8.1 B.Sc. DEGREE, COURSE CONTENT

100 LEVEL

FIRST SEMESTER

GROUPING	COURSE CODE	COURSE TITLE	CREDIT HOUR OR UNIT	LECTURE HOUR	TUTORIAL HOUR	PRACTICAL HOUR
GENERAL STUDIES COURSES	GSS 101 GSS 111	Use of English/Library I Introduction to Computer Studies	2 2	2 2	- -	- -
CORE COURSES	CHM 101	General Chemistry I	3	3	-	-
	PHY 101	General Physics I (Mechanics, Properties of Matter, Thermal Physics	3	3	-	-
	CHM 107	Practical Chemistry I	1	-	-	3
	MTH 111	Algebra and Trigonometry	3	3	-	-
	PHY 181	General Physics Laboratory I	1	-	-	3
	PHY 191	Geometrical Optics and Waves	3	3	-	-
	BIO 101	General Biology I	3	3	-	-
Total			**21**			
SECOND SEMESTER						
GENERAL STUDIES COURSES	GSS 102 GSS 114 GSS 122	Use of English/Library II Computer Application History and Philosophy of Science	2 2 2	2 2 2	- - -	- - -
CORE COURSES	PHY 102	General Physics II (Electricity, Magnetism and Optics)	3	3	-	-
	STA 102	Statistics for Physicists	2	2	-	-
	PHY 182	General Physics Laboratory II	1	-	-	3
	CHM 102	General Chemistry II	3	2	-	-

	CHM 108	Practical Chemistry II	1	-	-	3
	MTH 112	Calculus	3	3	-	-
	MTH 122	Coordinate Geometry	2	2	-	-
	BIO 102	General Biology II	3	3	-	-
Total			**24**			

200 LEVEL

FIRST SEMESTER

GROUPING	**COURSE CODE**	**COURSE TITLE**	**CREDIT HOUR OR UNIT**	**LECTURE HOUR**	**TUTORIAL HOUR**	**PRACTICAL HOUR**
GENERAL STUDIES COURSES	GSS 211 GSS 201	Introduction to Computer Studies Introduction to Entrepreneurial Studies	2 2	2 2	- -	- -
	MTH 211	Advanced Calculus	3	3	-	-
	PHY 211	Theoretical Mechanics	3	3	-	-
	PHY 221	Vibration and Waves	2	2	-	-
	MTH 231	Linear Algebra	3	3	-	-
	PHY 241	Thermal Physics	3	3	-	-
	PHY 251	Electromagnetism	3	3	-	-
	PHY 281	General Physics Laboratory III	1	-	-	3
Total			**22**			
SECOND SEMESTER						
GENERAL STUDIES COURSES	GSS 212	Computer Applications	2	2	-	-
	MTH 212	Introductory Differential Equation & Mathematical Methods	2	2	-	-
CORE COURSES	PHY 206	General Physics V (Introduction to Energy and Environment)	1	1	-	-
	PHY 212	Special Relativity	2	2	-	-

	MTH 222	Numerical Analysis	3	3		
	PHY 222	Atomic Physics	3	3	-	-
	PHY 252	Electric Circuit and Electronics	3	3	-	-
	PHY 262	Introduction to Space Physics	3	3	-	-
	PHY 282	General Physics Laboratory IV	1	-	-	3
	PHY 292	Physics of Solid Earth	2	2	-	-
Total			**22**			

300 LEVEL

FIRST SEMESTER

GROUPING	COURSE CODE	COURSE TITLE	CREDIT HOUR OR UNIT	LECTURE HOUR	TUTORIAL HOUR	PRACTICAL HOUR
GENERAL STUDIES COURSES	GSS 301	Introduction to Entrepreneurial Skills	2	2	-	-
CORE COURSES	PHY 301	Workshop Practice (Electronics & Mechanical)	2	2	-	-
	PHY 311	Analytical Mechanics	3	3	-	-
	PHY 321	Solid State Physics	3	3	-	-
	MTH 331	Complex Variables I	3	3	-	-
	PHY 341	Statistical Physics	3	3	-	-
	PHY 351	Electromagnetic Theory	3	3	-	-
	PHY 361	Electronics I	2	2		-
	PHY 381	General Physics Laboratory V	1	-	-	3
Total			**22**			
SECOND SEMESTER						-
CORE COURSES	PHY 342	Industrial Training (SIWES)	6	6	-	-

400 LEVEL

FIRST SEMESTER

GROUPING	COURSE CODE	COURSE TITLE	CREDIT HOUR	LECTURE HOUR	TUTORIAL HOUR	PRACTICAL HOUR

			OR UNIT			
CORE COURSES	PHY 401	Seminar	1	1	-	
	PHY 411	Computational Physics	3	3	-	-
	PHY 421	Theoretical Solid State Physics	3	3	-	-
	PHY 431	Quantum Mechanics I	3	3	-	-
	PHY 471	Nuclear Physics I	3	3	-	
	PHY 413	Energy & Environment	2	2	-	-
	PHY 441	Mathematical Methods in Physics I	3	3	-	-
	PHY 483	General Physics Laboratory VI	1	-	-	3
		Elective	3	3	-	-
TOTAL			**22**			
ELECTIVE COURSES	First Semester					
	PHY 415	Astronomy I	3	3	-	-
	PHY 417	Geophysics I	3	3	-	-
	PHY 445	Semiconductor Physics	3	3	-	-
	PHY 447	Elementary (High Energy) Particles Physics I	3	3	-	-
	PHY 461	Space Plasma Physics	3	3	-	-
	PHY 463	Atmospheric Physics	3	3	-	-
	PHY 481	Acoustics I	3	3	-	-
SECOND SEMESTER						
CORE COURSES	PHY 400	Project	6	6	-	-
	PHY 432	Quantum Mechanics II	3	3	-	-
	PHY 442	Mathematical Methods in Physics II	3	3	-	
	PHY 484	Electronics II	3	3	-	-
	PHY 492	Physical Optics	2	2	-	
		Electives	3	3	-	
Total			**20**			
ELECTIVE COURSES	**Second Semester**					
	PHY 418	Geophysics II	3	3		
	PHY 426	Non-conventional Energy	3	3		

	PHY 428	Waste Management and Recycling	3	3		
	PHY 434	Biophysics	3	3		
	PHY 436	Astronomy II	3	3		
	PHY 444	Semiconductor Physics	3	3		
	PHY 448	Elementary (High Energy) Particles Physics II	3	3		
	PHY 472	Nuclear Physics II	3	3		
	PHY 482	Acoustics II	3	3		

8.2 COURSE DESCRIPTION/OUTLINE

PHY101:General Physics I (Mechanic, Properties of Matter, and Thermal Physics) - 3 Credit Hours

Units and Dimensions; Vectors and Scalars. Kinematics; Fundamental Laws of Mechanics, Statics and Dynamics; Galilean Invariance; Universal Gravitation; Rotational Motion; Velocity; Acceleration; Projectile; Motion in a Plane; Angular Velocity; Angular Acceleration; Linear Momentum; Circular Motion; Newton's Laws of Motion; Force; Frictional Force; Mass; Translational and Rotational Equilibrium; Work Energy and Power; Simple Harmonic Motion; Atomic Theory of Matter; Solid State and Intermolecular Forces; Elasticity; Hooke's Law; Young's Shear and Bulk Moduli; Elastic Deformation; Hydrostatics; Bernoulli and Continuity Equation; Turbulence;

Reynold's number; Viscosity; Laminar Flow; Poiseuille's Formula; Surface Tension; Adhesion; Cohesion; Capillarity; Drops and Bubble; Equation of Fluid Flow; Stoke's Law; Supersonic Flow; Temperature and Work Heat; Capacities and Thermal Expansion of Solids, Liquids and Gas; Law of Thermodynamics.

PHY 102: General Physics II (Electricity, Magnetism and Optics) – 3 Credit Hours

Electrostatics; Electrical Nature of Matter; Induction; Sharp Points; Conductors and Insulators; Charges; Transport Charge; Generators and Accelerators; Van de Graaf Accelerator; Coulombs Law; Charge Distribution; Electric Field and Electric Potential; Capacitor and Capacitance; Energy Storage; Dielectrics.

Current Electricity: Conductors; Resistances; Resistivity; Conductivity; Ohm's Law; Simple Circuits and Circuit Components; Measurement and Measuring Instruments; Batteries and Accumulator; Electrolysis. **Electromagnetism:** Magnets and Magnetic

Field; Magnetic Force; Inductors and Motors; Galvanometer; Ammeter and Voltmeter; Induced Magnetic Field; Field Lines; Biot-Savart Law; Amperes Law; Faraday's Law; DC Motor; Ballistic Galvanometer and Flux Density.
Optics: Nature and Propagation of Light; Geometrical Optics and Wave Optics.

PHY 132: Modern Physics – 3 Credit Hours
Structure of Atom; Measurement of e/m for Electrons; Structure of the Nucleus; Static Properties of the Nucleus; Radioactive Transformations; Binding Energy; Wave Equation; Planck's Constant; Momentum; Speed of Light; Einstein's Energy Equation; de Broglie Hypothesis; Wave and Particle Duality; Basic Quantum Theories; Interaction of Radiation with Matter; Theory of Duality of Wave and Particle (Photoelectric, Bremsstrahlung, Compton Effect, Creation and Annihilation of Particle, Red Shift); Bohr Theory of the Atom; Quantum Number; Space Quantization; Spin; Pauli's Exclusion Principle; the Uncertainty Principle.

STA 102: Statistics for Physicists – 3 Credit Hours
Basic Concept and Implications of Statistics; Variable and Data Sampling; Data Collection; Data Table and Graphs; Central Tendency; Arithmetic Mean; Geometric Mean; Harmonic Mean, Median and Mode; Fractile; Variance; and Standard Deviation; Moment; Skewness; etc. Regression and Correlation; Time Series and Forecasting; Application of Excel Packages.

PHY 181: General Physics Laboratory I – 1 Credit Hour
Method of Measurements; Error Analysis; Graphs; Use of Balances; Meter Rule; Laboratory Vernier Calipers; Thermometer; Micrometer Screw Gauge; and Stopwatch; Experiments on Basic Measurements; Mechanics; Properties of Matter, and Heat.

PHY182: General Physics Laboratory II – 1 Credit Hour
Method of Measurements; Graphical Analysis; Error Analysis; Use of Ammeters and Voltmeters; Experiments on Light; Sound; Electricity and Magnetism.

PHY 191: Geometric Optics – 3 Credit Hours
Waves and Rays; Wave Fronts; Huygens's Principle; Reflection; Plane and Curved Mirrors; Laws of Reflection; Real and Virtual Images; Incline Mirrors; Focal Length; and Radius of Curvature; Refraction; Refractive Index; Real and Apparent Depth; Refraction

through Prism; Minimum Deviation; Dispersion; Lenses; Lens Equations; Lateral Magnification; Measurement of Focal Length; Human Eye; Defects of Vision; The Pin Hole Camera; Microscope; Telescope; Photometry.

PHY 201: General Physics III (Acoustics and Physics) – 3 Credit Hours (for Geology students)

Wave Phenomena; Production and Propagation of Waves; Longitudinal and Transverse Waves; Mechanical Waves; Wave Property; Intensity of Wave; Reflection; Refraction; Diffraction; Interference; Mathematical Presentation of Waves; Sound Waves; Speed of Sound in various Media; Echoes; Reverberation; Loudness of Sound; Sound Intensity Level; The Bel and Decibel; Noise, Hearing; The Ear; Effect of Noise; Measurement of Sound; Theories of Acoustic Signal; Propagation and Reflection in Seawater; Acoustic Soundings and Depth Determination.

PHY 202: General Physics IV – 3 Credit Hours (for Geosciences Students)

Phase Notation and Phasor; Addition and Subtraction of Sinusoidal Current and Voltages; Self-inductance and Mutual-inductance; Resonance in Electric Network; Transformers Types; Application, Limitations; Thermionic Emission and Vacuum Tubes; Brief Review; Applications of Vacuum Tubes; Amplification (qualitative); Rectification and Power Applications; Semiconductors; the Pn-junction; Field Effect Transistors; Bipolar Transistors; Characteristics and Equivalent Circuits; Amplifiers; Feedback Oscillators.

PHY 211: Theoretical Mechanics – 3 Credit Hours

Element of Vector Analysis; Scalar and Vector Products; Derivation of Products of Vector; The Unit Vector in a Moving Coordinate; Polar Coordinates; Linear and Curvilinear Motion; Centrifugal and Coriolis Forces; Centre of Mass; Vector Addition; Parallel Axis and Perpendicular Axis; Theorems; Moment of Inertia, Euler's EquationsUniversal Gravitation Inverse Square Law; Potential Energy; Inertial and Gravitational Mass; Kepler's Laws; Escape Velocity; Fluid Dynamics; Equation of Continuity; Bernoulli's Equation; Friction and Viscosity; Stoke's and Poiseuille's Formulae; Drag Coefficient; Aerofoil Lift.

PHY 206 GENERAL PHYSICS VI – 1 Credit Hour

Energy and Power; Principles, demands and outlook; transformation of energy and its costs;
thermal pollution; electrical energy from fossil fuels; hydroelectric generation: Principles and
problems. Costs, capacity, storage, reserves, efficiency, new environmental effects. Electricalenergy from nuclear creators; energy in the future breeder reactors; fusion power, solar power geothermal power, tidal power; etc. Promise and problems.

PHY 212: Special Relativity – 2 Credit Hours

Invariance of Physical Laws, Frame of Reference, Galilean Transformation, Velocity Transformation, Acceleration Transformation. Classical Relativity, the Absolute Reference Frame, Ether, the Michelson – Morley Experiment, the Postulates of Special Relativity, Relativity of Simultaneity, the Relativity of Length and Time: Length Contraction and Dilation. The Twin Paradox Relativistic Kinetic Energy, Momentum, Total Energy and Mass – Energy Equivalent. The General Theory of Relativity: Light and Gravitation. Relativistic Velocity Addition. Doppler Effect for Electromagnetic Waves, Relativistic Work and Energy Newtonian Mechanics and Relativity.

PHY 221: Vibrations and Waves – 2 Credit Hours

Damped and Undamped Vibrations (Oscillations); The Harmonic Oscillator. Force Oscillations; Super-position; Coupled Pendulum; Example of Application to Lattice Vibrations; Coupled Oscillation of a Loaded String; Plane Waves; Phase and Group Velocities; Stationary Waves; Diffraction; Doppler Effect; Acoustic Waves; Generation and Propagation in Elastic Media; Ultrasonics.

PHY 222: Atomic Physics – 3 Credit Hours

Atomic Structure: Atomic, Models of Rutherford, Bohr, Thompson, Atomic Spectra, Wilson-Somerfield Quantization Rules, Hydrogen Spectrum, Energy Levels, Ionization Potentials, Photon Absorption, Charge and Mass. Photoelectric Effect, De Broglie Hypothesis, Bohr's Postulate, Davidson and Germer Experiment. Magnetic Moment of Atoms, Intrinsic Spin, Orbital and Angular Moment, Fine and Hyper Structure. Many-Electron Atom, the Helium Problem. Pauli Exclusive Principle, Symmetry. The Periodic Table. L-S Coupling. Zeeman Effect. Atomic Spectroscopy, X-ray: Discovery, Production, Measurement, Properties, Absorption and Diffraction, X-ray Spectra of Element. Atomic Number. X-ray Crystallography.

PHY 241: Thermal Physics – 3 Credit Hours

Temperature, Heat, Kinetic Theory; Specific Heat; Heat Transfer Processes; Black Body Radiation; Emissivity; Green House Effect; Green House Gases; Gases Thermometry and Pyrometry; Foundation of Classical Thermodynamics; Law of Thermodynamics; Work, Heat; Internal Energy and Carnot Cycle.

Entropy: Phase Transitions; Molar Heat Capacities at Constant Volume and Constant Pressure; Boltzmann's Constant; Maxwell Boltzmann Law; Isothermal and Adiabatic Expansions; Transport Phenomena; Real and Ideal Gases; Van der Waal's Equation.

PHY 251: Electromagnetism – 3 Credit Hours

Electrostatics; the Structure of the Atom; Charging by Contact Conductors and Insulators; Quantity of Charge; Coulomb's Law; The Electric Field; Field of Dipole; Field due to Continuous Distribution of Charge; Lines of Force; Gauss's Law; Application of Gauss's Potential; Electrostatic Potential Energy; Potential of Charged Spherical Conductors; Poisson's and Laplace's Equations; Equipotential Surfaces; Magnetic Fields of a Current and of a Moving Charge; Straight Conductor; Parallel Conductor; Circular Turn; Solenoid; Induced Electromagnetic Force; The Faraday's Law; Lenz's Law; Measurement of Magnetic Flux (the search coiled method); Magnetic Properties of Matter; Hysteresis; Alternating Current Circuits; Root-Mean-Square or Effective Values/Phase; Relations between Voltage and Current; Rotating Vector Diagram; Currents in Series and in Parallel Resonance; Power in A. C. Circuits; The Transformer.

PHY 252: Electric Circuit and Electronics – 3 Credit Hours

D.C Circuits and Measurements, Kirchhoff's Laws, Thevenin's and Norton's Theorems, Network Analysis, Application of PSpice or Electronic Workbench. A.C. Circuits, Charge and Discharge of a Capacitor, L.C.R. Series Circuits, AC Power and R.M. S. Values Q-factors, Coupled Circuits, Resonance, the Transformer, Filters and Attenuators Transmissions Lines, Generators and Motors, AC Measurement.

Semiconductors: PN-junction, Field Effect Transistors; Bipolar Transistors; Characteristics and Equivalent Circuits, Amplifiers; Feedback Oscillators.

PHY 262: Introduction to Space Physics – 3 Credit Hours

The Sun and its Environment; Properties of Corona; Properties of Solar Wind;

The Heliosphere; the Structure of the Heliosphere; the Heliosphere Medium; the Heliospheric; Magnetic Field; the Heliopause; The Solar – Terrestrial Environment; the Solar Wind's Interaction with the Earth's Magnetic Field; the Formation of the Magnetosphere; the Formation of the Bow Shock; the Formation of the Magneto Sheath; the Ionosphere; Charged Particle Motion (in Particular; the Drift Motion; for e.g. the Ring Current) in Electric and Magnetic Fields.

The Derivation and Interpretation of the Conservation Equations in Space Plasmas; the Basics of Magnetohydrostatics and Magnetohydrodynamics; Applied to the Solar and Wind and the Earth's Magnetosphere.

PHY 281: General Physics Laboratory III – 1 Credit Hour

Seminar for Standard Experimental Techniques and Careful Analysis of Results; Experiments on Mechanics; Vibrations/Waves; Optics; Electricity and Electromagnetism.

PHY 282: General Physics Laboratory IV – 1 Credit Hour
Experimental Techniques; Use of Multimeters and Oscilloscopes; Experiments on Basic Electricity, Basic Electronics, Modern and Atomic Physics.

PHY 291: Introductory Physics I (for Chemistry Students)
Structure of Atom; Cathode Ray; Measurement of e/m; e and m of Electron; Positive Rays and Mass Spectrometry; Photoelectric Effect; Electron Emission; Processed Static Properties of the Atom; Reynold's Number; Viscosity, Laminar Flow; Poisecuille's Formular; Surface Tension; Adhesion; Cohesion; Capillarity; Drops and Bubbles; Equation of Fluid Flow; Strokes Law; Supersonic Flow.

PHY 292: Physics of Solid Earth – 2 Credit Hours
Structure of Earth, Layer of Rocks. Age of Rocks, Interior of the Earth, Volcanoes and Earthquake. Mineral and Mineral Prospecting, Introduction to Concepts of Continental Drift, Sea Floor Spreading and Plate Tectonics.

PHY 301: Workshop Practice – 2 Credit Hour

a) Mechanical Workshop
Tool Handling, Bench Work, Safety, Drilling Cutting, Lathe, Machines Operations and Accessories. Metal Joining, Bolts, Nut Brazing, Soldering and Welding.

b) Electronics Workshop
Safety, Test Equipment, Meter Signal Generator, Scopes, Colour Codes, Circuit Symbols, Amplifier, Rectifier, Oscillators, Block Diagrams, Use of Characteristics, Projects.

PHY 311: Analytical Mechanics – 3 Credit Hours
Newtonian Mechanics: Motion of a particle in one, two, and three dimensions; Systems of particles and collision theory. Newtonian gravitation; conservative forces and potentials; motion under central force. Degrees of freedom; Generalised coordinates. Lagrange's formulation of Mechanics Applications; The calculus of variations and the action principle; Hamilton's formulation of mechanics; Applications.Constraint's analysis. Oscillatory systems including damped, forced and coupled Oscillations; normal modes.

PHY 321: Solid State Physics – 3 Credit Hours
The Bravis Lattice; Space Lattices Crystal Structures; Symmetry Groups; Braggs's Law; Thermal Properties of Metal and Insulators; Normal Models; Einstein and Debye Models; Equation of State for Solids; Thermal Expansion; Thermal Equation of State for Solids; Vibration in Crystals Brillouin Zones; Drude Model; Hall Effect; Ettingshausen Effect; Nernst Effect; Contact Phenomena; Work Function; Semiconductors; Thermoelectric and Seebeck Effect; Peltier and Thompson Effect.

PHY 341: Statistical Physics – 3 Credit Hours
Statistical Equilibrium; Macro and Microstatics; Statistical Distribution; Maxwell-Boltzmann Statistics; Entropy; Ideal Gas; Equipartition of Energy; Fermi Dirac Statistics; Electron Gas; Thermionic Emission; Nuclear Gas; Bose-Einstein Statistics; Black Body Radiation; Photon Gas; Heat Capacity of Solid. Quantum Statistics; Bose Condensation; Phase Transition; Condensed States and Quantum Distributions.

PHY 342: Industrial Physics (SIWES) – 6 Credit Hours
Students are expected to embark on industrial work experience training for a period of six months and submit a written report for evaluation both by the industry and the department.

PHY 351: Electromagnetic Theory – 3 Credit Hours
Energy Density of Field; Force on Charge Conductor; Electric Dipole; Dielectrics; Polarization; Poisson and Laplace Equations Method of Images.
Theory of Magnetic Materials; Shells, Circuits; Vector Potentials; AX Theory, Resistance; Impedance RLC Circuits; Transformers; Filters; Biot-Savart Law; Faraday's Law; Maxwell's Equation; Electromagnetic Potentials; Wave Equations; Propagation of Plane Waves; Transmission Line; Wave Guides and Resonant Cavities; Electromagnetic Radiation.

PHY 361: Electronics I - 3 Credit Hours
SemiconductorDiodes; Amplifier and Bipolar Transistor; the Field Effect Transistor; Thermionic Emission; Negative Feedback; Impedance Matching; Amplification at High Frequencies; Low Frequency Signal; The Differential Amplifier Power Supplies and Control; Time Constants; Logics, Counters and Timers; Operational Amplifier.

PHY 381: General Physics Laboratory V – 1 Credit Hour
Scientific Writing; Statistics and Data Handling; Experimental Techniques in Electronics; Electricity, Optics; Atomic Physics; Thermal Physics (Heat/Temperature).

PHY 401: Seminar - 1 Credit Hour

PHY 411: Computational Physics – 3 Credit Hours

Use of Numerical Methods in Physics; various Methods of Numerical Integration; Differentiation; Numerical Solutions of some Differential Equations in Physics; Statistical Analysis of Experimental Data.

PHY 413: Energy and Environmental Physics – 2 Credit Hours

Conventional and Non-conventional Energy Sources; Renewable and Non-renewable Energy Sources; Nigeria's Resources; Consumption; Conservation and Costs; Fossils Fuels and Extraction; Cable Drilling and Rotary Drilling; Mining of Coal; Coal Conversion Technology and Environmental Pollution.

The Environment; Green House Effect; Pollution Monitoring; Soil and Underground Water; Pollutants and Management; Baseline Studies and Data; Post Impact Monitoring and Environmental Impact Assessment (EIA); Regulatory Bodies and Regulatory Laws and Standards for Effluents and Geoenvironmental Field Station, etc. The Environment; Pollution Baseline Studies and Data; Physiological Acoustics; Noise and its Regulations; Atmospheric Radioactivity; Meteorology and Air Quality Studies; Blackbody Radiations.

PHY 415: Astronomy 1 – 3 Credit Hours

Nuclear-synthesis; Birth and Death of Star; Stellar Evolution; Neutron Star' Stellar Distance; Par Sec; Light Years; Age of the Universe; Old and Young Stars; Life Cycles of Star Hubble's; Constant and Einstein's Cosmological Constant.

PHY 417: Introductory Geophysics I - 3 Credit Hours

The Solar System; Earth's Composition and Rock Types; ElasticWaves; Body Waves Seismology; Surface Waves, Dispersion; Study of Earth by Surface Waves; Electrical Methods; Rotation of Earth; Chandler Wobble; Geopotential Field Methods; Satellite Geoid; Crustal Structure; Isostacy; Geophysical Well Logs; Heat Flow; Melting Point and Adiabatic Temperature; Gradients; Radioactivity and Age of the Earth; MechanicalBehaviour of Earth Materials; Folding; Rheology; Plate Tectonics.

PHY 418: Geophysics II - 3 Credit Hours

Geomagnetism, Its Causes and Fluctuations; Direct and Transients Current Conduction; Magnetic Induction; Electromagnetic Wave Propagation into the Earth; Apparent Resistivity and Skin Depth; Layered Media; Geophysical Instrumentation and Spectral Techniques; Geophysical Applications in Minerals and Oil Search; Applications in Engineering.

PHY 424: Solar Energy Physics – 3 Credit Hours

Principles and Design of Solar Energy; Conversion Systems; Quality and Availability of Solar Energy; Physics and Chemistry of Solar Energy Conversion; Solar Optics; Optical Excitation; Capture of Excited Energy and Transport of Excitations or Electronic Charge; Conversion Methods; Thermal, Photoelectric; Photoelectrochemical; Photosynthetic;

Solar Energy Systems; Low and High Temperature Conversion; Photovoltaics; Storage of Solar Energy; Advanced Conversion Techniques; Conversion Efficiency; Systems Cost, and Lifecycle Cost.

PHY 426: Non-conventional Energy Physics - 3 Credit Hours

Introduction to Non-conventional Energy Sources; Importance; Primary & Secondary Energy Sources; Limitations to Primary Sources; Various Sources of Non-Conventional Energy; Renewable Energy; Solar Energy - Solar Radiation; Solar Radiation Angles; Local Solar Time; Solar Collector-flat; Plate Collector & Solar Concentrator; Solar Heater-water; Heater & Air Heater; Solar Cooker; Solar Distillation; Solar Energy Storage - Sensible Heat Storage & Latent Heat Storage; Photovoltaic Energy Conversion; Photovoltaic Effect; Equivalent Circuit & V-I Characteristics of PV Cell; Types of Solar Cell & their Characteristics; Solar Cell Array & Module and their Configurations; Specifications of PV Module; PV System & their Components; Isolated & Grid Connected PV Systems; Wind Energy; Wind Energy Conversion; Wind Turbine Rotor – Classification; Characteristics & Analysis of Ideal Wind Turbine Rotor; Power Co-efficient; Air Foils; Lift & Drag Forces; Fuel Cell: - Introduction; Energy Conversion Principles; Types of Fuel cell; Components of a Fuel Cell, Polarization; Energy from Bio-mass; Introduction; Bio-mass Conversion Technologies; Bio-gas Generations; Classifications of Bio-gas Plants; Selection of Site for Bio-gas Plant; Utilization of Bio-gas; Thermal Gasification of Bio-mass; Geo Thermal Energy: - Sources and Use of Geo-thermal Energy; Geo-thermal Power Plants and Applications; Energy from the Ocean:- Tidal Power; Components of Tidal Power Plants; Generation of Tidal Power; Estimation of Energy & Power, Ocean Thermal Energy Conversion (OTEC); Introduction, Types; Plants & their Specifications; Magneto Hydro Dynamic Generation: - Principles of MHD Generation; MHD Generator, Equivalent Circuits; MHD System; Combined Operation Utilizing More Than One Source, Composite Systems.

PHY 427: Research Methodology – 2 Credit Hours

Research Theory and Practice; Research Basics; Research Theory; Structuring the Research Project; Research Ethics; Finding and Reviewing the Literature; The Nature of Data; Quantitative Data Analysis; Qualitative Data Analysis; Writing the Proposal and Writing Up the Research; Referencing

PHY 428: Waste Management and Recycling – 3 Credit Hours

Waste Management Resources; Best Waste Management; Recycling Construction Waste; Environmental Sanitations; E-waste; Making Money; Waste Management Bins; Waste Management Process; Waste Management Recycling; Waste Recycling Benefits; Waste Incineration; Waste to Energy.

PHY 431: Quantum Mechanics I – 3 Credit Hours
Wave-particle Duality; de Broglie Hypothesis; Uncertainty Principle; Wave Packets; Schrodinger's Theory of Quantum Mechanics; Solution of Schrodinger's Equation for Different Potential; One Dimensional Box; Potential Step and Barrier; Well of Finite Depth; The Harmonic Oscillator; Hydrogen Atom; Quantum Mechanical Definition of Angular Momentum; Bohr's Interpretation of Wave Function; Normalization for Wave Functions; Operations; Calculation of Expectation Values; Postulates of Quantum Mechanics; General Formalism of Quantum Theory; Matrix Representations; Schrodinger and Heisenberg Representations.

PHY 432: Quantum Mechanics II – 3 Credit Hours
The Theory of Angular Momentum and Spin; Systems with Spin; Electro Spin Precession; Paramagnetic Resonance; Eigen Value Equations; Time-independent Perturbation Theory; Scattering Cross Sections; Laboratory and Centre of Mass Coordinate System; Born Approximation; Partial Waves; Resonant Scattering; Identical Particles and the Exclusion Principle; Methods of Approximation; Multielectron Atoms; Time-dependent Perturbation Theory; Elastic Potential Scattering; Green's Function and Partial Wave Methods; Selected Phenomena from Each of Atomic Physics and Molecular Physics; How Solid State Physics and Nuclear Physics are Described and Interpreted Using Quantum Mechanical Models.

PHY 434: Biophysics - 3 Credit Hours
X–ray Diffraction and Electron Micro-Elements of the Physics of Macromolecule; Basic Enzyme Behaviour; Radiation Physics; Radiation Hazards and Protection; Thermodynamic Properties of Biological Molecules; Irreversible and Open Systems; Information Theory; Biophysical Measurements; Structure and Properties of Proteins; Enzyme Action; Structure and Properties of Nucleic Acids; Genetics at the Molecular Level; Molecular Aspects of Important Biological Systems.

PHY 436: Astronomy II – 3 Credit Hours
Galaxies; Stars; Star Formation; Space Dynamics; Birth and Death of Stars; Big Bang Theory; Black Holes; Chanderskhar Limit; White Dwarfs; Red Giants; Astrocatastrophies; Nucleo-synthesis; Supernovac Cosmological Constant; Cephids Astrology and Cosmic Density; Extraterrestial Life Forms; Quasars and Pulsars.

PHY 441: Mathematical Methods in Physics I – 3 Credit Hours
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 transform; Laplace transform; Applications of transform methods to the solution off elementary differential equations of interest in Physics and Engineering.

PHY 442: Mathematical Methods in Physics II – 3 Credit Hours

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.

tensors analysis: Qualitative introduction; co-ordinate transformation; contravariant and co-variant Tensors. Tensors of second rank. Basic operations with tensors Quotient Law. The line element and metric tensor. Associated tensor: Geodesics in a Riemannian Space. Covariant differentiation.

PHY 445: Semiconductor Physics – 3 Credit Hours

Electron Theory of Conductivity; the Fundamentals of Band Theory of Semiconductors, Electrons and Hole; Statistics in Semiconductors; Kinetic Phenomena in Semiconductors; Theory of Charge Carrier; Scattering and Recombination; Contact Phenomena in Semiconductors; Optical and Photoelectric; Introduction to the Theory of Groups.

PHY 447: Elementary (High Energy) Particle Physics I – 3 Credit Hours

Conservation Laws; Classification of Particle; Fundamental Interactions. Charge Conjugation; Time Reversal CP Violation and CPT in Variance SU (2); SU(N). Particle Classification; Leptons and Hadrons; Mesons and Baryons; Nucleons and Hyperons.

PHY 448: Elementary Particle Physics II – 3 Credit Hours

Delitz Plot; Quantum-chromodynamics (QCD) Colour; Quarks; Gluons; Young Tableau.

PHY 451: Reactor Physics – 3 Credit Hours

Basic Principles and Modern Issues of Nuclear Power Safety; Nuclear Fission-Fissionable Materials; Fission Products and their Cross Sections; Neutron Transport; Diffusion Theory Applied to Reactors; Dynamic Behaviour of Reactors; Nucleon Thermalisation; Monte Carlo Methods; Nuclear Fuel Cycle and Nuclear Waste Management; Reactor Types and Future Generation; W. Reactors; Accelerator Driven Systems and Transmutation; and Chain Reaction; Nucleon Thermalisation; Neutron Diffusion Equation; Reactor Kinetics and Reactor Dynamics; Monte Carlo Methods; Nuclear Fuel Cycle and Nuclear Waste Management; Reactor Types and Future Generation; IV Reactors; Accelerator Driven Systems and Transmutation; Basic Principles and Modern Issues of Nuclear Power Safety.

PHY 461:Space Plasma Physics - 3 Credit Hours
Definition of Plasma; Plasma State, Collection of Particles; Description of Plasma; Simple-particle Approach; Trapped Particle; Magneto-hydrodynamics (MAD); Discontinuities; Waves in Plasma Fluid; Instability in Space.

PHY 463: Atmospheric Physics – 3 Credit Hours
The Sun, Activity Region; Sunspot; Solar Radiation; Solar Wind; Solar Radiation and the Earth's Atmosphere; Composition of the Atmosphere; Types of Atmospheres; Heat Transfer in the Atmosphere; Optical Depth; Energy Absorption; Density; Temperature Diffusion; Chemical Processes; Photo Dissection and Excitation; Collision Activation and Deactivation; Recombination and Interchange Reaction; Atmosphere Models; Theoretical and Empirical Minor Constituents; Atmosphere Radiation; Airglow and Aurora; Morphology; Atmospheric Effects; the Ionosphere; Solar Ionospheric Phenomena; Flare Effects; Eclipse Phenomena; Ionospheric Irregularities.

PHY 471: Nuclear Physics I – 3 Credit Hours
Nomenclature; Review of Basic Nuclear Properties; Radioactive Decays; Introduction to Nuclear Reaction; Nuclear Binding Energy; Nuclear Forces and Brief Review of Nuclear Models;; Radioactivity; Experimental Methods in Nuclear Physics; Radiation Sources; Nuclear Spectroscopy; Thermonuclear Energy; Cross Sections; Accelerating Dosimetry Machine; Review of Elementary Particles; Introduction to Neutron Physics; Charges Symmetry and Independence.

PHY 472: Nuclear Physics II – 3 Credit Hours
Nuclear Interaction; Strong; Weak and Electromagnetic Interactions; Low-energy Neutron; Proton Scattering; Nucleon-Nucleon Scattering; the Electric Quadrupole Moment of Deuteron; Capture of Slow Neutrons by Hydrogen; Nuclear Structure and Models of Nucleus; Unified Models; Decay Processes; Gamma Emission; Integral Conversion; Nuclear Isomerism.

PHY 474: Nuclear Instrumentation - Credit Hours
Radiation Types and Sources; Detectors; Scintillation; Counters; Solid State Detectors; Review of Nuclear Electronics Unit; Radiation Spectra Interpretation; Coincidence and Anti-coincidence Methods; Dosimetry and Monitoring Equipment.

PHY 480: General Physics Laboratory VI – 1 Credit Hour

Seminar on the Use of Equipment for Experimentation/Research as well as Interpretation of Results; Advanced Experiments on Electricity/Electronics (Analog and Digital); Optics; Sound; Temperature and Atomic/Nuclear Physics.

PHY 485: Electronics II – 3 Credit Hours

Review of Linear Amplifiers: Circuit Parameters, Boolean Algebra; Amplifier Characteristic; Feedback Amplifier; Oscillator Circuits; Stability Operational Amplifiers; Inverting and Non-inverting; Diodes and Transistors; Analysis of Circuits; Linear Integrated Circuits; Logic Gates; RTL. DTh. etc. Applications of Gate. Linear and Non-linear Analogue system; Power Circuits and Systems; Pulse and Digital Circuits. Examples of Computing Devices.

PHY 481: Acoustics I – 3 Credit Hours

Propagation and Attenuation of Sound in the Atmosphere; Sound Isolation and Absorption; Reverberation; Sabine and Eyrings' Formulae; Hearing; Articulation and Intelligibility; Acoustics of Auditoria; Models; Anechoic Rooms; Noise Problems and Abatement.

PHY 482: Acoustics II – 3 Credit Hours

Acoustics Transducers; Loudspeakers; Microphones; Calibration of Instruments; (Transducers); Ultrasonics; Underwater Acoustics; Sound Channels; Shadow Zones; Sound Transmission; Transmission Losses; Divergence; Refraction Reverberation Sound Level Meter.

PHY 491: Material Science – 3 Credit Hours

Molecular Bonding and Types of Bonds; Crystal Structure; Crystallographic Parameters; Electron; Theory of Metals; Magnetism; Diamagnetic and Paramagnetic Materials; Curie's Law; Ferro Magnetics; Ferrites; Magnetization; Curves for Ferromagnetic Materials; Temperature Dependence of Magnetization; Magnestostriction; Dielectrics; Ferroelectrics: (Semiconductors, Atomic Theory, Elastic Properties of Continuous Media; Elastic Deformation; Absorption by Metals (Fe, Al, Cu); Material Testing with X-rays; Hall and Peltier Effects; Electrical Conduction; Methods of Measuring Electrical, Magnetic and Optical Properties of Materials. Alloys; Equilibrium Phase Diagrams; Properties of Steel, Brass and Cements; Polymers: Long Chain Molecules; Thermosetting and Thermoplastic Polymers; Mechanical Properties; Elastomers.

PHY 492: Physical Optics - 2 Credit Units

Interference; Coherence; Young's Fringes Michelson's interferometer; Huygens's Principle; Fraunhofer Diffraction Grating; Airy Disc; Polarization; Optical Activity; Spherical Waves; Thin Films Crystal Diffraction; Holography; Dispersion and Scattering.