
2. Discuss modern electronic theory of atoms.
3. Write electronic configurations of elements in the Periodic Table.
4. Identify and balance oxidation – reduction reactions.
5. State LeChatelier's principle and apply it to solving problems.
6. Analyze and perform calculations on the thermodynamic variables.

Learning Outcomes

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

1. Define atom, molecules and explain chemical bonding between atoms/elements.
2. Discuss the Modern electronic theory of atoms.
3. Write electronic configurations of elements in the periodic table.
4. Justify the trends of atomic radii, ionization energies, electronegativity of the elements based on their position in the periodic table.
5. Identify and balance oxidation – reduction equation and solve redox titration problems.
6. Illustrate shapes of simple molecules and hybridized orbitals.
7. Identify at least four characteristics of acids, bases and salts, and solve problems based on their quantitative relationship.
8. Apply the principle of equilibrium to aqueous systems using LeChatelier's principle.

Course Contents

Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration. Periodicity and building up of the periodic table. Hybridization. Shapes of simple molecules. Valence Forces and structure of solids. Chemical equations and stoichiometry. Chemical bonding and intermolecular forces. Kinetic theory of matter. Elementary thermochemistry. Rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions. Electrochemistry. Radioactivity.

Minimum Academic Standards

Chemistry laboratory with NUC-MAS requirements and facilities.

Course Contents

GOU-PHY 131: General Biology for Physics (2 Units; Compulsory; LH = 30; PH = 0)

Senate -Approved Relevance

This course exposes students to the basic knowledge of living organism especially the Homo sapiens. Physics students would be acquainted with the basic knowledge of Biology, function and organizations of cells and cell structure that make tissue and organs, etc. With the knowledge of GOU-BIO 131, Physics students would be acquainted with the prerequisite knowledge and skill sets required for career advancement and inter-disciplines research; Medical physics, Biophysics, Health, Bioelectronics, Biomedical engineering, etc,. This is in agreement with Godfrey Okoye University's mission and vision to produce graduates who are empowered with epistemic knowledge in all its ramifications.

Overview

Biology and Physics are two distinct fields of science, but they are interconnected in several ways. While Physics provides the fundamental principles that govern the behavior of matter and energy, biology examines the structure, function and evolution of living organisms. The study of Biology is aided by the exposition of the physical principles that underlie biological phenomena.

This course is important for students of Physics because it provides a framework for understanding the physical principles that underlie biological phenomena. The students will use the acquired knowledge and skill sets for further study and career advancement.

Objectives

The objectives of this course are to:

1. Explain cell, cell structure, and organizations of cell.
2. Explain tissue and organs of living organism.
3. Classify living organism.
4. Describe the characteristics of living organism especially the Homo sapiens.
5. Describe the concept of cell evolution and heredity.
6. Describe the interrelationship between living organisms.
7. Enumerate the habitats of living organisms.

Learning Outcomes

Course Contents

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

1. Explain cells structures and organizations.
2. Describe five functions of cellular organelles.
3. Explain ten characteristics of living organisms.
4. Describe the interrelationship that exists between living organisms.
5. Discuss the concept of heredity and evolution.
6. Enumerate all habitat types and their characteristics.
7. Discuss genetic engineering.

Course Contents

Cell structure and organization. Functions of cellular organelles. Characteristics and classification of living things. Chromosomes and genes; their relationships and importance. General reproduction. Interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat. Human Anatomy and Physiology. The structure and function of the human body. Nervous system. Cardiovascular system. Respiratory system. Digestive system. Endocrine system. Ethics and Biotechnology: The ethical considerations of genetic engineering. Stem cell research, and other biotechnological advancements.

Minimum Academic Standards

Biology laboratory with NUC-MAS requirements and facilities.

200 Level

GST 212: Philosophy, Logic and Human Existence

(2 Units C: LH 30)

Learning Outcomes

A student who has successfully gone through this course should be able to:

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

Course Contents

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, etc.

ENT 211: Entrepreneurship and Innovation

(2 Units C: LH 15; PH 45)

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, and financial independence; and
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe stages in enterprise formation, partnership and networking including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa, and the rest of the world.
8. state the basic principles of e-commerce.

Course Contents

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 deduction. 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 (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 forming alliances and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational

Course Contents

entrepreneurs, youth and women entrepreneurship. Entrepreneurship support institutions. Youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

PHY 201: General physics IV (Elementary Modern Physics) (2 Units C: LH 30)

Learning Outcomes

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

1. explain the notion of an inertial frame and the concept of an observer;
2. relate the limitations imposed by and consequences of motion of bodies at the speed of light;
3. state the principles of Special Relativity and use them to derive relations for time dilation and length contraction;
4. perform calculations using the Lorentz transformation formulae;
5. derive relativistic energy and momentum and use these to solve problems in mechanics;
6. apply the mathematical treatment of the wave function and Schrodinger's equation;
7. relate the atomic structure and energy associated with the particles of the atom;
8. apply the ideas of a wave-particle duality and the uncertainty principle to solve problems in quantum mechanics;
9. apply the Bohr formula to calculate energies and wavelengths in the context of atomic hydrogen; and
10. explain the interaction of photons and electrons with matter.

Course Contents

Defects in Newtonian Mechanics. Galilean relativity. The speed of light. Inertial frames and the concept of an observer. The principles of Einstein's Special Theory of Relativity. Lorentz transformation. Time dilation and length contraction. Transformation of velocities. Doppler effect. Relativistic energy and momentum. Basic properties of atoms and molecules. Experimental basis of quantum theory. Electrons and quanta. Bohr's theory of atomic structure. Energy levels and spectra. De Broglie hypothesis. The uncertainty principle. Black body radiation. The momentum operator. Time-independent Schrödinger equation. The infinite square well. Simple applications in particle and nuclear physics. Compton effect. Thermionic emission. Radioactivity. Detection and measurement of charged particles (including the treatment of detectors). X-rays.

PHY 202: Introduction to Electric Circuits and Electronics (2 Units C: LH 30)

Learning Outcomes

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

1. identify circuit diagrams and symbols;

Course Contents

2. determine current flows, potential drops, power, and energy dissipation in circuits using Ohm's law;
3. simplify series and parallel combinations of resistors;
4. state Kirchhoff's laws and apply same in solving for currents and voltages in dc. and ac. circuits;
5. apply potential divider and current divider techniques in calculating circuit potential differences and branch currents;
6. state and apply circuit theorems and principles to solve problems;
7. apply the Mesh currents and Node – Voltage methods in network analysis;
8. discuss the nature of ac. currents and voltages in resistors, inductors, capacitors and determine impedances;
9. analyse a.c. circuits using phasor diagrams;
10. determine power, Q-factor, and resonance in ac. circuits;
11. explain the principle of the transformer and applications;
12. distinguish between conductors, semiconductors, and insulators and explain crystal and band structure;
13. identify semiconductor devices and explain their principle of operation;
14. explain the current – voltage characteristics of semiconductor devices; and
15. explain the function of semiconductor devices (diodes, transistors etc.)

Course Contents

D.C. Circuits. Sources of emf and current. Resistor combinations. Kirchhoff's Laws. Network analysis and circuit theorems. Mesh currents method, Node-voltage, Thevenin and Norton theorem, superposition principle. A.C. Circuits. Sinusoidal wave-forms. RMS and peak values. Power. Resistance, inductance and capacitance in a.c. circuits. Impedance and admittance. Series and parallel RLC circuits. Q factor. Resonance. The transformer. Electronics: filters. Amplification and the transistor. Bipolar junction and field effect transistors. Equivalent circuits. Amplifiers. Feedback. Oscillators. Signal generators. Semiconductors (devices and characteristics). The pnjunction. Simple diodes. Photodiodes. LEDs.

PHY 204: General Physics V (Waves and optics)

(2 Units C: LH 30)

Learning Outcomes

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

1. describe the wave phenomena and explain the nature and properties of waves;
2. explain wave propagation in different media;
3. describe geometric optics and image formation;
4. analyse simple examples of interference and diffraction phenomena;
5. identify and explain functions of optical devices;
6. explain the principles of optical instruments and applications; 7. explain the principles of operation of the Michelson interferometer;
8. describe the polarization states of light.

Course Contents

Course Contents

Wave phenomena (types and properties of waves). SHM. Harmonic oscillator. Waves on a string. Energy in wave motion. Longitudinal waves. Standing waves. Acoustical waves. Group and phase velocities. Doppler effects. Physical Optics: Spherical waves. Interference. Superposition. Young's slits. Single and double slits. Multiple slits. The Michelson interferometer. Diffraction. The diffraction grating and spectrometers. Thin films. Dispersion and scattering. Echo and beats. Sound in gases, liquids, and solids. Geometrical optics (waves and rays). Reflection at plane and spherical surfaces. Refraction. Thin lenses. Prism. Optical lenses and optical instruments e.g., microscopes, telescopes, etc. Lens maker's formula. Polarization and polarization states. Unpolarised and partially polarized light. Brewster's angle. Polarizing beam splitters. Photometry and light spectrum analysis.

PHY 205: Thermal Physics

(2 Units C: LH 30)

Learning Outcomes

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

1. discuss the concept of heat and temperature;
2. explain and determine thermodynamic processes;
3. explain and evaluate properties of real and ideal gases;
4. evaluate the consequences of the thermodynamic laws;
5. describe the basis of the kinetic theory; and
6. describe the statistical behaviour of gases with applications.

Course Contents

The foundations of classical thermodynamics including the definition of temperature. The first law. Work, heat and internal energy. The second law. Carnot cycles and Carnot engines. Zeroth law. Entropy and irreversibility. Thermodynamic potentials and the Maxwell relations. Ideal gas equation. Internal energy and internal molecular modes. Qualitative discussion of phase transitions. Gibbs free energy. Clausius-Clapeyron equation. Examples of phase transitions. Van der Waals gas. Kinetic theory. Mean free path. Equipartition of energy. Heat transfer. Diffusion rate.

PHY 206: General Physics VI (Energy and Environment)

(2 Unit C: LH 30)

Learning Outcomes

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

1. explain the origin and sources of energy and power;
2. describe the inter relation and transformation of energy sources and types;
3. illustrate and explain the principles of generation of power;
4. outline the concept of energy demand and supply;
5. explain the economics, politics and problems associated with energy demand and supply;
6. identify and assess categories of environmental pollutants;
7. describe effect of carbon emission on global warming;

Course Contents

8. describe the environmental effect of energy generation, supply, and consumption;
- and 9. identify and evaluate the merits and demerits of power generation from different sources.

Course Contents

Energy sources and climate impacts. Energy requirements and consumption. Energy processing and conversion. Energy units and pricing. The greenhouse effect. Biological forms of energy (fossil fuels and biofuels). Basic nuclear physics. The atom, radioactivity and decay laws. Interaction of radiation with matter. Nuclear fission principles and energetics. Chain reaction and dynamics. Reactor types and control. Current status of nuclear fission as a power source. Nuclear fusion principles and energetics. (Examples in stars and on earth). Thermonuclear fusion. Nuclear fuels. Ignition and the Lawson criterion. Magnetic and inertial confinement. Current status of nuclear fusion as a power source. Stellar fusion. Proton-proton chain and CNO cycle. Solar power technologies. Solar thermal. Solar photovoltaic. Wind energy. Nature of wind. Wind power and wind turbines. Betz criterion. Energy from waves and tides. Principles of water waves, energy, and power. Wave power extraction. Origin and properties of tides. Tidal stream power and tidal range power. Power from fluids. Hydro power. Energy transportation and storage. Thermal pollution. Energy costs, capacity, reserves, and efficiency. Emerging environmental effects of energy processing.

PHY 207/208: Experimental Physics I & II

(2 Units C: PH 90)

Learning Outcomes

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

1. identify the two physical quantities to be measured as independent and dependent variables;
2. determine the relationship between the two variables in form of graph;
3. determine some physical constants such as acceleration due to gravity, force constant of a spring, refractive index of a prism and focal length of converging and diverging lenses using different methods; and
4. determine momentum of inertia of a fly wheel and determine coefficient of static and dynamic friction for wood.

Course Contents

The laboratory course consists of a group of experiments drawn from diverse areas of Physics (optics, electromagnetism, mechanics, Modern Physics, etc.). It is accompanied by seminar studies of standard experimental techniques and the analyses of famous and challenging experiments.

PHY 213: Classical Physics I

(2 Units C: LH 30)

Learning Outcomes

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

1. relate the concepts of space coordinates, time, and linear motion;

Course Contents

2. describe particle dynamics, equilibrium, and conservative forces;
3. solve problems on central forces, energy, and angular momentum;
4. explain the dynamics of rotational motion;
5. discuss and apply the potential theory;
6. explain the dynamics of rigid bodies;
7. apply Newton's theory of gravitation to problems of planetary motion and space travel;
8. use inertial forces to explain motion from the viewpoint of rotating frames of reference; and
9. derive the general relation between the angular velocity and angular momentum of a rigid body and use this to solve problems in rotational dynamics.

Course Contents

Introduction to classical mechanics. Space and time. Linear kinematics. Linear and angular momentum. Force and torque. Motion in a plane. Newtonian gravity. The two-body systems. Forces and equilibrium. Particle dynamics. Force fields and potentials. Collisions. Conservative forces. Inertial frames and non-inertial frames. Motion in rotating frames. Centrifugal force. Central force motions. Kepler's motion in a central force field. Particle orbits as conic sections. Kepler's laws. Rigid body motion and rotational dynamics. Moment of inertia. Free rotation and stability. Gyroscopes.

PHY 214: Classical Physics II (Electrodynamics)

(2 Units C: LH 30)

Learning Outcomes

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

1. use scalar and vector potentials and explain the concept of gauge invariance;
2. demonstrate the compatibility of electrodynamics and special relativity;
3. use Lorentz covariant formalism in the context of electrodynamics and special relativity;
4. solve Poisson's equation and the inhomogeneous wave equation;

PHY 211: Workshop Practice

(2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. identify safety signs for various workshop types and abide by the underlining regulations while working in the workshop;
2. handle workshop tools and machineries;
3. illustrate simple metal processing methods;
4. describe the criteria for selection of construction materials;
5. identify electrical and electronic devices and explain some instrumentation techniques for measuring parameters;
6. explain types and methods of wood and plastic processing.

Course Contents

Course Contents

Workshop layout and safety. Basic hand tools and bench work practices. Measurement and gauging. Sheet metal operations. Casting. Cutting, drilling, turning, and milling. Metal joining devices and adhesives in common use. Soldering techniques and wrap joints. Plain and cylindrical generation of smooth surface using power operated machines. Criteria for selection of materials used for construction (metallic and non-metallic). Instrumentation and measuring techniques. Multi-meters and oscilloscopes. Extension of instrument range. A survey of the use of electronic circuit devices (e.g., diodes, transistors including FET, integrated circuits). Photocells. Basic circuit development and analysis. Wood logging. Wood types and processing. Plastic types and working. Plastic moulding, bending, and encapsulation.

GOU-PHY 201: Meteorology and Climatology (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

Graduates of Meteorology and Climatology from Godfrey Okoye University should be capable of using the Philosophy of epistemic dialogue to solve the daily environmental problems, and above all interact with the society in adapting to weather and climatic variables. Graduates of this course are equipped to organize themselves effectively to avoid the problems occasionally arising from the vagaries of weather and climate. The knowledge and practice of weather reading, recording and interpretations will promote entrepreneurial competence, and as well offer solutions to societal problems. The senate approves the program because of health and economic contributions to the societal sustainability.

Overview

Meteorology and climatology are crucial for the understanding of the characteristics and interactions of atmospheric components. The role the atmosphere components, their interaction and function aid in the understanding of the atmosphere. The study and application of these concepts of meteorology and climatology for effective environmental planning and environmental relationships are paramount. The general distribution and circulation latitudinal and longitudinal atmospheric components are necessary in human survival and economic growth. These understandings and applications are important either employed in the industry or in homes.

Meteorology and climatology integrate very effectively the needs and activities of environment, human survival and economic growth. Physics students should be able to read, record, and interpret weather variables and use them to solve societal problems.

Course Contents

Objectives

The objectives of this course are to:

1. Define meteorology and climatology.
2. Distinguish between meteorology and climatology.
3. Explain clearly the elements of weather and climate.
4. Distinguish between weather systems and climate systems-temperature, rainfall, monsoon.
5. Explain and describe some atmospheric observances.
6. Explain the use of local materials for building weather observation instruments.
7. Apply climate changes to plan agricultural activities.
8. Discuss the use of parameters over time to plan harvesting time, food preservation and choice of plants and choice of planting periods.

Learning Outcomes

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

1. Discuss weather and climate.
2. Identify the various types of weather and climate.
3. Distinguish between weather and climate and measure their variables clearly.
4. Measure five weather elements/variables and discuss the outcome.
5. Determine when the weather is or would be friendly and unfriendly.
6. Predict the nature of weather and climate for purposes of using the environment for its advantage.
7. Superimpose weather and climate on the environment for their productivity.

Course Content

Definition of weather and climate and insolation. Elements of weather and climate: precipitation, temperature, insolation, wind and humidity, climate variables, instruments for weather observation. Temperature. Humidity. Precipitation and wind distribution. Vertical and horizontal weather systems and atmospheric disturbances. Agro-practices and timing over time and space. Preservation of crops and types being preserved. Macro and micro climate. Factors affecting agro practice and crop choice. Production of elementary weather instruments.

Minimum Academic Standards

(1) Thermometer- dry and wet bulb (2). Maximum and minimum thermometers (3). Earth thermometers- complete set (4). Wind vane, wind run, anemometer (5) Class A pan, evaporimeter

Course Contents

(6) Rain gauge (7) Upper air balloons (8) GPS machine (9) Meter rules (10) Prismatic compass (11) Tapes - metal fibre, 50mm and 100mm (12) Measuring wheel (13) Steven's Screen (Complete Set)

GOU-PHY 203: Satellite Communication System (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

In agreement with the vision and mission of Godfrey Okoye University and her Philosophy which stresses on acquisition of all round knowledge, this course is geared towards producing Physics graduates with broad-based knowledge and understanding of the basic concepts of satellite, complemented with practical understanding satellite communication system which will help to advance their capacity in the field of space communication.

Overview

Satellite communication refers to the use of artificial satellites to transmit and receive signals over long distances. This technology has revolutionized global communication and enabled reliable and efficient transmission of voice, data, and video signals between different points on Earth.

Satellite communication has numerous applications, including television and radio broadcasting, internet access, military communication, navigation, remote sensing, weather forecasting, and scientific research. The study of these applications make this course highly advantageous over other means of communication.

Objectives

The objective of the course are to:

1. Describe the basic concepts of a satellites.
2. Identify the modern concepts of communication.
3. Explain the concept of a cable satellite.

Course Contents

4. Explain different types of satellite.
5. Describe the motion of planets and satellite.
6. Explain the mechanics of satellite.
7. Describe the techniques of modulation in satellite broadcasting.
8. Build a mini satellite.

Learning Outcomes

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

1. Define satellite.
2. Outline at least three basic concepts of satellite.
3. Distinguish between radio astronomy and optical astronomy.
4. Describe the principles of construction and installation of a satellite.
5. Explain the dynamics of satellite.
6. Discuss at least two energy sources of a satellite.

Course contents

Introduction. Meaning of satellite. Satellite communication. Radio Astronomy. Telecommunication in Nigeria. Mechanics of Satellites. Satellite station and earth station. Modulation techniques. Wavelength solar bust with periodic modulation. Factors affecting satellite communication. Building a satellite. Satellite Architecture. Anatomy and sensors. Other considerations in building a satellite. The system design approach. Assembly Testing and after launch. Satellite subsystems. Launch vehicles and orbit selection. Satellite operations and maintenance. Satellite applications. Satellite market. Emerging trends and technologies.

Minimum Academic Standards

- RF receivers.
- Satellite modems.
- Splitters.
- Switchover units.
- Transceivers.
- Translators.
- Transmitters.

Course Contents

GOU-PHY 223: Computer programming for Physics I (3 Units; Compulsory; LH = 30; PH = 45)

Senate -Approved Relevance

This course is developed to equip the students of Physics with the prerequisite knowledge and skillsets in computer coding and writing programs. This course acquaints Physics students with the basic and intermediate knowledge and skillsets in computer coding and programming. It is fashioned in line with the Godfrey Okoye University's Philosophy, Mission, and Vision to empower their graduates with skillsets and to producing Physics graduate concepts complementary with applications that will advance their knowledge in coding and use of programming languages for advanced computation and programming in Physics and applications.

Overview

Digitization has broadened our concept and utilization of most electronic devices/gadgets. Developing of Apps, Games, and software requires in-depth knowledge and skillsets in coding and programming. Therefore, GOU-PHY 223 will impart positively on the students the coding and programming skillsets. These skillsets when acquired will nurture and prepare the students to be competitive in the labor market to be outstanding in their discharge of duty.

Besides the ability to be a consultant to many young students that want to path their career in the same profession as well as provide services to clients, companies, a good programmer can construct digital circuit which requires programmable IC's. Basic, intermediate, and advanced programming skillsets is paramount in building Hi-tech circuit deployed in drones and other electronic devices used in tackling security, and monitoring and imaging.

Objectives

The objectives of this course are to:

1. Identify different programming paradigms.
2. Discuss how to write programmes.
3. Design and implement programming problems.
4. Classify data abstractions.
5. Develop programmes.
6. Design and implement programming problems involving arrays.

Learning Outcomes

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

Course Contents

1. Identify at least three programming paradigms and their approaches to programming.
2. Write two programmes using basic data types and strings.
3. Design and implement two programming problems using selection and loops.
4. Use and implement classes as data abstractions in an object-oriented approach.
5. Implement simple exception handling in programmes.
6. Develop at least three programmes with input/output from text files.
7. Design and implement two programming problems involving arrays.

Course Contents

Introduction to computer programming. Functional programming. Declarative programming. Logic programming. Scripting languages. Introduction to object-orientation as a technique for modelling computation. Introduction of a typical object-oriented language, such as Java. Basic data types. Variables. Expressions. Assignment statements and operators. Basic object-oriented concepts: abstraction, objects, classes, methods, parameter passing, encapsulation. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism. **Labwork:** Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting. Practice in developing and tracing simple recursive algorithms. Developing programmes involving inheritance and polymorphism.

Minimum Academic Standards/Requirements

Computer systems with capacity to run software systems, Programming environment and tools (e.g., Compilers/interpreters, debuggers, etc. for Java, Python, C+, C++, compiler compilers, e.g., flex, yacc, SableCC, etc.), Operating systems environments and tools (e.g., Windows, LINUX, TempOS, Nachos, Xinu or MiniOS), Tools for systems analysis and design (e.g., Unified Modelling Language (UML)).

Course Contents

GOU-PHY 225: Atmospheric Physics (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

This course prepares students to apply their learning of the interactions of atmospheric constituents in dealing with their fellow humans. The Physics programme and in particular Atmospheric Physics can be used to produce problem solving graduates in industries, skill development and job acquisitions. These will go a long way in taking care of certain societal needs and the demands of the sustainable development goals (SDGs) through manipulative competence and epistemic dialogue. The course is developed in consonance with Godfrey Okoye University's mission to produce graduates who are equipped for the labour market and skilled to solve societal problems.

Overview

This course trains students in strict and critical observations, analysis, prediction, and information desecration through interpretation and forecasting. In addition, this course enhances the student's manipulation ability and skill which improves the student's employability.

The ability to construct weather measuring instruments increases students' entrepreneurship competence, economic survival, and employment of others. The course equally transfers its usefulness to engineering, environmental, social, and health sciences. It is equally useful for urban development, and coastal and recreational planning as well as helping coastal impact assessment preparations.

Objectives

The objectives of the course are to:

1. Identify the various layers and feature of the atmosphere and their boundary zones.
2. Identify the temperature characteristics of the various levels and their demarcating layers.
3. Identify the weather variables and how they influence life at various levels.
4. Enumerate and describe the weather variables in the atmosphere.
5. Measure, record, and analyze the various atmospheric parameters.

Course Contents

6. Discuss how to apply the weather and atmospheric parameters in developmental planning, environmental impact assessment studies and resource conservation.
7. Define and describe various instruments for measuring, and characterizing upper air weather condition.
8. Explain the use of satellite imageries for land surveying.
9. Emphasize the importance of the course as an entrepreneurial resource.

Learning Outcomes

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

1. Explain the structure of the atmosphere.
2. Describe three characteristics of the individual layers of the atmosphere.
3. Distinguish between meteorology and climate and show their inter-relations.
4. Identify at least four weather variables in the atmosphere and their features and measurements.
5. Explain and illustrate the distinguishing features of atmospheric variables and their significance for weather prediction.
6. Measure specific variables and record them, draw, label, and construct different weather measuring instruments.
7. Determine the uses of recorded variables (@ no 6).
8. Describe the uses of at least two different types of balloons for upper air sounding systems.
9. Define satellite imagery and its application for land surveying.

Course Contents

Concept of atmospheric physics. Review of atmospheric variables and their measurements. Meteorological instruments. Instrumentation and observation. Weather and climate. Weather systems. The transmission of meteorological messages and preparation of meteorological maps. Analysis of scalar quantities. Graphical analysis and computation. Upper air surrounding systems. Pilot balloons. Radar. Radiosonde. Constant level balloon. Drop sounds. Rockets. Comets. Satellites and other heavenly bodies. Satellite imagery and applications. Use of meteorological charts. Operations on thermodynamic analysis.

Minimum Academic Standards

Thermometer- dry and wet bulb (2) Maximum and minimum thermometers (3) Hygrometers
Rain gauge (4) Earth thermometers- complete set (5) Wind vane, wind run, anemometer (6) Class

Course Contents

A pan, evaporimeter (7) Rain gauge (8) Upper air balloons (9) GPS machine (10) Meter rules (11) Prismatic compass (12) Tapes - metal fibre, 50mm and 100mm (13) Measuring wheel (14) Steven's Screen (Complete Set).

GOU-PHY 231: Design Engines (2 Units; Elective; LH = 15; PH = 15)

Senate -Approved Relevance

This Design engine physics is a branch of Physics that focuses on the fundamental principles and laws of physics which govern the behavior of machines and systems used in engineering and design. This course is developed to inculcate in students strong design techniques and construction of four stroke engines. This is in agreement with GOU's mission and vision to empower their graduates with educational skillsets in design and construction of engine systems.

Overview

Physics concepts, principles and laws are applied in the design and analysis of mechanical systems. Working individually and in teams, students complete a series of design challenges to develop key skills in computer programming, 3-D modeling software, engineering technology, and physics concepts. The course culminates with competition-ready, semi-autonomous devices presented as marketable products designed to serve a specific purpose in the local community. These projects promote critical thinking, communication, collaboration, and creativity and provide a foundation for data collection, analysis, reflection, presentations and technical writing skills.

By successfully completing the course, students will be prepared for success in college science and engineering as well as in high-demand careers like automation and advanced manufacturing

Objectives

The objectives of the course are to:

1. Describe the concept of engine design.
2. State the methodology of engine design.
3. Explain the simple and multi-functional engines.
4. Explain the kinematics of engine design.
5. Explore mechanics of engines.

Course Contents

6. Interpret electromagnetic wave charts for design engines.
7. Explain the importance of robotic systems in system engines.
8. Enumerate the disadvantages of poor engine design.
10. Analyze faults resulting from poor engine maintenance.

Learning outcomes

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

1. Develop at least three kinematic concepts of motion.
2. Apply the knowledge of kinematics to a design engine system.
3. Construct the design cycle.
4. Solve at least four engineering design problems.
5. Make measurements and calculations.
6. Design two engine prototypes.
7. Discuss the opportunities in engine design industries and automobiles.

Course Contents

Introduction. Design Process. Introduction to kinematics. Mechanics. Force and energy. CAD. 3-D Modeling. Robotics. Electricity. Electromagnetism. Robotic Devices. Engine System Analysis. Student-Designed Capstone Project. Thermodynamics. Fluid dynamics. Combustion Theory. Aerodynamics. Mechatronics. Product Development. Design Optimization. Design for Manufacturability. Engineering Ethics. Case Studies. Teamwork and Collaboration.

Minimum Academic Standards

Automobile Design Engines workshop with NUC-MAS requirements and facilities.

Course Contents

GOU-PHY 235: Welding and Fabrication (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

This course aims to provide Physics students with the knowledge and practical skills needed in creativity and innovation to work effectively and sagely in welding and fabrication industries. This is in agreement with Godfrey Okoye University's mission and vision to empower their graduates with knowledge and skillsets in creative works. Graduates of this course will become great entrepreneurs and equipped enough to compete in the labour market.

Overview

Welding is vital in today's high-tech approach to manufacturing and metal construction. Students will learn several different welding techniques including arc, gas and plastic welding along with learning plasma cutting and oxy-fuel cutting. They will also be introduced to welding codes and standards used in industry, such as AWS, ASME, API, and ISO demonstrated.

Students will have practical hands-on session on welding and fabrication to develop techniques and practical skillsets. Prospective opportunities include welding inspectors, welding engineers, welding supervisors, and welding technicians.

Objectives

The objectives of the course are to:

1. Explain the concept of welding.
2. Explain welding techniques/processes.
3. Describe the safety measures in welding.
4. Classify metals according to their strength and durability.
5. State the methodologies employed in welding.

Course Contents

6. Identify and use welding tools.
7. Mention the gasses used in welding.
8. Describe the applications of welding.
9. State the advantages and disadvantages of welding and Fabrication.
10. Weld and fabricate a solid metallic body/structure.

.Learning Outcomes

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

1. Define Welding and Fabrication.
2. Explain five safety measures to be put in place during the art of welding.
3. Identify gasses used in welding and their specific applications.
4. Identify metals, their strength and durability.
5. Analyze and estimate the cost of fabricating a sizable safety contour.
6. Fabricate and weld metallic go-kart.
7. Prepare three containers for Welding and Cutting.
8. Practice Arc welding.
9. Exhibit shield Flux in Arc Welding.
10. Write specifications for filler metals and electrodes.

Course Contents

Introduction. Safety in Welding and Cutting. Allied Processes (Filter Plate). Lens Shade Selector (Filter Plate). Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping. Arc Welding and Cutting Noise. Arc Welding and Cutting Safety. Fire Safety in Welding and Cutting. Oxyfuel Gas Welding. Heating. Safety. Preparing Containers for Welding or Cutting. Welding codes and standards: Welding codes and standards used in industry, such as AWS, ASME, API, and ISO. Practical hands-on experience: Hands-on welding and fabrication exercises to develop practical skills and techniques. Career opportunities: career opportunities in welding and fabrication, including welding inspectors, welding engineers, welding supervisors, and welding technicians.

Minimum Academic Standards

Welding and Fabrication workshop with NUC-MAS required facilities including

Course Contents

auto-darkening, welding helmet, welding gloves, MIG welding pliers, welding magnets, chipping hammer, welding framing jig, speed square and metal brush.

Course Contents

GOU-PHY 251: Radar Physics (2 Units; Compulsory; LH = 30; PH = 0)

Senate -Approved Relevance

Radar Physics is a constantly evolving brand of new techniques, technologies, development and advancement. Radar system technology has a wide range of applications in military, aviation, weather forecasting, and so on. This course is developed to impart positively on the Physics students the principles and application of Radar technology in diverse areas of human endeavor. This is in agreement with Godfrey Okoye University's mission to train and empower its students with state-of-the art knowledge and skill sets in order for them to be outstandingly excellent in character and learning, competitive in the labour market and hone entrepreneurial skills.

Overview

This course will go through radar equations, wave forms, the Doppler Effect, synthetic aperture radar (SAR) and antenna, propagation and radar applications/usages in different human endeavor.

Graduates of this course can work as technologists, radar scientists or professional data trackers in information and telecommunication, military, oil and gas industries that employ radar technology for different applications/usages.

Objectives

The objectives of this course are to:

1. Discuss the concept of radar.
2. State the branches of radar technology.
3. State the use of radar technology in information technology.
4. Explains the applications of radar in Physics.
5. Describe the advantages and disadvantages of radar technology.
6. Explain the operational principles of radar technology.
7. Examine the conditions necessary for the accurate performance of radar technology.
8. Distinguish radar from optical and infrared sensing devices.
9. Explain the radar transmission of electromagnetic energy towards a target.
10. Measure the range of transmissions of a radar system.

Course Contents

Learning Outcomes

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

1. Explain the interactions of radiation with the Earth's surface and atmosphere.
2. Design new sensors, using the knowledge of radar systems.
3. Solve at least three (3) specific problems in information technology using radar sensing.
4. Differentiate infrared and optical sensing from radars.
5. Explain remote sensing instrumentation in radar physics.
7. Set up and launch simple radar systems for data transfer.
8. Describe at least three characteristics of images formed by synthetic apertures.
9. Identify the importance of Antennas in radar communication.

Course Contents

Introduction to Radar Technology. Electromagnetic Waves and Propagation. Radar Range Equation. Radar Cross Section. Antennas for Radar Systems. Signal Processing in Radar Systems. Radar Systems Architecture. Radar Pulse Compression Techniques. Radar Detection and Tracking. Doppler Radar and Its Applications. Synthetic Aperture Radar. Ground Penetrating Radar. Meteorological Radar. Airborne Radar. Space-Based Radar. Radar Jamming and Counter measures. Radar System Design. Implementation.

.

Minimum Academic Standards

RADAR network workshop with NUC-MAS requirements and facilities.

Course Contents

GOU–PHY 264: Semi-Conductor Technology (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance

Semiconductor Technology is the hallmark of the electronics industry. Semiconductors play vital roles in the electronics industry which in turn plays a major role in the industrial development of a nation. Japan and China are world powers today because of their advanced development in industrialization in the field of electronics. Semiconductor technology is the manufacturing of electronic components, using semiconductor materials such as silicon, germanium, and so on. Godfrey Okoye University, in her vision as well as mission statement, stresses on a wholistic education aimed at producing graduates who will not only be employable but employers of labour. This course is therefore aimed at producing Physics graduates with sound knowledge and understanding of semiconductor Physics and Technology and consequently providing entrepreneurial opportunities in the field of study.

Overview

Semiconductor chips production and miniaturization is drastically evolving, and electronics industries utilize manufactured chips and miniaturized circuits in the construction of state-of-art facilities / gadgets for human consumption and other purposes. These components include transistors, diodes, integrated circuits and microprocessors, which are used in various electronic devices like computers, smartphones, television, and more.

Given the above, the course is a gateway to diversification of our economy through industrialization. The acquired knowledge and skill sets by students will position them to work in Silicon Valley, and manufacturing of electronics chips for diverse applications in industries and otherwise.

Objectives

The objectives of this course are to:

1. Identity the basic concepts of semiconductors.
2. Describe the processes of electron generation.
3. Outline and describe charge carriers in semiconductors.
4. Outline and describe the types of semi-conductors.
5. Describe the physical and chemical properties of semiconductors
6. Explain the concept of doping technology
7. Evaluate the chemical structure of crystals.

Learning Outcomes

Course Contents

On completion of this course the students should be able to;

1. Define and explain the term semiconductor.
2. Explain the concept of electron generation in semiconductors.
3. Explain P-type and N-type semiconductor.
4. Explain the mechanism in generation of major and minor charge carriers in P-type and N-type semi-conductors.
5. Explain the processes involved in doping of semiconductors.
6. Describe semiconductor chips production by using doping technique.

Course Contents

Physical and chemical properties of semiconductors. Preparation simple purification. Growth of sample crystals. Evaluation of chemical structure and properties. Doping effect. Mechanical and metallurgical properties of crystals. Thermodynamics and kinetic considerations in crystals. Growth of crystals from one to the other and their chemical vapour transportation techniques. Thin film deposition techniques for semiconductor device fabrication. Photolithography and patterning for semiconductor device fabrication. Etching techniques for semiconductor device fabrication. Diffusion and ion implantation for dopant profiling in semiconductor devices. Oxidation and annealing processes in semiconductor device fabrication.

Minimum Academic Standards

Semiconductor Workshop with NUC-MAS requirements and Facilities.

300 Level

GST 312: Peace and Conflict Resolution

(2 Units C: LH 30)

Learning Outcomes

At the end of the 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;
5. describe roles of international organisations, media, and traditional institutions in peace building.

Course Contents

Course Contents

Concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of Conflicts (ethnic, religious, economic, and 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-Jukun; Zango Kartaf, 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 & security Council (international, national and local levels). Agents of conflict resolution (conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution, ADR. a). Dialogue b). Arbitration, c). Negotiation d). Collaboration etc. 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. Media and traditional institutions in peace building. Managing post-conflict situations/crisis (Refugees. Internally displaced persons, IDPs0. The role of NGOs in Post-conflict situations/crisis.

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 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; 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,

Course Contents

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, Ecommerce 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 (IoT), blockchain, cloud computing, renewable energy etc. Digital Business and E-commerce strategies).

PHY 301: Analytical Mechanics I

(2 Units C: LH 30)

Learning Outcomes

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

1. explain and evaluate particle motion in one, two, and three dimensions;
2. describe the two-body problem and many body systems;
3. define and solve problems of conservative forces;
4. explain Newton theory of gravitation;
5. describe the nature of generalized motion;
6. explain the theory of relativity;
7. choose an appropriate set of generalized coordinates to describe a dynamical system and obtain its Lagrangian in terms of those coordinates and the associated 'velocities'; and
8. derive and solve the corresponding equations of motion. Treat small oscillations as an eigenvalue problem.

Course Contents

Review of Newtonian Mechanics. Motion of a particle in one, two and three dimensions. Internal forces. External forces. Forces of constraint. Systems of particles and collision theory. Newtonian gravitation; conservative forces and potentials, oscillations, central force problems; accelerated frames of reference. Rigid body dynamics. Rotational problems and space coordinates. Mechanics of continuous media. Galilean relativity. Relativistic kinematics and dynamics. Applications of relativistic kinematics.

PHY 303: Electromagnetism

(3 Units C: LH 45)

Learning Outcomes

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

Course Contents

1. derive Maxwell's equation set from the empirical laws of electromagnetism;
2. use the fundamental laws of electromagnetism to solve simple problems of electrostatics, magnetostatics and electromagnetic induction in a vacuum;
3. modify Maxwell's laws to apply in the presence of materials and solve problems involving them;
4. derive the electromagnetic boundary conditions which apply at the interface between two simple media, and to use them to solve problems involving two or more materials;
5. explain the properties of plane electromagnetic waves in a vacuum and in simple media and to be able to derive these properties from Maxwell's equations;
6. apply the special theory of relativity to problems in electromagnetism.

Course Contents

Review of Vector calculus. Electrostatics and Magnetostatics. Magnetization and magnetic susceptibility. Laplace's equation and boundary value problems. Multipole expansions. EM waves in dielectric and magnetic materials. Polarization of EM waves. Electromagnetic induction. Faraday's and Lenz's laws. A.C. Circuits. Maxwell's equations. Lorentz covariance and special relativity. Gauss theorem in dielectrics. Poisson's equations. Uniqueness theorem. Magnetic properties. Motors. Generators. Poynting vectors.

PHY 304: Electromagnetic Waves and Optics

(3 Units C: LH 45)

Learning Outcomes

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

1. explain plane electromagnetic waves and waves propagation;
2. derive the wave equation;
3. describe the transport of electromagnetic energy;
4. explain scattering, interference, diffraction, reflection, polarization, and refraction of electromagnetic waves;
5. use complex notation competently for wave phenomena;
6. solve problems which require the use of wave representations of electric and magnetic fields in propagating electromagnetic waves;
7. analyse simple examples of interference and diffraction phenomena;
8. explain the principles of operation of a range of equipment used in modern optics, notably the Michelson interferometer and Fabry-Perot etalon;
9. explain the physics of the laser and processes involved in producing laser radiation to solve simple problems;

Course Contents

Review of Maxwell's equations and wave equations in a dielectric. Electromagnetic potentials. Propagation of plane and spherical waves. Huygen's wavelets and Fermat's principle. Recap of polarization states. Interference. Michelson interferometer and Fabry-Perot etalon. Fourier transform spectroscopy. Young's slits. Lloyd's mirror. Fraunhofer diffraction. Resolution of optical instruments.

Course Contents

Reflection and refraction. Transmission lines. Wave guides and optical cavities.
Lasers (rate equation, Steady state operation; threshold and efficiency).

PHY 305: Quantum Physics

(3 Units C: LH 45)

Learning Outcomes

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

1. explain the origin of quantum physics and principles of quantum theory;
2. apply the mathematical tools of quantum physics;
3. explain how quantum states are described by wave functions;
4. apply operators and solve eigenvalue problems in quantum mechanics;
5. solve the Schrodinger equation and describe the properties of the simple harmonic oscillator;
6. use the algebra of angular momentum operators and solve the simple eigenvalue problems of an angular momentum in quantum mechanics;
7. apply quantum mechanics to describe the hydrogen atom;
8. employ quantum mechanics to describe the properties of one-electron atoms;
9. use quantum mechanics to describe the simple multi-electron systems such as helium atom and hydrogen molecule.

Course Contents

Wave-particle duality and the uncertainty principle. Basic principles of the quantum theory. Time dependent Schrodinger equation. Energy levels and potential wells. Reflection and transmission of potential barriers. Operators and quantum states. Commutation relations and compatibility of different observables. Orbital angular momentum. Particle in two dimensions. Familiar wave phenomena and their associated wave equations. Physical interpretation of the wave function as a probability amplitude. Energy levels and stationary states. Energy bands in periodic lattice. Solution of Schrodinger equation for a central potential in three dimensions. The hydrogen atom. Multi-electron atoms. The harmonic oscillator. Exchange symmetry.

PHY 306: Statistical and thermal physics I

(2 Units C: LH 30)

Learning Outcomes

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

1. describe an ideal gas on the basis of classical statistics;
2. explain the basic concepts of statistical mechanics, including entropy, its statistical interpretation and relation to disorder, and the statistical origin of the second law of thermodynamics;
3. illustrate the canonical and grand-canonical partition functions for systems in thermal equilibrium and use them to obtain thermodynamic quantities of interest;
4. describe the implications of the indistinguishability of particles for systems of non-interacting quantum particles;

Course Contents

5. deduce the Bose-Einstein and Fermi-Dirac distribution functions and apply them to calculate the properties of Bose and Fermi gases, for example in the context of white dwarf stars and black-body radiation; and
6. explain the physical origin of Bose-Einstein condensation, to characterize it quantitatively, and to explain the experiments confirming Bose-Einstein condensation

Course Contents

Basic theory of thermodynamics. Basic of probability theory. Microstates and macrostates. The concept of ensembles. Statistical interpretation of entropy and temperature. Isolated systems and the microcanonical ensemble. Statistical physics of non-isolated systems. Derivation of the Boltzmann distribution and canonical ensemble. The partition function in thermodynamics. Noninteracting systems. Equipartition theorem. Density of states. Grand canonical ensemble. FermiDirac and Bose-Einstein distributions. The ideal Fermi gas. Fermi energy. Heat capacity. The ideal Bose gas. Black body radiation. Bose-Einstein condensation.

PHY 307/308: Experimental Physics V & VI

(2 Units C: PH 90)

Learning Outcomes

On completion, the students should be able to:

1. verify some equations, physical laws and theorems;
2. identify apparatus, design and set up experiments;
3. investigate relationships between physical quantities numerically and graphically; and
4. prepare and present laboratory reports.

Course Contents

A year-long series of mini courses on important experimental techniques. Topics covered include electronics, optics, electricity, atomic, molecular nuclear and low temperature physics, statistics and data handling and scientific writing.

PHY 311 Complex Variable and Vector Space

(3 Units C: LH 45)

Learning Outcomes

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

1. determine whether or not a given function of a complex variable is differentiable;
2. use conformal mappings of the complex plane to solve problems in 2D electrostatics, fluid flow and heat flow;
3. construct the Taylor-Laurent series for functions that are analytic in an annular region of the complex plane;
4. determine the location and nature of the singularities of a function and determine the order of a pole and its residue;
5. use the residue theorem to evaluate integrals of functions of a complex variable, and identify appropriate contours to assist in the summation of series and the evaluation of real integrals;
6. find an orthonormal basis for a given vector space;

Course Contents

7. define the adjoint of a linear operator and determine whether a given operator is Hermitian and/or unitary; and
8. employ methods from this and prerequisite units to solve previously unseen problems in linear algebra, using Dirac's notation where appropriate.

Course Contents

Complex numbers. Functions of complex variable. Functions as mappings. Complex differentiation, analytic functions and the Cauchy-Riemann equations. Conformal mappings. solutions of 2D Laplace equation in physics. Integration in the complex plane. Contour integration. Cauchy's Theorem. Cauchy's integral formulae. Taylor and Laurent Series. Cauchy's residue theorem. Real integrals and series. Vector spaces. (Abstract vector spaces, linear independence, basis and dimensions, representations, Inner products, linear operators). Hermitian and unitary operators. Eigenvalues and eigenvectors.

GOU-PHY 324: Computer programming for Physics II (3 Units; Compulsory; LH=30; PH = 45)

Senate -Approved Relevance

This course is aimed at acquainting the students with the intermediate and advanced computer programming knowledge and skillsets. The students will be trained on advanced programming concepts, Class hierarchies and programme organization using packages/name spaces, String processing, searching, sorting, etc, recursive algorithm, graphic user interface, etc., This is in agreement with GOU's mission and vision to empower their graduates with knowledge and skillsets to be outstandingly excellent in character and learning towards applying the acquired knowledge in solving relevant problems in Physics and electronics industries and advancing their career pursuit and advancement in life endeavor.

Overview

Computer programming is the process of writing code to facilitate specific actions in a computer, application or software program and instructing them on how to perform. Computers can do amazing things, from basic laptops capable of simple word processing and spreadsheet functions to incredibly complex supercomputers completing millions of financial transactions a day and controlling the infrastructure that makes modern life possible.

Students trained in GOU-PHY 223 and GOU-PHY324 become computer programmers and they can create instructions for a computer to execute by writing and testing codes that enables applications and software programs to operate successfully. Given this, the students can be a consultants and entrepreneur to numerous electronics/ICT companies and industries.

Objectives

Course Contents

The objectives of the course are to;

1. Develop solutions for a range of problems using object-oriented programming.
2. Use modules/packages/name spaces for programme organization.
3. Use API to write applications.
4. Write simple multi-threaded applications.
5. Explain divide and conquer strategy to searching and sorting problems using iterative and/or recursive solutions.
6. Explain the concept of exceptions in programming and how to handle exceptions in programmes.
7. Design and implement simple GUI applications.

Learning Outcomes

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

1. Develop solutions to at least five problems using object-oriented programming.
2. Use modules/packages/namespaces for programme organization.
3. Use API in writing two applications.
4. Apply divide and conquer strategy to searching and sorting problems using iterative and/or recursive solutions.
5. Explain the concept of exceptions in programming and how to handle exceptions in programmes.
6. Write simple multithreaded applications.
7. Design and implement three simple GUI applications.

Course Contents

This course is a continuation of GOU-PHY223. Review and coverage of advanced object-oriented programming-polymorphism, abstract classes and interfaces. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming. **Lab work:** Programming assignments leading to extensive practice in problem-solving and programme development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

Minimum Academic Standards/Requirements

Overhead projector, smart board, Laptop, text books on programming language, internet access, Computer systems with capacity to run software systems, Programming environment and tools (e.g., Compilers/interpreters, debuggers, etc. for Java, Python, C+, C++, compiler compilers, e.g., flex, yacc, SableCC, etc.), Operating systems environments and tools (e.g., Windows, LINUX, TempOS, Nachos, Xinu or MiniOS), Tools for systems analysis and design (e.g., Unified Modelling Language (UML)).

Course Contents

GOU–PHY 371: Robotic Systems (2 Units; Compulsory; LH = 15; PH = 45)

Senate – Approved Relevance

Robotics is one the disruptive technology in our present day world. This course will inculcate in Physics students the basic and intermediate knowledge and skillsets in robotics including the techniques of assembling and test-running robots, programming, interfacing, automation and applications/usage. This is in unison with Godfrey Okoye University’s Mission and Vision to produce Physics graduates that are outstanding in character and learning, in creative works, design, programming and construction of robots and high-tech robotic devices.

Overview

A robotics system is a combination of hardware and software components that work together to perform tasks autonomously or with human guidance. The hardware components include sensors, actuators, manipulators, power sources and control systems. The software components include programming languages, algorithms and operating systems. Industrial robots are typically used in manufacturing and production industries to perform tasks such as welding, painting and material handling automation. Service robots are designed to perform tasks in non-manufacturing settings such as healthcare, hospitality and retail. Mobile robots are designed to move around and navigate through environments such as warehouses, hospitals and outdoor settings. Finally, humanoid robots are designed to resemble humans and can be used in a variety of applications such as entertainment and education.

The students will utilize their acquired knowledge and skillsets in assembling robotic parts, write codes and programmes and construct electronic-human interface devices / gadgets.

Objectives

The objectives of this course are to:

1. Define Robotics.
2. Describe the relationship between robotics and artificial intelligence.
3. Explain the processes involved in robotic system design.
4. Differentiate between the hardware and software of a robotic system.
5. Describe the steps in programming a robot.
6. Explain automated manufacturing as a step in robotics system design.
7. Determine the cost of designing and constructing a prototype robotic system.

Course Contents

8. Explain the maintenance process for a robotic system.
9. Design and construct a control system with robotic features.
10. Determine the usefulness of artificial intelligence in robotic systems.

Learning Outcomes

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

1. Explain the meaning and applications of Robotic systems.
2. Define the types of manufacturing systems and their relationship to Robotics and Automated Manufacturing.
3. Explain the major components of robotic systems.
4. Define the function of the robot arm, controller, and power source.
5. Define end-of-arm tooling.
6. Explain the characteristics of robotic systems.
7. Define the Degree of Freedom, Position Axes, and Orientation Axes.
8. Define Work Envelope.

Course Contents

Introduction. Devices and roles in Robotic safety. Classification of robotic systems. Arm geometry of robotic systems. Open-loop system. Closed-loop system. Sensors and their uses in robotic systems. End-of-arm tooling. Robotic components. Assembling. Programming. Methods of programming in robotics systems. Numbering systems for robotic application. Power ON procedure for robots. Automation. Robotic applications in different diverse of life endeavor.

Minimum Academic Standards

Computer hardware workshop with NUC-MAS requirements and facilities.

Course Contents

Senate – Approved Relevance

Improvement of the system of an institution for imparting knowledge to students and ensuring concrete educational experiences are consistently advocated for. Instilling a strong personality that will promote epistemological dialogue, and to produce graduates who will be outstandingly excellent in learning, balanced in character and personality and ready to pursue epistemic unity in agreement with the GOU's mission and vision to empower their graduates with skills. Moreover, this course is created in line with the philosophy of Godfrey Okoye University towards producing Physics graduate with expertise in Geophysics which is an indisputable study of the Earth's physical characteristics. The students will be endowed with skills in seismic processing and groundwater exploration. Also, students will be able to analysis of the Earth's crust and overview of the environment above the Earth's surface in line with sustainable development goals.

Overview

The rocks do not differ only by their macroscopic or microscopic properties studied by field geologists or petrologists. They also differ in their chemical and physical properties. Hence, as the rocks differ in their origin, structure, texture, etc, they also differ by their density, magnetization, resistivity, etc. The bad news is that the physical properties do not always clearly correlate with geological classifications and do not necessarily easily translate into geological terms.

Therefore Applied Geophysics is the use of physics principles and laws to study the interior of the Earth, from land surface to the inner core. Students will be endowed with skills in seismic processing and groundwater exploration as well as the analysis of the Earth's crust and overview of the environment above the Earth's surface.

Objectives

The objectives of this course are to:

1. Define the concept of geophysics.
2. State the applications of physics in the geophysical examination.
3. Describe the importance of studying the physics of the Earth.
4. Explain the advantages and disadvantages of seismic processing.
5. Determine the lifespan of the Earth's crust.

Course Contents

6. Determine the thickness of the Earth's crust.
7. Describe the process of hydrocarbon exploration in Geophysics.
8. Identify shallow structures of the Earth for engineering site investigations.
9. Explain the processes of exploring groundwater sources using seismic methods.
10. Identify at least five minerals and other economic resources gotten through geophysical surveys.

Learning outcomes

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

1. Create the mapping of archaeological remains.
2. Describe at least five problems involved in geophysical surveys.
3. Locate buried objects using seismic methods.
4. Map "apparent" physical properties.
5. Identify boundaries where physical property values change.
6. Create a detailed map of locations and depths of actual physical property values.
7. Describe physical properties in relation to geophysical work.
8. Determine a suitable geophysical survey, and design an effective and efficient field survey.
9. Identify possible sources of error, noise and misinterpretation.
10. Analyze geophysical data.

Course Contents

Introduction. General survey of the elementary theory. Field methods of geophysical investigation. Electrical method. Electromagnetic method. Computational methods. Curve fitting techniques. Methods of interpretation. Earth seismicity. Gravity. Minerals and rocks. Structure geology. Petroleum. Origin and Migration of petroleum sedimentary basin. Accumulation of petroleum sedimentary basin. Anambra Basin. Afikpo Basin. Abakiliki Basin. Sokoto Basin. Niger Delta Basin. Dahomey Basin. Gongola Basin. Chad Basin.

Minimum Academic Standards

Geophysics laboratory with NUC-MAS requirements facilities.

400 Level

PHY 414: Solid State Physics I

(2 Units C: LH 30)

Course Contents

Learning Outcomes

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

1. explain crystal binding, structure, and dynamics;
2. describe models of the free electron and transport properties of conduction electron
3. describe band structure;
4. determine reciprocal lattices of simple crystal structure and relate them to x-ray diffraction data;
5. calculate band structures for simple 2D and 3D tight-binding models and construct nearlyfree electron approximations;
6. use the nearly-free-electron approximation to calculate equilibrium properties;
7. apply the semiclassical dynamics of electrons in solids to interpret magneto-conductance data and its relationship with the Fermi surface; and
8. describe and make use of the relationship between bonding and electronic structure of semiconductors, metals, and insulators;

Course Contents

Crystal structure and binding. Reciprocal lattice. Basic concepts of the quantum theory in solids. The free electron model. Weak and tight binding approximations. Energy band structures in metal, semiconductors and insulators. Electrons in solids. Density of states. Fermi surface. Fermi-Dirac distribution. Weidemann-Franz law. Interaction of electron with crystal lattice. Scattering of electrons. Crystal defects. Physics of surfaces. Schottky devices. Use of photo-electric emission in the study of solids. Elastic properties. Lattice vibrations. Super-conductivity. Graphene (Band structure and properties).

PHY 318/418: Semiconductor Devices

(3 Units C: LH 45)

Learning Outcomes

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

1. explain the type, functionality, and operation of semiconductor devices;
2. distinguish between conductors, semiconductors, and insulators;
3. describe the crystal structure of representative semiconductor diodes and amplifying devices;
4. describe the operation of semiconducting devices in a circuit;
5. be familiar with semiconductor device packaging and symbol representations;
6. recognize the functional operation of diodes and amplifying semiconductor devices;
7. describe how to test semiconductor devices and evaluate their status;
8. describe forward and reverse bias characteristics of diodes;
9. explain voltage-current characteristics of semiconductor devices;
10. explain the physics and operation of the transistors;
11. describe metal - semiconductor junction characteristics; 12. explain the basics of FET's and MOSFET's structures; and
13. state the principle of operation of photonic devices.

Course Contents

Course Contents

Classes of semiconductor. The physics of semiconductors. Band structure of metals, semiconductors, and insulators. Semiconductor equilibrium. Doping and statistics. Carrier distribution, transport, and recombination. Carrier drift, diffusion, and conductivity. Hall effect. semiconductor growth. Semiconductor quantum structures. Modelling and application of selected semiconductor devices. P-n junction. Review of junction and bipolar transistor physics. Major emphasis on MOS devices including field effect transistors and charge coupled devices. Consideration of advanced bipolar structures. Schottky barrier devices. Optical properties of semiconductors (light emitting diodes and photo-detectors). Solar cells.

PHY 399/499: Industrial Attachment II (12/24 weeks)

(3/6 Units C)

Learning Outcomes

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

1. develop practical skills of the theories learned in the classroom;
2. acquire working experience of the industries;
3. handle relevant tools and equipment in the industries; and
4. write technical reports on their industrial work and present seminar.

Course Contents

Students should be attached to some relevant organizations for additional 12 weeks at the 300 level for the four (4) year program preferably during the long vacation, and for 24 weeks at the 400 Level for the five (5) year B.Tech. program during the second semester and the long vacation for more industrial experience training. Students to be assessed based on seminar presentation, technical reports, and assessment by supervisors.

400 Level

PHY 401: Quantum Mechanics I

(3 Units C: LH 45)

Learning Outcomes

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

1. state the postulates of quantum mechanics;
2. explain the basics of vectors and tensor operators;
3. solve a variety of physical problems using the Schrodinger equation;
4. work with angular momentum operators and their eigenvalues both qualitatively and quantitatively;
5. explain electron spin and the Pauli principle; and
6. apply perturbation theory and other methods to find approximate solutions to problems in quantum mechanics, including the fine-structure of energy levels of hydrogen.

Course Contents

Course Contents

The formulation of quantum mechanics in terms of state vectors and linear operators. Time evolution of the Schrodinger equation. The theory of angular momentum and spin. Electron spin and the Stern-Gerlach experiment. Identical particles and the Pauli exclusion principle. Multielectron atoms. Approximation methods. Variational methods and WKB approximation for bound states and tunnelling. Time - independent perturbation theory. The fine structure of hydrogen. Harmonic oscillator. Creation and annihilation operators. External fields. Zeeman and Stark effects in hydrogen.

PHY 402/502: Quantum Mechanics II

(3 Units C: LH 45)

Learning Outcomes

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

1. apply the mathematical tools of quantum mechanics;
2. recognise approximation methods in quantum mechanics;
3. explain the scattering theory;
4. identify the unitary transformations linked to symmetry operations;
5. apply time-dependent perturbation theory to variety of problems;
6. derive a mathematical description of quantum motion in electromagnetic fields;
7. apply the relativistic wave equations to simple single-particle problems; and
8. use Dirac notation to represent quantum-mechanical states and manipulate operators in terms of their matrix elements.

Course Contents

Time-independent and time-dependent perturbation theory. Scattering theory. Elastic potential scattering. Green's function and partial wave methods. Symmetries in quantum mechanics.

Rotations, space-time reflections and parity. Selection rules for atomic transitions. Emission and absorption of radiation. Selection rules for hydrogen. Description and interpretation of selected phenomena from each of atomic physics, molecular physics, solid-state physics, and nuclear physics using quantum mechanical models. Relativistic wave equation. The Klein-Gordon equation. The Dirac equation. Chirality. Lorentz invariance and non-relativistic limit.

PHY 403: Mathematical Methods for Physics I:

(3 Units C: LH 45)

Learning Outcomes

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

1. explain the concepts of scalar and vector fields;
2. describe the properties of div, grad and curl and be able to calculate the divergence and curl of vector fields in various coordinate systems;
3. calculate surface and volume integrals in various coordinate systems;
4. calculate flux integrals and relate them to the divergence and the divergence theorem;

Course Contents

5. calculate line integrals and relate them to the curl and to Stokes' theorem;
6. apply the methods of vector calculus to physical problems; and
7. calculate the fourier series associated with simple functions and apply them to selected physical problems.

Course Contents

Vector and scalar fields. Vector operators. Div, grad, and curl. Divergence theorem. Stoke's theorem. Linear Algebra and functional Analysis. Transformations in linear vector spaces and matrix theory. Hilbert space and complete sets of orthogonal functions. Special functions of mathematical physics (The gamma function; hypergeometric functions; Legendre functions; Bessel functions. Hermite and Laguerre functions. The Dirac - Delta function. Integral transforms and fourier series. Fourier series and fourier transforms. The Dirichlet conditions. orthogonality of functions. Fourier coefficients. Complex representation of fourier series. Laplace transform. Applications of transform methods to the solution of elementary differential equations of interest in physics and engineering.

PHY 404/504: Mathematical Methods for Physics II

(3 Units C: LH 45)

Learning Outcomes

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

1. describe the properties of different types of functions and be able to sketch them in both 2D Cartesian and polar coordinates;
2. integrate and differentiate functions of one variable using a range of techniques and be able to apply integration and differentiation to a range of physical problems;
3. show how smooth functions can be expressed in terms of power series;
4. explain the properties of complex numbers and construct some basic complex functions;
5. employ matrix notation, carry out matrix algebra and use matrices to solve systems of linear equations;
6. compute the properties of determinants, be able to evaluate them, and use them to test for unique solutions of linear equations; and
7. solve first and second order ordinary differential equations using a range of techniques.

Course Contents

Partial differential equations. Solution of boundary value problems of partial differential equations by various methods which include separation of variables, the method of integral transforms. Sturm-Liouville theory; uniqueness of solutions. Calculus of residues and applications to evaluation of integrals and summation of series. Applications to various physical situations, which may include, electromagnetic theory, quantum theory, diffusion phenomena; complex variable theory and their relation to selected physical problems. Complex differentiation and integration. Cauchy's theorem. Taylor's and Laurent's series. Ordinary differential equations of first and second order and their physical applications. Homogeneous partial differential equations.

Course Contents

PHY 405: Physics Entrepreneurship

(2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. develop creative ability to apply physics knowledge to real-world settings;
2. generate ideas of innovation and entrepreneurship; and
3. apply entrepreneurial skills and mindset in approaching societal problems.

Course Contents

Creativity. Developing questioning attitude. Concept development. Reconstructionism. Critical thinking and brainstorming. Use of practical and creative techniques in concept development. Identifying underlining physics principles in real life situations and physics principles driving equipment design. Product development and requirements. Team building. Product and service design concepts. Consumer driven design. Business planning. Marketing and market research. Intellectual property. Pricing and financial strategies. Finding sources of funding.

PHY 411: Nuclear and Particle Physics I

(2 Units C: LH 30)

Learning Outcomes

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

1. describe the nuclear structure and properties;
2. explain the nuclear forces;
3. explain nuclear particle reactions and nuclear reactors;
4. illustrate the mechanism of scattering and absorption of nuclear particles;
5. describe the models for nuclear reactions; 6. calculate binding energies in nuclear reactions;
7. determine the decay rate in nuclear reactions.

Course Contents

Basic concepts in nuclear physics. Measurements of nuclear mass and charge radii. Electron scattering. Muonic atoms. Electromagnetic moments. Hyperfine structure. Nuclear deformation. Mechanisms of nuclear decay (α decay). Barrier penetration; Geiger-Nuttal systematics. Relationship to proton/heavy fragment emission. β decay. Fermi theory. Selection rules. γ decay of excited states. Multipolarity. Selection rules and decay probabilities. Excited States of Nuclei. Description of the properties of excited states using the nuclear shell model. Rotational and vibrational states. Nuclear reactions (cross section; simple features of nuclear reactions. direct and compound nuclear mechanisms; fusion and fission; liquid drop model.

PHY 513: Physics of the Solar Systems

(2 Units C: LH 30)

Learning Outcomes

Course Contents

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

1. provide a qualitative description of the solar system from origin to present state;
2. apply dynamical principles to understand phenomena such as tides and orbits in the solar system;
3. carry out a simple orbit calculation, based on energy and angular momentum conservation on the basis of Kepler's laws and the Virial theorem;
4. describe the nature of the sun by considering it as a black body and body in hydrostatic equilibrium;
5. explain the basic principles behind the energy generation in the sun;
6. describe the nature of planetary atmospheres and explain the origin of the Earth's greenhouse effect;
7. describe the internal constituents of the planets;
8. explain how planetary ring systems may be formed;
9. state the consequences of planetary interaction in the solar system; and
10. explain the evolution of the solar system.

Course Contents

Overview of the solar system (general description and inventory). Coordinates and time keeping. Gravity. (Kepler's laws and Newton's law of gravity). Properties of orbits. The virial theorem. Tidal forces and tidal friction. Evolution of the moon and the Sun. Freefall time scale and Kelvin Helmholtz time scale. Hydrostatic equilibrium. Nuclear reactions. Neutrinos. Helioseismology. Planetary atmospheres. Albedo and optical depth. Scale height. Reducing and oxidizing atmospheres. Greenhouse effect. Ice ages. Planetary surfaces: Impact craters. Isotope dating. Planetary interiors. Liquid cores. Heat generation. The formation of the solar system.

PHY 529: Introduction to Astrophysics and Cosmology

(2 Units C: LH 30)

Learning Outcomes

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

1. explain the composition and structure of the atmosphere;
2. explain the magnetosphere and its boundaries and interactions with plasma;
3. state the nature of the sun's radiation and principles of radiative heat transfer;
4. describe the sources and nature of atmospheric turbulence;
5. apply the concept of charge production, transport, and loss in the atmosphere; and
6. explain the transport of atmospheric electricity via thunderstorm and the fair-weather condition.

Course Contents

The Universe and its physics (A tour of the Universe, its scale and contents, gravity, pressure and radiation). The age of the universe. Evolution of the universe. Evidence for the Big Bang theory. Observational astronomy. The electromagnetic spectrum. Geometrical optics. Resolving power and the diffraction limit. Telescopes and detectors. Gravitational waves. Astronomical distances. Parallax

Course Contents

measurements. Standard candles. Physics of the sun and stars. Blackbody radiation. Stefan-Boltzmann and Wien laws. Effective temperature. Interstellar reddening. Hydrogen spectral lines and Doppler effect. Hertzsprung-Russell diagram. Freefall and Kelvin-Helmholtz time.

Nuclear fission and fusion. Basic stellar structure (hydrostatic equilibrium, equation of state). White dwarfs. Neutron stars and black holes. Planetary systems. Kepler's laws. Detection methods of extrasolar planets. Search for life elsewhere. SETI. Galaxies. Star formation and the interstellar medium. Stellar populations. Galaxy rotation curves. Mass and dark matter. Galaxy collisions. Cosmology: Olber's paradox. Hubble's Law. Dark energy and the accelerating Universe.

PHY 421: Biophysics I

(2 Units C: LH 30)

Learning Outcomes

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

1. describe the processes and effect of interactions of radiation with matter;
2. explain the concept of electricity and magnetism at the cellular levels;
3. illustrate and explain the effect of impulse in nerves and muscles; and
4. explain solute transport in membranes.

Course Contents

Molecules and Cells. Mesoscopic forces. Phase transitions. Motility. Aggregating and selfassembly. Surface phenomena. Biomacromolecules. Charged ions. Polymers. Membranes. Rheology. Sensory motors. Chemical kinetics. Enzyme kinetics. System biology. Spikes. Physiology of cells and organisms. Biological sensors. Ionization of biomolecules. Thermodynamic principles. Energy transfer in living systems. Bioelectricity (ion channels, action potentials nerve impulse transmission).

PHY 455/555: Research Project

(6 Units C: PH 270)

Learning Outcomes

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

1. design and or conduct a research work on the basis of some physical laws or principles;
2. write scientific reports;
3. present and defend on a scientific research work.

Course Contents

The course offers students the opportunity to do research in contemporary physics under the supervision of a staff. A detailed report on the research is to be presented and defended by the student when the project is completed.

GOU-PHY 416: Borehole Geophysics (2 Units; Elective; LH = 15; PH = 45)

Course Contents

Senate–Approved Relevance

Water exploration and borehole drilling for efficient water supply in the university and its environs is an indisputable study of the Earth's physical characteristics. This course is developed to train the students on groundwater and environmental investigations to obtain information on good construction, rock lithology and fractures, permeability and porosity, and water quality. The students will acquire prerequisite skillsets needed to analyze the Earth's crust and determine water channels below the Earth's crust as well as harness the available water resources. This is in agreement with the Godfrey Okoye University's Mission and Vision statement which centered on training, education, and empowering students with undiluted knowledge and skillsets so that the students will be outstandingly excellent in character and learning as well as becoming entrepreneurs and employers of labour.

Overview

This course is an introduction to the measurements of physical properties that are done in wells. It elucidates the diverse methods and tools used to collect data, and also gives basics information for the interpretation of graphically displayed data from logs which can be used in groundwater, oil, and environmental investigation to obtain information from wells. The rocks do not vary only by their macroscopic or microscopic properties studied by field geologists, but they also vary in their chemical and physical properties.

Borehole geophysics is used in groundwater and environmental investigations to obtain information on good construction, rock lithology and fractures, permeability and porosity, and water quality. Students can analyze the Earth's crust and discover water channels below the Earth's crust and as well harness the available water resources.

Objectives

The objectives of this course are to:

1. Define the concept of geophysical drilling.
2. State the applications of geophysics in borehole drilling.
3. Explain the importance of studying the physics of borehole drilling.
4. Explain the advantages and disadvantages of seismic processing in borehole drilling.
5. List at least five hydrogeologic units.
6. Explain the processes involved in examining groundwater quality.

Course Contents

7. Define logging in borehole drilling.
8. State the types of logging in borehole drilling.
9. List five types of equipment used in logging.
10. Integrate borehole geophysics logging with water-quality sampling.

Learning Outcomes

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

1. Define the fundamentals of rock physics.
2. Explain the recovery factor of hydrocarbon reservoirs.
3. Explain the relationship between borehole measurements and surface measurements.
4. Describe the scale limitation of the surface data and also the limitations of borehole data, as it is being used for calibration.
5. Explain the concept of good logging.
6. Explain surface seismic methods in borehole geophysics.
7. State the tools used in borehole drilling.
8. Conduct ground surface analysis for tracking water channels.

Course Contents

Introduction. Concept of logging and techniques. Electrical logging methods. Conventional resistivity logs. Focused electrode logs. Induction logs. Micro-resistivity logs. Self-potential. Gamma-ray logs. Induced polarization. Dip meter. Porosity logs. Sonic logs. Formation-density. Neutron logs. Neutron-density logs. Determination of lithology. Porosity. Saturation. Permeability in clay. Logs in reservoir characterization.

Minimum Academic Standards

Geophysical laboratory with NUC-MAS requirements and facilities including Fluid temperature, fluid resistivity, mechanical caliper, optical and acoustic viewers, natural gamma, borehole flow meters (heat-pulse flow meter and the flow impeller), and advanced borehole logging.

GOU-PHY 434: Environmental Physics (2 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance

Course Contents

Environmental Physics points to the oneness of the Earth as a system and as an entity. The study is a typical illustration of the Philosophy of the university rooted in epistemic dialogue. The course not only illustrates the unity of the Earth as a system, but also demonstrates contributions of the atmosphere, hydrosphere and the lithosphere and the sustainability of each component. Human exploitation of these components determines the possibility of human survival. The course points to and emphasizes the utility of the environment for man in general both as a natural gift and as a cultural heritage. Senate appreciates this course for its sustainability content, and so approves it as a Physics course

Overview

This course drills students in the understanding the socio-economic implications of the interactions of the components of the environment viz: the Earth's crust, i.e. the lithosphere, the atmosphere and the hydrosphere. The physics aspect emphasizes on the processes involved without understanding the physical aspects of the environmental interactions, it will be difficult to understand and appreciate our survival contest of the environment. It is only when the above (atmosphere) is clear to man that he can effectively apply physics in and to our survival.

The study of environmental physics as a core course will rationalize its application to our daily lives as well as making the study part and parcel of socio-economic survival sources of employment and the production of goods for sales. The study will also equip us with strategies for healthy living.

Objectives

The objectives of the course are to;

1. Explain the history of the Earth.
2. Explore the development of the Earth's interior.
3. Explain the process of the continental drift and its effects on the land-water disposition.
4. Discuss the process of stream development.
5. Define weathering and soil formation.
6. Identify and explain the contributions of weather and stream development to environmental pollution.
7. Describe the solar system and explain its contributions to the temperature of the environment and heat transfer.
8. Describe the process of the generation of environmental temperature.
9. Identify environmental temperature variables; land, water and air temperature.
10. Develop weather recording and analysis skills.

Learning Outcomes

Course Contents

On the completion of this course, students should be able to;

1. Identify all the components of environmental physics and the uses and implications to life.
2. Use the available instruments to measure environmental variables.
3. Explain the environmental variables and decipher how to avoid their adverse effects for the preservation of life, conservation of the environment and the products.
4. Produce two instruments for the environmental conservation and reading e.g., instruments for weather reading.
5. Discuss strategies for erosion control, firefighting and so on.
6. Construct products that can be marketable.

Course Contents

Introduction. History of the Earth. Earth's interior. Content of the Earth's interior. Mechanism of the interior of the Earth. Soil layers and types. Continental drift. Rock weathering. Soil erosion. Ground water. Surface water development. Ecology and vegetation. The Earth's atmosphere. Structure of the Atmosphere. Atmospheric circulation. Weather. Environmental Variables. Weathering and Soil formation. Impacts of weather on the environment.

Minimum Academic Standards

Thermometer- dry and wet bulb, maximum and minimum thermometers, earth thermometers- complete set, wind vane, wind run, anemometer, class A pan, evaporimeter, rain gauge, upper air balloons, GPS machine, meter rules, prismatic compass, tapes- metal fibre, 50mm and 100mm, measuring wheel, Steven's Screen (Complete Set)

GOU-PHY 496: Thin Film Technology (2 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance

In harmony with the vision and mission of Godfrey Okoye University which emphasizes the dissemination and acquisition of wholistic knowledge, this course aims towards producing physics graduates with thorough understanding of the concept of thin film technology and solar energy with broad practical knowledge of renewable energy sources. The goal is to create entrepreneurial opportunities in the area of solar energy in line with sustainable development goals.

Course Contents

Overview

Energy plays a pivotal role in the overall well-being of mankind. The significance of renewable energy cannot be overemphasized in our ever-changing world. As the energy demand of the world continues to increase by the day, the economy of the world gets driven also by technology.

Non-renewable energy such as fossil fuel, crude oil and natural gas can hardly meet the world energy needs. Hence, the indispensability of renewable energy. More importantly, it will help in producing Physics graduates that would be self-reliant which is in congruence with the sustainable development goals (SDGs).

Objectives

The objectives of the course are to:

1. Identity the basic concepts of solar energy.
2. Describe the fundamental concepts of thin films.
3. Describe the methods of deposition.
4. Describe the physical techniques of thin-film technology.
5. Describe the chemical techniques of thin film technology
6. Explain the concept of scanning electron microscope (SEM).

Learning Outcomes

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

1. Define thin film.
2. Explain three basic concepts of thin films.
3. Outline two principles of thin film technology.
4. Describe the basic procedures in constructing a thin film.
5. Distinguish between physical and chemical characterization.
6. Describe the working principles of a scanning electron microscope.
7. Explain the working principles of a transmission electron microscope (TEM).
8. Construct a thin film unit of solar energy device.

Course contents

Course Contents

Introduction to thin films. Materials and Wafer preparation. Safety and precautionary measure before deposition. Deposition. Methods of deposition. Physical techniques. Chemical techniques. Scanning Electron Microscope (SEM) and its principle of operation. Transmission Electron Microscope (TEM) and its principle of operations. Chemical Vapour Deposition (CVD) and its principle of operation. Physical Vapour Deposition (PVD). Four point probes and its principle of operation. Sputtering machines. Characterization.

Minimum Academic Standards:

- **CIGS Evaporation System**
- **Sputtering Deposition System**
- **Metal Thermal Evaporation System**
- **Glove Box**
- **CdS Film Deposition**
- **Spin Coaters**
- **Furnace**
- **Semiconductor/Solar Cell Characterization Stations:**
- **Electrochemical Test Station**
- **Quantum Efficiency System**
- **UV-VIS Photospectrometer**
- **Surface Profilometer**
- **Four-Point Probe Station**
- Scanning electron microscopes

Minimum Academic Standards

Staffing

Academic Staff

The guidelines on academic staff/student ratio of 1:20 for Science Programmes shall apply. To start any programme in Science, there should be a minimum of six academic staff. There is need to have a reasonable number of staff with PhD degrees accounting for at least 70% of the total number and having adequate teaching experience for every programme in the Discipline.

Administrative Support Staff

Course Contents

The services of the administrative support staff are indispensable in the proper administration of the Department. It is important to recruit very competent, computer literate senior staff.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance.

Classrooms, Laboratories, Workshops and Office

Space The NUC recommends the following physical space requirements:

Description		Size m ²
Professor's Office	-	18.50
Head of Department's Office	-	18.50
Tutorial Teaching Staff's Office	-	13.50
Other Teaching Staff Space	-	7.00
Technical Staff Space	-	7.00
Secretarial Space	-	7.00
Research Laboratory	-	16.50
Seminar Space/per student	-	1.85
Laboratory Space per FTE	-	7.50
Conference Room	-	37.0

Library

The University Central Library should be well stocked with current journals, textbooks, and reference materials for the use of staff and students. The library should be linked with internet for information sourcing. There should be subscription to at least two relevant database.

Equipment

S/N	Description
1	Measuring cylinder 250 ml (glass + plastic)
2	Measuring cylinder 50ml
3	Measuring cylinder 25ml
4	Measuring cylinder glass (0 – 1000 ml)

S/N	Description
5	Harris ripple tank
6	Beaker (50ml, 250 cc)
7	Glass beaker (4,000ml)

Course Contents

8	Flat bottom flask
9	Stopwatch
10	Stop clock
11	Weight (1Kg, 2Kg, 5Kg)
12	Weight (500g, 200g, 100g, 50g, 20g, 10g, 5g)
13	Weighing balance digital
14	Weighing balance Metter
15	Air blower
16	Pulleys
17	Calorimeter
18	T Square
19	Wet cells
20	Tripod stand
21	Hydrometer
22	Spring balance
23	U Tube
24	Glass funnel
25	Conventional air apparatus
26	Rectangular glass block
27	Convex lens
28	Glass prism
29	Bar and gauge
30	Telescope
31	Linear expansion apparatus
32	Bulb hide
33	Mercury metal (800g)
34	Resistor Box (100 Ω , 1000 Ω)
35	Resistor (0.6 Ω)
36	Turning forks
37	Standard resistors (1, 2, 5, 10, 20, 50, 100 Ω etc.)
38	Rheostat
39	Decade resistance box
40	Oscilloscope (Double beam)
41	Signal generator
42	Spectrometer
43	Transformer
44	Sodium lamp
45	Mercury lamp
46	Extensometer

Course Contents

47	Density bottle
48	Wooden board
49	Meter bridge

S/N	Description
50	One way key
51	Boyles law apparatus
52	Voltmeter
53	Ammeter
54	Galvanometer
55	Universal indicator
56	Relays
57	Burette
58	Meter rule
59	Table lamp
60	Optical bench
61	Micrometre screw gauge
62	Vernier calliper
63	Filter paper
64	Litmus paper
65	Standing fan
66	Thermometer (Mercury in glass, alcohol in glass)
67	Slotted masses (1, 2, 5, 10 Kg)
68	Slotted masses (5, 10, 20, 100, 200, 500g)
69	Micro amplifier
70	Pyrometer
71	Micrometre screw gauge
72	Decade capacitor
73	Standard capacitors
74	Long Glass tubes
75	High Current DC power supply
76	Turning forks
77	Plastic tubes
78	Aluminium sheets
79	Tetrameter
80	Connecting cable
81	Metal electrode
82	Interface cable
83	Metallic-bucket

Course Contents

84	Drawing board
85	Force board
86	Young modulus apparatus
87	Meter rule
88	Optical bench (Wooden)
89	Ray box
90	Avometer (Analogue)
91	Copper sheets
92	Discharge lamp
93	Meldes apparatus
94	Soldering wire

S/N	Description
95	Battery charger
96	Burette (50cc)
97	Lens holder (Wooden)
98	Spiral spring
99	Plane mirror
100	Microscope slide
101	Sonometer
102	Soldering iron
103	Simple Microscope
104	Travelling microscope
105	Specific gravity bottle
106	Barometer
107	Hydrometer
108	Diffraction grating
109	Sodium lamp
110	Table lamp
111	AC Ammeter /voltmeter
112	Ammeter (Double Range)
113	Milliammeter (Double Range)
114	Beaker (Pyrex 500cc)
115	Retort Stand (Complete)
116	Millivolt meter
117	Chemical Balance
118	Galvanometer
119	One-Way-Key
120	Jockey

Course Contents

121	Wheatstone Bridge
122	Electrolyte Capacitor
123	P – N Junction Diode
124	Standard Electrodes
125	Bar Magnet
126	Decade Capacitance Box
127	High Vacuum Intonation (Edwards)
128	Projector
129	Science Workshop 750 Interface (USB)
130	Model CI 75gg with accessories
131	Vacuum Pump
132	Spectrum Analyzer
133	Model 80 801OB
134	Hydro - electrical Power Station Apparatus
135	Volume determination of a solid Kit No.042
136	Air as a thermal insulator Kit No.045
137	Steam Canon KL No. 017
138	Osmotic pressure Kit No. 084
139	Conductivity of Solution with Kit No.006

S/N	Description
140	Conductivity of Solid Kit No.005
141	Visualizing Hydrostatic pressure Kit No.063
142	Marioff's column and flow rate devices Kit No.064
143	Liquid at different sensitivities Kit No.048
144	Conductivity in Liquids Kit Nos. 036 & 037
145	Porosity of Bricks Kit No. 072
146	Chemical activation of an electric motor Kit No. 032
147	Floating Bodies in Liquids of different densities Kit No.049
148	Thermal expansion of a bimetallic strip Kit No. 040
149	Prism Kit 075+076+077
150	Experiments in electromagnetism Kit Nos. 003 & 007
151	Electric Generator Kit No.018
152	Steady hand Kit No. 038
153	The cave of Dogs Kit No.079
154	Two –ball pendulum Kit No.030
155	Melting a metal in Hot Water Bismuth Alloy Kit No.046
156	Flow rate of Liquids with different viscosities Kit No.055

Course Contents

157	Maxwell's Pendulum Kit No.031
158	Air Occupies Space Kit No.041
159	Intermolecular Spaces in Liquids Kit No.069
160	Inter atomic forces in metals Kit No. 068
161	Conductivity of Solutions and Solids Kit No.004
162	Heating Water with a Concave Mirror Kit No.078
163	Electromagnetism: Oested's effect Kit
164	Double Slit
165	Grating
166	Convex Mirror
167	Plane Mirror
168	Electric field meter
169	Altitude meter
170	Hot Plate
171	Digital Stop Clock
172	Compound Pendulum
173	Optical Bench (Metallic Screen& Lens Holder)
174	Avometer (Analogue)
175	Avometer (Digital)
176	Mercury Lamp
177	Box of Aluminium Foil
178	Handling Tong
179	Radioactive Sources
180	Radioactive Cabinet
181	EMS Radiation Meter
182	Heat Index Meter
183	New Temperature Coefficient Apparatus

S/N	Description
184	Distiller
185	Ammeter (Variable range AC/DC or DC)
186	Angle Table Lamp
187	Abingdon Sound Wave Kit
188	Air Cell
189	Adaptor WPA (Shunts)
190	A/C Potentiometer (Wide Range)
191	Tetrameter SAS 1000
192	Adaptor WPA (Shunts)
193	A/C Potentiometer (Wide Range)

Course Contents

194	Audio Amplifier
195	A/C – DC Lamp (S N)
196	AC/DC Converter Trainer (AD 4101)
197	AC/DC Power Supply Baku (BK 1502 DD)
198	Analogue dial (Various turns)
199	Aluminium Solder (16 SWG)
200	AM/DSB Transmitter (KL 93061)
201	AM Radio Transmitter
202	Battery Charger
203	Basic Spark Source
204	Bunsen Burner
205	Bi-convex Lens (Various focal length)
206	Bi-concave Lens (Various focal length)
207	Beaker Pyrex (Various ml)
208	Beaker Plastic (250 ml)
209	Beaker CSN (Various ml)
210	Bar Magnet
211	Blade Connector
212	Battery Clips
213	Cathode ray tube (Unilab)
214	Ballistic Module 099624
215	Bench Power Supply (Philip Harris G85458)
216	Copper Wire
217	Constantan Wire
218	Constantan Alloy
219	Camera Lens
220	Camera (Simple type)
221	Camera (For Oscilloscope)
222	Capacitance Box (Type C500)
223	Capacitance substitution box 012308
224	Cathode ray Oscilloscope 099622
225	Convex Mirror (Various Focal Length)
226	Concave Mirror (Various Focal Length)
227	Coiled Core
228	Cable (3 Core)

S/N	Description
229	Cable, (Individually screened 4 core)
230	“ (Screened, twin)

Course Contents

231	“ (Low noise)
232	“ (Air spaced coax)
233	“ (300 Ohms twin feeder)
234	Capacitor, electrolyte (Various values)
235	Cable Polystyrene (Various values)
236	“ Silvered mica (Various values)
237	“ Ceramic (Various values)
238	“ Paper (Various values)
239	“ M D C (Various values)
240	“ Trimmers Compression
241	“ Trimmers
242	Circuit Breaker (Various amps)
243	Capacitor Suppression
244	Choke Suppression (Various values)
245	CMOS Logic checker
246	Crystal Sockets
247	Crimp connectors (Various types and sizes)
248	Communing block
249	Communing connectors
250	Clock timer IC
251	Condenser microphone
252	Dart Board Set
253	Discharge lamp holder
254	Discharge lamp transformer
255	Discharge lamp, sodium
256	Discharge lamp, cadmium
257	Discharge lamp, mercury
258	Discharge lamp, Helium
259	Discharge lamp, Neon
260	Digital multimeter
261	Diode (Various types)
262	Digital dial (10 turns)
263	Differential amplifier 1445
264	Diffraction Grating
265	Digital Clock module
266	D to A converter IC ZN 425 E
267	Darlington drivers
268	4-Decade counter driver
269	Dual pin recorder

Course Contents

270	D C Power Supply (ST 4078)
271	Electric timer 6 – 12V AC
272	Etch resist ink pen
273	Electro conductive paint

S/N	Description
274	Electronic alternator IC
275	Electricity LAB (NV6000)
276	Electronics Kit (Basic Elect. Expt PK101)
277	e/m Apparatus (SE 9638)
278	Frequency counter
279	Fuses (Various values and sizes)
280	Fresnel Biprism
281	Ferrite beads
282	F E T input OP amp DIL
283	“ (Various types)
284	Function Generator
285	Fibre Optic Kit (Fok 721)
286	FM Transmitter (KL 93063)
287	Geissler's tube Helium
288	“ “ Argon
289	“ “ Hydrogen
290	“ “ Nitrogen
291	“ “ Mercury
292	“ “ Oxygen
293	“ “ Neon
294	“ “ Unknown
295	“ “ Carbon Dioxide
296	“ “ Holden
297	Galvanometer
298	“ Electronic
299	Manganin wire
300	Mobile Phone Trainer
301	Nanovolt pre-amplifier
302	Neon indicator 250V (Various colours)
303	Nichrome wire
304	Solar Cells
305	LED Lights
306	Waveform generator

Course Contents

307	Holography set
308	Interferometer
309	Physical optics kit
310	Leak rate meter
311	Photocell
312	Photodiode
313	Rectifier unit
314	T S Module 401.1 Diode characteristics
315	T S Module 401.2 DC power supply unit
316	Transmission Line Trainer (ST 2261)
317	Junction transistor common base connection
318	Junction transistor common emitter
S/N	Description
319	Transistor Tester
320	Unijunction transistor (U J T)
321	Constant Current Source
322	Emitter Follower voltage stabilizer
323	Free-running multivibrator
324	Silicon controlled rectifier
325	Travelling microscope
326	Multivibrator
327	555 Timer
328	Relay
329	Sunshine Recorder with Accessories
330	Solar Power Meter
331	Sound Level Meter
332	Advanced Spectrometer
333	Semiconductor Kit
334	Modern Tech. & Electronic Trainer System
335	Communication Training System
336	Technology & The Computer Training System
337	Analog Communication Training System
338	Digital Communication Training System
339	Optical Communication Trainer
340	Analog-Digital Signal Conversion Trainer
341	Electricity & Semiconductors Training System
342	Analog Electronics Training System