JUPEB BIOLOGY SYLLABUS 2020/2021

GENERAL OBJECTIVES

At the end of the series of courses, candidates should be able to:

1. describe the fundamentals and level of organization in living things:
2. explain functional units of biological molecules and principles of interactions among organisms;
3. describe cells as living organisms and their rules in nature
4. describe cells as living organisms and their roles in nature
5. explain the application of Cell Biology in medical, industrial, and biotechnological sub-sectors of the economy;
6. discuss diversity, characteristics, structures, functions, and taxonomy of living organisms (micro-organisms, plants, and animals);
7. enumerate economic importance of living organisms;
8. describe the morphological and biochemical characteristics of micro-organisms;
9. conduct laboratory and field practical in Biology, Botany, Microbiology, and Zoology; Highlights and explain the basic concepts of ecology;

10. explain the role of evolution in the hierarchical classification of living organism's vis a vis the theories of evolution;
11. define basic terminologies of Genetics and state Mendelian Laws of inheritance.

FIRST SEMESTER COURSES

BIO 001: General Biology	(3 UNITS)
BIO 003: Microbiology	(3 UNITS)

SECOND SEMESTER COURSES

BIO 002: Basic Botany	(3 UNITS)
BIO 004: Fundamental Of Zoology	(3 UNITS)

COURSE DESCRIPTION

BIO 001: General Biology (3 Units)

Specific Objectives

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

1. explain living things in nature and biological molecules;
2. discuss the cell as the fundamental unit of living things
3. describe levels of organization of living things
4. discuss biological methods and their applications (Biostatistics, taxonomy, and nomenclature);
5. discuss principles of genetics, variation, and heredity; and
6. conduct laboratory and field practical in biology.

Course content

S/N	Topic	Sub-topic	Details
1.	Origin of Living Things	i. The Science of Biology ii. Origin of Organic Molecules iii. Origin of the First Cells iv. The Earliest Cells: v. Living	i. Definition of biology ii. Importance of biology iii. The nature of science iv. Scientific methods

		vi. Fossils	v. Testing of hypothesis vi. Data collection and analysis vii. Application of scientific methods in biological experiments viii. Relationship between Biology & Medicine, Agriculture, etc
2.	Living things in nature and biology molecules	i. Diversity of Living Things ii. Biological Molecules	i. Different kingdoms and characteristics ii. Carbohydrates, lipids, protein and nucleic acids
3.	Cell organisation structure and functions	i. Cell theory ii. Cell structure and functions iii. Cell organizations iv. Forms in which cells exist	i. Demonstration of cell structure on microscopes ii. Biological drawings of palm and animal cells iii. Comparisons of plant and animal cells

4.	Cell division principles of Genetics, variations and heredity	i. Cell divisions ii. Mitosis in somatic cells iii. Meiosis in Germ cells iv. Principles of Genetics v. Variation and Heredity vi. Mendel's Laws of Inheritance vii. Human Inheritance viii. Human Genetic Disorders e.g. sickle cell anaemia, albinism ix. Rhesus Factors x. Polyploidy xi. Sex-linked Traits xii. Application of Genetics in Agriculture, Medicine, Criminology etc	i. Basic concepts in genetics: Chromosome, Gene, allele, dominant, recessive, homozygous, heterozygous, hybrid, genotype, phenotype etc ii. The nature of genes and chromosomes Practical class Determination of inheritance using coloured seeds e.g., beads, grains, etc Verification of principles of Mendel's law and its deviation

			iii. Cell division experiment using onion root iv. Identification of the stages of meiosis v. Traits controlled by Multiple alleles e.g. blood group, eye colour vi. Determination of inheritance using coloured seeds e.g. beads, grains etc vii. Verifications of the principles of Mendel's laws
5.	Systematics: Taxonomy and Nomenclature	i. Basic of Taxonomy ii. Rules of Systematics iii. Naming of Organisms (Nomenclature)	Practical class: Classification and identification of organisms Highlighting adaptive features and their uses

6.	Ecology	i. Basic concept in Ecology ii. Biological Associations and Interactions iii. Ecological Studies iv. Types of Habitats v. Ecology and Natural Selection	i. Symbiosis ii. Mutualism iii. Parasitism iv. Environmental studies v. Practical use of ecology equipment vi. Population study in a specific habitant vii. Environmental studies viii. Practical use of ecological equipment ix. Population study in a specific habitat x. Environmental changes xi. Biological impacts of climate change
7.	Biology Methods and Application	i. Rules of Biological Drawings	Standard drawing rules governing: use of pencils, specimen proportions,

			magnification, size of specimen drawing and labelling. i. Diagrams must be according to length specification. ii. Lines must not be woolly or broken iii. Drawings must carry appropriate titles at the correct positions iv. Labelling must be horizontal & parallel with ruled guidelines v. Drawing must not be artistic i.e. no shading or painting vi. Spellings must be correct and touched by labelling lines.

8.	Evolution	i. Geological Times, and Mega Geological Events ii. Evolutionary Trends in Animals and Plants iii. Theories of Evolution: Landmark and Darwin Theories of Evolution iv. Evidence of evolution from Anatomy, Embryology, Biochemistry	i. Definition of evolution ii. Types of evolution Application of Evolution to Plants & Animal Taxonomy

BIO 002: Basic Botany (3 UNITS)

Specific Objectives

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

1. discuss the general characteristics of plants:
2. explain the taxonomy of lower and higher plants;
3. discuss biodiversity and conservation of plants
4. explain plant structures and functions
5. explain physiological processes in plants; and
6. enumerate the economic and ecological importance of plants.

Course Content

S/N	Topic	Sub-topic	Details
1.	General characteristics and diversity of Plants	i. Plant Diversity and Classifications (Lower and Higher Plants) ii. Characteristics of Lower and Higher Plants groups iii. Morphology and Life Cycle of Lower and Higher Plants	i. Classification of major plant groups (Lower and Higher plants) ii. Divisions up to generic level iii. Level plants-stage, fungi, bryophytes, Pteridophytes. iv. Morphological and life cycle of named

			example in each major group considering the simplest and the complex in each group of the lower plants v. Economic and ecological importance of plant groups vi. Practical class-classifications and morphological drawing of lower plants Algae (Chlorella, England/Chlamydomonas, Volvox, Spirogyra) Fungi e.g. yeast, Rhizopus, Mucor, Aspergillus, Penicillium, mushroom,

			phytophthora, Bryophytes e.g., Riccia, Marchantia, Funaria Pteridophytes e.g. (Lycopodium), Selaginella, Nephrolepis Higher plant (Non-Vascular and vascular plants) Spermatophytes e.g. Cycas, Pinus, Gnetum, Hibiscus rosa-sinensis Eleusine indica and Talinum triangulare treated comparatively
2.	Taxonomy of Lower and Higher Plants	i. Plant Taxonomy and systematics ii. Taxonomy of lower and higher plants	i. Plant Nomenclature ii. Plant classification iii. The difference between taxonomy and systematics

3.	Plant conservation	i. Importance of Plant Conservation ii. Measures in Plant Conservation iii. Climate change	i. In-situ and ex-situ conservation ii. Advantages and disadvantage of each iii. Biological control iv. Poor management v. Impact of climate change on plants
4.	Plant tissues and functions	i. Plant tissues anatomy ii. Functions	Emphasis on composition, distribution, forms and functions of each limits: i. Parenchyma ii. Collenchyma iii. Sclerenchyma iv. Epidermal v. Per dermal vi. Vascular (cambium, phloem, xylem) vii. Practical class in osmosis and transpiration in plants.
5.	Plant Morphology/Anatomy	i. Morphology of Plant Parts	vii. Morphology of roots, stems, leaf

		ii. Anatomy of Plant Parts iii. Types of Root	types and their modifications due to functions viii. Anatomy of monocot and dicot roots, stems and leaves with emphasis on tissue arrangement in relation to functions and environment. Practical class Roots i. Advantages and tap root systems, modification and adaptations ii. Anatomical observation and drawing of permanent/temporary mount of monocot and dicot roots (T.S and L.S)

		iv. Types of Leaves v. Types of Flowers	iii. Locate, draw and label different plant tissues (parenchyma, collenchyma etc) Leaves- i. Simple and compound leaves, arrangements, modifications to suit habitants. ii. T.S of leaves of both monocot and dicot and label different plant tissues (parenchyma, collenchyma etc) Flowers- i. L. S of dicot flowers e.g. regular and irregular flowers floral diagrams and formula

		vi. Types of Fruits	Fruits- i. L. S and T.S of various types of fruits (dry dehiscent indehiscent and fleshy fruits should be observed and drawn).
6.	Nutrition in Plants	i. Nature and Types of Nutrition	i. Autotrophic (photosynthesis and chemosynthetic) ii. Dark and light reaction in photosynthesis iii. Heterotopic iv. Holozoic nutrition v. Mineral requirements of plants their sources, roles and deficiency symptoms vi. Composition of chemical fertilizers

			vii. Composition of chemical fertilizers Practical class- i. Demonstration of etiolation ii. Measurement of photosynthesis in leaf iii. Growth experiments to show deficiency symptom iv. Field study of deficiency symptoms in plants
7.	Transport system in plants	i. Need for transport system ii. Water relation	i. Mineral requirements of plants ii. Transport in xylem iii. Transport in phloem iv. Transport media in plant and materials to be transported

			Practical class i. Transpiration, osmosis, and food transport in plants
8.	Respiration	i. Mechanism of Gaseous Exchange	i. Stomata apparatus ii. Lenticels iii. Aerobic and anaerobic respiration
9.	Plant reproduction	i. Asexual and sexual reproduction	i. Angiosperm flower and differences between monocots and dicot flowers
10.	Growth regulators	i. Roles and interactions of growth regulators	i. Auxins ii. Gibberellins iii. Cytokines iv. Ascorbic acids v. Ethylene
11.	Crop improvement	i. Importance of GMC	1. Generally Modified Crops (GMC) 2. Challenges of resistant plant species 3. Ethical implications of

			genetic modifications
12.	Economic and ecological importance of plants	1. Plants of Economic & Medical Importance	i. Economically important food plants ii. Economically valuable medicinal plants iii. Ornamental plants

BIO 003: Micro Biology (3 UNITS)

Specific Objectives

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

1. discuss history and discovery of microorganisms;
2. discuss the different types of microorganisms and the taxonomic groupings:
3. explain microbial cellular structures, morphology and biochemical characteristics:
4. explain microbial genetics and applications in biotechnology and
5. enumerate economic importance of microorganisms.

Course Content

S/N	Topic	Sub-topic	Details
1.	History of the discovery of microorganisms	i. Spontaneous generations ii. Microorganisms as the cause of some disease	i. The theory of spontaneous generation of organisms ii. Conflict over spontaneous generations iii. The golden era of microbiology (1860-1910)

			iv. The germ theory of disease v. The discovery of viruses vi. Microorganisms in the 20th century Practical class i. Introduction to basic microbial laboratory equipment, principles of operation and drawings
2.	Types and taxonomic groupings of microorganism	i. Seven levels of classification ii. Prokaryotic cells iii. Eukaryotic cells	i. Bacteria-size, shapes, motility, unusual types, general methods of bacteria classification ii. Fungi-yeast and mould-size, shape, general fungal classification iii. Protozoa-specific examples, motile and non-motile types, nutrition types

			iv. Viruses-sizes, bacteriophages, viroid, prions v. Algae-sizes, types, diatoms, sea weeds, lichens, sexual and asexual evolution Practical class aseptic techniques in microbiology
3.	Structures, Morphology and Characteristics of Microorganisms	i. Morphology and Structures of Microbial Cells ii. Biochemical Characterization iii. Reproduction, Growth Types and Phases	i. Structure of bacteria cells-capsule, flagella. Pilli and fimbriae, cell wall, plasma membrane, cytoplasm ii. Cell wall of fungal cells, cytoplasm iii. Cultural characteristics of bacterial growth-on solid and liquid media, forms of growth. iv. Cultural and cellular characteristics of

			mould and yeast on solid and liquid media, hyphal and mycelial types. v. Biochemical characteristics of bacteria and fungi vi. Viruses and their structures vii. Reproduction and microbial growth phases Practical class cultivation and identification of bacteria from soil, water and decomposing food
4.	Microbial Ecology	i. Microbial interactions with animals, plants and microbes	i. Predation ii. Competition iii. Synergism iv. Commensalism v. Infectious diseases vi. Immunity vii. Spoilage of food viii. Control of microbial activities

5.	Microbial Nucleic Acids in information storage and transfer	i. Genetic materials ii. Mutation and mutagenesis	i. Nature of DNA ii. Nucleosides and nucleotides iii. Types of RNA iv. Enzymes in DNA replication v. Genetic code vi. Transcription and translation vii. Transfer of genetic materials in prokaryotes viii. Spontaneous mutation, induced mutation, expression of mutation ix. Biotechnological use of microorganisms in Food industry: Environment, Pharmaceuticals, Medical, and agricultural fields

BIO 004: Introductory Zoology (3 UNITS)

Specific Objectives

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

1. discuss the general characteristics of kingdom Animalia:
2. explain the taxonomy of invertebrates and vertebrates
3. discuss diversity of animal species;
4. explain physiological processes in animals; and
5. enumerate the economic and ecological importance of animals.

Course Content

S/N	Topic	Sub-topic	Details
1.	Diversity and General Characteristics of Animals	i. What is Zoology? ii. What are Animals? iii. Scope and areas in Zoology iv. Importance of Zoology	i. General characteristics of animals ii. Diversity of lifestyles, habitants iii. Categories of animals
2.	Systematics (Taxonomy) of animals	i. Classification of animals ii. Basic of animal organization iii. Phyla of animals iv. Tissues and organs in animals	i. Unicellular levels of organizational: metazoan ii. Classification of invertebrates Animals without tissues

			Animals with tissues Animals exhibiting bilateral symmetry (bilateral) Animals with body cavity (coelomates) Segmented animals Animals with jointed appendages Animals with backbone (vertebrates) iii. Major and minor phyla iv. Types of tissues and organ systems Practical class- Identification and classification of animal specimens the different phyla Dissection of selected animals-cockroaches, fish, frog, rat, etc
3.	Evolution of animals	i. History and origin of animals	i. Adaptation of animals in water

		ii. Major evolutionary adaptation of animals	ii. Adaptation of animals on land iii. Adaptation of animals in air
4.	Invertebrates	i. Phylum protozoa ii. Phylum porifera iii. Phylum Cnidaria (Coelenterate) iv. Phylum Platyhelminthes v. Phylum nematoda vi. Phylum annelida vii. Phylum arthropoda	i. Taxonomy, characteristics, diversity, lifestyles, morphology and life cycle providing named representative examples in such order ii. Free living flatworms iii. Parasitic flatworms (trematodes and cestodes) of medical and veterinary importance iv. Emphasize the body plan v. Why arthropods are successful
5.	Introduction to Chordates	i. Adaptation of Chordates to water, land and air ii. Protochordates iii. Class pisces	i. Challenges and adaptations to living in the different habitats ii. History and important adaptations

		iv. Class amphibia v. Class reptilia vi. Class aves vii. Class mammalia	iii. Diversity, classification, morphology and life cycle, providing representative examples from the different orders iv. History and importance of adaptations v. Rise and fall of dominant reptiles vi. Cleary state the taxonomic features that warrant the grouping into classes
6.	Ecologic and economic of importance of animals	i. Diverse economic importance of Animals: Invertebrates vertebrates Ecological importance of Animals	i. Benefits of animals to man ii. Economics importance of arthropods
7.	Physiological processes	i. Nutrition in animals	i. Types of nutrition in animals ii. Nutrition in human

			iii. Types of definition in animals iv. Alimentary system in man v. Digestion (diverse enzymes) and absorption Practical class food test
		i. Respiration in Mammals	i. Lung as a respiratory organ ii. Role of a circulatory system in respiration
		i. Skeletal system	i. Morphology and function of human skeleton ii. Forms of skeleton iii. Components of and differences between bone and cartilage iv. Parts of mammalian endoskeleton v. Definition and types of joint
		i. Reproduction	i. Vertebrate reproduction

			ii. Structure and function of human female and male reproductive system
8.	Transport of substance across Membranes	i. Excretion	ii. Morphology of the excretory system iii. Osmoregulation iv. Structure and function of the nephron – ultrafiltration, selective reabsorption and excretion v. The effects of weather on excretion
		i. Circulatory system	i. Human circulatory/transport system ii. Blood as agent of transport iii. Components of blood iv. The functions of blood v. Types of circulation
		i. Growth and development	Principles of development i. stages in embryology
		i. Diffusion ii. Osmosis	i. Osmotic balance

		iii. Plasmolysis iv. Flaccidity v. Haemolysis vi. Crenation vii. Turgidity	ii. Selective transport of substance across members iii. Osmotic pressure iv. Turgor pressure v. Active transport Practical class experiment demonstration diffusion, osmosis and plasmolysis

JUPEB PHYSICS SYLLABUS 2020/2021

GENERAL OBJECTIVES

At the end of the series of courses in this syllabus, Candidates should be able to:

1. describe the properties of matter and waves, and various physical phenomenon at the microscopic and macroscopic levels.
2. analyse and apply physics laws and principles to solve real life problems:
3. design, implement and draw meaningful inferences from the results of experiments:
4. explain natural and physical phenomena using physics laws and concepts:
5. develop and enhance creativity in students in their day to day activities:
6. prepare students for further and higher studies in physics related courses.

FIRST SEMESTER COURSES

PHY 001: MECHANICS AND PROPERTIES OF MATTER (3 UNITS)

PHY 002: HEAT, WAVES AND OPTICS (3 UNITS)

SECOND SEMESTER COURSES

PHY 003: ELECTRICITY AND MAGNETISM (3 UNITS)

PHY 004: MODERN PHYSICS (3 UNITS)

COURSE DESCRIPTION

PHY 001: MECHANICS AND PROPERTIES OF MATTER (3 Units)

Specific Objectives

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

1. Differentiate between fundamental physical quantities and derived quantities:
2. Explain and apply the concept of dimensional analysis:
3. Define and explain various physical laws in relation to mechanics:
4. Describe the phases of matter:
5. Describe and explain physical phenomena in relation to fluid mechanics; and
6. Solve problems using the laws, principles and theories of mechanics.

Course Content

Topics	Sub-Topics	Details and notes
Units	Order of Magnitude, Definition of Units: Length, Mass, Time, Unit Conversion and Measurements, Methods of Measuring Length, Mass and Time. Basic	Revision of types of motion: translational, random, oscillatory, and rotational, linear motion: distance, displacement, uniform velocity and uniform acceleration are required.

	and Derived Units, Dimensional Analysis (L.M.T. only)	The following suggested experiments will enhance the students understanding of the topics covered in this course: 1. Error analysis and significant figures. 2. Measurement of velocity and acceleration. 3. Investigation on the proportionality of acceleration and force. 4. Investigation of the relationship between period and length of simple pendulum and hence calculations of acceleration due to gravity (g) 5. Verification of the principle of conservation of momentum. 6. Investigation of the laws of equilibrium for a set of coplanar forces.
Vectors	Vector Representation, Addition and Subtraction of Vectors (geometrical Method Only), Resolution of Vectors. Vector Multiplication, Vectors in Cartesian, Coordinate System.	
Particle Kinematics	Types of Motion: Translational, Random, Oscillatory, And Rotational. Linear Motion: Uniform Velocity Motion, Uniform Acceleration Motion, Graphs of Kinematic Equations. Instantaneous and Average Velocity and Acceleration in Two or Three Dimensions. Relative Motion in One or Two Dimensions, Free Fall, Projectile Motion.	

Dynamics	Newton's Laws of Motion, Types of Force Newton's Universal Law of Gravitational, Equilibrium of Forces, Centre of Mass and Centre of Gravity, Moment of a Force, Linear Momentum and its Conservation Laws, Elastic and Inelastic Collisions. Collisions in Two Dimensions. Motor in Inclined Planes, Frictional Forces.	7. Elasticity of materials – Hooke's law experiments. 8. Investigation of contact forces – static and dynamic friction. 9. Investigation of forces in fluids – surface tension n and capillarity. 10. Rigid body and Torsional oscillation – Moment of Inertia
The Gravitational Field	Kepler's Law of Planetary Motion, Newton's Law of Gravitation, Field Strength, G and its Measurement, Gravitational Potential, Satellite Motion and Escape Velocity.	
Work, energy, and power	Work, Energy and Sources, Types of Energy, Conversation and Conservation of Energy, Power, the	

	Kilowatt hour, Principle of Mechanical Energy Conservation	
Circular and oscillatory motions.	Angular Displacement, Angular Velocity, Torque and Angular Acceleration, Angular Momentum, Centripetal Acceleration, Centripetal Force, Rotational Kinetic Energy, Work done in Rotation, Conservation of Angular Momentum. Simple Harmonic Motion, Damped and Forced oscillations, Resonance.	
Elasticity	Hooke's Law, Elastic Limit, Elastic and Plastic Deformations, Ductile and Brittle Substances, Stress, Strain, Elastic and Plastic Behaviour, Young's Modulus, Energy Stored, Energy per Unit Volume, Shear Modulus, Bulk Modulus.	

Hydrostatics	Matter (solid, liquid and gases), Density, Pressure in Fluids, Change of Phases, Archimedes' Principle. Principle of Floatation, Stoke's law, Terminal Velocity. Bernoulli's Principle, Pitot-static Tube Principle.	
Hydrodynamics	Molecular Properties of Fluids, Viscosity, Surface Tension, Adhesion, Cohesion, Capillarity, Drops and Bubbles, Bernoulli's Principle, Pascal principle, Reynold's Number, Turbulent and Laminar Flow, Poiseuille's Equation.	

PHY 002: HEAT, WAVES AND OPTICS (3 UNITS)

Specific Objectives

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

1. explain the concept if ideal gas;
2. explain the concept of heat, temperature and nodes of heat transfer;
3. explain light as an Electromagnetic phenomenon and identify the components of the electromagnetic spectrum;
4. locate by graphical means and by calculation the position of images formed by mirrors and lenses;
5. describe the operations of various optical instruments and their applications;
6. explain the dual nature of light – the particle nature and the wave nature;
7. explain the properties of light arising from its wave nature; and
8. explain the principles of sound propagation.

Course Content

Topics	Sub-topics	Details and notes
Ideal Gases	Gas Laws: Boyle's Law, Charles' Law and Pressure Law. Equation of State, Kinetic Theory of Gases, Pressure of a	Revision of Rectilinear propagation of light, laws of reflection and refraction, reflection on plane and curved mirrors, refraction at plane

	Gas, Kinetic Energy of a molecule.	surfaces, total internal reflection, and critical angle are required. The following suggested experiments will enhance the students understanding of the topics covered in this course: 1. Calibration curve of a thermometer using the laboratory mercury thermometer as a standard. 2. Verification of Boyle's law. 3. Measurement of specific heat capacity of water or metal by mechanical and electrical methods 4. Measurement of specific latent heat of Fusion of ice. 5. Measurement of specific latent heat of vaporization of water.
Temperature and Thermometry	Concept of Heat and Temperature, Thermal Equilibrium, Temperature Scales, Practical Thermometers, Expansion of Solids and Liquid.	
Heat and Energy	Heat Capacity, Specific Heat Capacity, Latent Heat, Internal Energy, Thermal Conductivity, Blackbody radiation.	
Thermodynamics	Work done by Gas, Internal Energy of Gas, First and Second Law of Thermodynamics, Concepts of Isothermal and Adiabatic Processes'.	
Electromagnetic Waves	Electromagnetic Spectrum. Applications of Components of the Electromagnetic Spectrum.	

Geometrical Optics	Rectilinear Propagation of Light. Laws of Reflection and Refraction, Reflection on Plane and Curved Mirrors, Refraction at Plane surfaces, Total Internal Reflection, Critical Angle, Dispersion by Prism.	6. Change of state – The cooling curve experiment. 7. Measurement of the speed of sound in air. 8. Investigation of the variation of fundamental frequency of a stretched string with length. 9. Investigation of fundamental frequency of stretched string with tension. 10. Resonance tube experiments - fundamental frequency and higher harmonics. 11. Measurement of the focal length of a concave mirror. 12. Verification of Snell's law of refraction.
Lenses and Optical Instruments	Lenses, Formation of Images by Lenses, the Eye, Defects of Vision. Optical Instruments (camera, refractor and reflector telescopes, simple microscope, compound microscope and ophthalmoscope).	
Oscillations and Waves	Classification of Waves, Wave Parameters, Graphical Representation of Waves, Wave equation, Progressive and Stationary Waves, Reflection, Refraction, Diffraction, Principle of	

	Superposition, Interference.	13. Measurement of the refractive index of a liquid and a solid. 14. Measurement of the focal length of a converging lens. 15. Investigation of interference phenomenon – Young's double slit experiment. 16. Experiment with diffraction – Measurement of the wavelength of a monochromatic light. 17. Measurement of the speed of light. 18. Investigation of polarization – Optical activity experiments.
Wave Theory of Light	Wave-Particle Nature of Light, Huygens' Principle. Interference and Diffraction, Coherent Sources, Young's Double Slit Fringes. Diffraction of Light Waves, Resolving Power, Diffraction Grafting Polarization and its Applications.	
Sound Waves	Pitch, Loudness, Quality, Intensity of Sound, Decibel, Beats and Application. Doppler principle of Sound, Waves in Strings and Pipes.	

PHY 003: ELECTRICITY AND MAGNETISM (3 UNITS)

Specific Objectives

At the end of this course, candidates should be able to;

1. state the fundamental laws in electricity and magnetism;
2. explain the relationship between the electronic force and the electric field;
3. explain the relationship between the magnitude force and the magnitude field;
4. describe and explain the interaction between the electric field and the magnetic field;
5. explain the effect of charges in motion;
6. describe and explain physical phenomena in electricity and magnetism;
7. solve problems using the laws, principles and theories of electricity and magnetism; and
8. identify and describe some industrial application of electromagnetic theory.

Course Content

Topics	Sub-topics	Details and notes
Electronics	Coulomb's Law, Gauss's Law and application, Concepts of an Electric field, Force Between point charges, Electric field at a point, Electric Potential, Potential Due to a Point Charge and Charged Sphere, Relationship between Electric Field and Electric Potential, Equipotential surfaces.	Revision of electric current, potential difference, resistance and resistivity, Ohm's law, Ohmic and non Ohmic conductors, resistors in series and parallel are required. The following suggested experiments will enhance the student's understanding of the topics covered in this course: 1. Verification of Joule's law. 2. Measurement of resistivity of a wire. 3. Experimental verification of Ohms law. 4. Investigation of the variation of resistance of a metallic conductor with temperature.
Capacitors	Capacitors and Capacitance, Dielectric and Relative Permittivity, Capacitors in Series and Parallel, Energy stored in a capacitor, Effects of Dielectrics, Charging and Discharging in C-R Circuit Time constant.	

Current Electricity	Electric Current, Potential Difference, Resistance and Resistivity, Ohm's law, Ohmic and Non-Ohmic Conductors, Resistors in series and parallel, Electromotive Force and circuit, Electrical power, Electrical energy and efficiency, cells in series and parallel, Kirchhoff's laws, Temperature coefficient of resistance, principle of potentiometer and Wheatstone Bridge, Galvanometer.	5. Investigation of the variation of resistance with temperature. 6. Experiment with the Wheatstone bridge 7. Emf and internal resistance of cells. 8. Comparison of emf – the Potentiometer. 9. Basic electrochemistry experiments. 10. Alternating currents – The R. L .C circuits. 11. Basic semiconductors diode characteristics.
Magnetic Field	Earth's Magnetic Field, concepts of Magnetic Field, magnetic Flux and flux density –**B** (of solenoids, straight Conductors and narrow Circular coil).	
Force on Conductor	Force on a current-carrying conductor, Force	

and Moving Charge	Between current-carrying conductors, Fleming Left-Hand Rule, Torque, application to moving coil meters, Ampere's Law, Biot-Savart's law	
Electromagnetic Induction	Faraday's law, Lenz Law, Fleming Right-Hand rule, Dynamo, Transformer, Eddy current, current in L-R circuit, self and mutual inductance, Energy in coil, motors and Generators.	
Alternating current (A.C) Circuit	Characteristics Of alternating current (period, frequency, peak value and Root-Mean-Square value as applied to an alternating current and voltage), Resistive Circuit, Capacitive Circuit, Inductive Circuit, Capacitance- Resistance Circuit, Inductance	

	–Resistance circuit, L-C-R Series circuit, resonance L-C-R circuit, power in A.C Circuit, parallel circuit.	

PHY 004: MODERN PHYSICS (3 Units)

Specific objectives

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

1. Describe the structures of the atom;
2. Describe the structure of the atom and its energy spectrum
3. Explain the wave-particle duality of matter;
4. Explain the limitation of classical physics;
5. Describe the nature and properties of X-rays;
6. Explain the interaction of radiation with matter;
7. Explain the radioactive disintegration and calculate radioactive decay constants of different radioactive elements; and
8. Explain the concept of semi-conductors

Course Content

Topics	Sub-topics	Details and notes
Atomic Structure	The Nucleus (proton and neutron), The Electron, specific Charge, isotopes, Millikan's Experiment, Cathode Ray electroscope, Types of spectrum, hydrogen Spectrum, Spectra Series	The following suggested experiments will enhance the student's understanding of the topics covered in this course; 1. Experiments on alpha particles, beta particles and gamma rays. 2. Measurement of long and short half-life.
Elements of Modern Physics	Defect of the Wave Theory, The Ultraviolent Catastrophe,	

	Photo Electric Emission, Bohr's Theory of the Hydrogen Atoms, And Energy Levels of the Atom, Excitation Absorption and Emission, Fraunhofer Lines. Interaction of Radiation with Matter, Laser Principle.	3. Geiger-Marsden experiment 4. Experiment with mass spectrometer 5. Millikan's oil Drop Experiment – determination of e/m ratio.
X-rays	Nature and properties of X-rays, Crystal Diffraction, Bragg's Law, Moseley's Law, X-ray Spectrum, Minimum Wavelength Value. X-Ray Absorption Spectra.	Simple application and operation of some conductors is required
Wave-Particle Duality	Electron Diffraction, De-Broglie Formula. Momentum and Energy, Duality, Compton Effect. Heisenberg's Uncertainty Principle	
Radioactivity and	Radioactivity, Mass Excess and nuclear binding Energy. Nuclear	

Nuclear Energy	fission and nuclear fusion, Geiger-Muller tube, Radioactivity Decay – half life and decay constant, nuclear Relations, isotopes, nuclear Energy, Einstein Mass-Energy relation	
Introduction to Semiconductors	Intrinsic Semiconductors, energy Bands in solids, Doping of semiconductors; p-n junction diodes, Half and full wave rectification, The bridge Rectifier, transistor as an Amplifier and switch.	
Applied Physics	Basic Applications of physics to the Life Sciences, Fundamental principles and Application of Ultrasound, X-ray and Nuclear Magnetic Resonance	

RECOMMENDED TEXTS

1. Michael Nelkon & Philip Parker (1995). *Advanced Level Physics*. London: Heinemann.
2. Young P.L., Anyakoha, M. W. & Okeke, P. N. (2002). *University Physics* (Also for Polytechnics and Colleges). Onitsha: Africana-FEP Publishers Ltd.
3. Giambattista, A., Richardson, B. & Richardson, R. C. (2010). *College Physics*. Boston: McGraw Hill Higher Education.
4. Tom Duncan (2008). *Advanced Physics*. London: Hodder Education.
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9. Physics Writers Series Creation (2015). *Mechanics and Properties of Matter*. San Press Ltd. Enugu.
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11. Physics Writers Series Creation (2015). *Electromagnetism and Modern Physics*. Ebenezer Production Ltd. Enugu.
12. Physics Writers Series Creation (2015). *First Year University Physics Practical*. Ebenezer Production Ltd. Enugu.
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JUPEB MATHEMATICS SYLLABUS 2020/2021

GENERAL OBJECTIVES

At the end of the series of courses, candidates should be able to:

1. identify and solve problems in general algebra which includes set, real number system, trigonometry, complex numbers, and coordinate geometry.
2. solve problems on calculus which involve the different rules of differentiation and integration of various functions. Solve problems on ordinary differential equations of first and second-order using different techniques.
3. manipulate the problems in Mechanics through the understanding of vectors, kinematics of motion, forces, Newtonian laws, inclined plane, the motion of particles in a plane, the equilibrium of rigid bodies.
4. evaluate the general analysis of statistical data, deal with random variables using different probability density functions such as Bernoulli, Binomial, Geometric, and Poisson random variable; and
5. model data using the Normal Distribution and the use of the Normal standard tables, Hypothesis Testing, Correlation, and Regression.

FIRST SEMESTER COURSES

MAT 001: Advanced Pure Mathematics	(3 UNITS)
MAT 002: Calculus	(3 UNITS)

SECOND SEMESTER COURSES

MAT 003: Applied Mathematics	(3 UNITS)
MAT 004: Statistics	(3 UNITS)

MAT 001: Advanced Pure Mathematics (3 UNITS)

Specific Objectives

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

1. manipulate in this course, candidates should be able to:
2. identify and perform operations with the number system, sequences, and series;
3. solve problems on circular functions: and
4. use trigonometric identities and apply the concept of trigonometry in solving problems.

Course Contents

Topic	Sub-topic	Details
Real numbers	Real numbers	Integers, rational and irrational numbers, Mathematical induction, real sequence, and series (AP and GP), Sum to infinity of Geometric Progression and its convergence, and binary operations
Algebra	Set Theory	Elementary set theory, subset, union, and intersection, complements, Venn diagram, and its applications to word problems.

	Mapping	Compositions of mapping, domain, range one-to-one, onto mapping, inverse functions, and composite functions
	Theory of Quadratics	The roots of quadratic (completing the square, using the discriminant to determine the roots), the theory of quadratic equations
	Polynomials	Polynomial is an equation up to degree 3, the Factor theorem, and the remainder theorem. Partial functions.
	Binomial theorem	Binomial theorem, pascal triangle
	Logarithmic functions	The relationship between logarithm and indices, change of base, and the natural logarithm
	Matrices and determinants	Matrices and determinants of not more than 3 x 3, inverse, addition, subtraction, multiplication, and its application to a system of equations up to three unknowns. Linear, quadratic, simultaneous (one linear, one quadratic), and graphical solution. Absolute value and intervals.
Complex numbers	Complex numbers	Basic concepts numbers, Algebra of complex numbers, the Argand diagram, complex numbers in polar form,

		De-Moivre's theorem with proof (n^{th} root unity) and loci problems
Trigonometry	Circular measure	Radians and degree conversion, length of an arc, area of sector, area of the segment of a circle Trigonometric functions of angles of any magnitude and simple trigonometric equations, graph of trigonometric functions (Sine, Cosine, and Tangent) The inverse of trigonometric functions. Use of trigonometric identities.
Coordinate geometry	Straight line Other circles equations	Length, gradient, and mid-point of a straight line. Equation of straight line (coordinate of two points and one point, and their gradients). Association between the gradients of parallel and perpendicular lines Circles, parabola, ellipse, hyperbola and their properties (e.g. tangents and normal)

MAT 002: Calculus (3 UNITS)

Specific Objectives

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

1. solve problems on limits
2. differentiate various functions including algebraic, logarithmic exponential, and implicit functions
3. apply the techniques of differentiation in solving practical problems; and
4. use the techniques of integration in solving a practical problem

Course Contents

Topic	Sub-topic	Details
Differentiation	Differentiation	Functions of a real variable, graphs, limits, and notion of continuity, differentiation from the first principle, differentiation of algebraic functions, and trigonometric functions. Composite functions: chain rule, product rule, and quotient rule. Derivatives of implicit and parametric functions. Higher-order derivatives

	Applications of differentiation	Rectilinear motion, tangent and normal to a curve, maximum and minimum, rate of change, and curve sketching. Maclaurin and Taylor series.
Exponential functions	Exponential functions	The graph of the exponential function (a^2), limit, and derivative of the functions (a^2). The exponential function (e^2), the graph, limit, and derivative of exponential functions (e^2).
Logarithm function	Logarithm functions	The relationship between logarithmic and exponential functions, the graph, limit, and derivative of the logarithm function ($\log_e X$).
Integration	Integration	Standard integrals, integration as the inverse of differentiation, definite integrals, techniques of integration (substitution method, inverse trigonometric function, integration by parts, use of partial fraction and reduction formula). Area, volumes, numerical methods of integration: Trapezoidal and Simpson rules.

Differential equations	Differential equations	Formulations of simple first-order differential equations, solution when the variables are separable, solution when the equation is homogeneous and solution when the equation is linear (Bernoulli equation) and use of an initial condition.
Second-order differential equations	Second-order differential equations geometric applications	Homogeneous second-order differential equations with constant coefficients The exponential growth and decay problems

MAT 003: Applied Mathematics (3 UNITS)

Specific objectives

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

1. evaluate the various operations of vectors
2. solve problems involving the motion of vectors in a straight line;
3. state and apply Newton's laws of motion
4. solve problems of a particle on an inclined plane: and
5. solve problems of forces in equilibrium and equilibrium of rigid bodies

Course Content

Topic	Sub-topic	Details
Vectors	Vectors	Scalar and vector quantities types of vectors, representation, and naming of vectors.
	Algebra of Vectors	Addition, subtraction and scalar multiplication, commutativity and associativity, linear dependence and co-linearity of vectors, perpendicularity of vectors, and the angles between two vectors

	Vector Equations	Vectors equation of lines and planes, application to geometry, vectors in three dimensions, and the rectangular unit vectors i, j, and k. Representation of vectors functions (one integral and differential operations of at most order 3).
Kinematics of motion in a straight line	Motion in a straight line	Unit vectors, position vectors, speed, velocity, acceleration and displacement in simple cases. Area under velocity-time graph representing displacement, and gradient of velocity-time graph representing acceleration. Gradient of a displacement-time graph representing velocity.
	Motion in a plane	Rectilinear motion with uniform acceleration, motion under gravity, and graphical method. Rectangular components of velocity and acceleration, resultant velocity, relative velocity and relative path.
Newtonian mechanics	Newtonian Mechanics Force and Motion	Energy, work, and power (simple cases).

		Force and motion, momentum, Newton's laws of motion, different kinds of forces (gravitational reactions, tension, and thrust), the motion of connected particles, the Atwood's machine (simple cases), and motion of a particle on an inclined plane.
Forces and equilibrium	Forces and equilibrium	Forces acting at various points of a rigid body, parallel forces, couple, movement, and application of vectors in statics (simple cases).
	Frictional forces and center of mass	Friction, smooth bodies, tension, and thrust, bodies in equilibrium (rough, horizontal, and inclined planes). Centre of gravity (simple cases).
Equilibrium of a rigid body	Equilibrium of a Rigid Body	Moment of inertia, the radius of gyration, parallel and perpendicular axes theorems, the kinetic energy of a body rotating about a fixed axis (simple cases)

MAT 004: Statistics (3 UNITS)

Specific Objectives

At the end, of the course, candidates should be able:

1. analyze data sets using descriptive measure and pictorial analysis
2. solve problems using probability theory;
3. evaluate the Random variable by apply Probability Density Function and Probability Distribution Function:
4. test hypotheses by applying normal distribution, student t, and normal standard table; and
5. solve problems on Regression and Correlation.

Course Content

Topic	Sub-topic	Details
Description of Data set	Data set	Population and sample, random variables, and graphical representation of data (histogram, bar chart, Ogive, and frequency polygon). The measure of central tendency for grouped and ungrouped data (mean, median, and mode). The measure of dispersion for grouped and ungrouped data (mean, deviation, standard

		deviation and variance). Skewness and Kurtosis
Mathematics of counting	Mathematics of counting	Permission and combination, fundamental principles of probability theory, discrete and continuous random variables.
Random variables	Probability	Probability density function and probability distribution function
	Discrete random variables	Find the mean and variance from a probability distribution table and the linear properties of expectation and variance.
	Discrete Probability Density Function, Expectation, and Variance	Expectation and variance of the following distributions: Bernoulli, Binomial, Geometric, and Poisson. Use of the Binomial and Poisson tables
Normal Random Variables	Normal Table	Use of standard Normal table, Normal distribution as a model for data and its applications to real life problems.
	Significance Testing	Test of hypothesis, errors in hypothesis testing, significance tests using normal distribution significance test using Nominal distribution and Student t-distribution, Chi-contingency test (goodness of fit test and contingency table), one sample mean test difference of mean, one-sample proportion test.

Regression and Correlation	Simple regression and correlation	Types of correlation, simple correlation and simple linear regression
Basic sampling techniques	Types of sampling techniques	Simple sampling technique, finite and infinite sampling sizes

JUPEB CHEMISTRY SYLLABUS 2020/2021.

GENERAL OBJECTIVES

At the end of the series of courses, candidates should be able to:

1. provide a course of instruction and other facilities for the acquisitions of knowledge in the field of Chemistry;
2. build on the knowledge acquired in chemistry at the Senior Secondary School level;
3. provide candidates with advanced knowledge in chemical concepts and principles through an efficient selection of content;
4. enable candidates to improve on and develop new laboratory skills including an awareness of hazards and safety in the laboratory;
5. provide candidates with unique and sufficient academic and technical knowledge for professional careers in industries, government agencies, research institutes, and academia; and
6. make the study of chemistry enjoyable and satisfying by creating a sustained interest in the subject.

FIRST SEMESTER COURSES

CHM 001: General Chemistry	(3 UNITS)
CHM 002: Physical Chemistry	(3 UNITS)

SECOND SEMESTER COURSES

CHM 003: Inorganic Chemistry	(3 UNITS)
CHM 004: Organic Chemistry	(3 UNITS)

COURSE DESCRIPTION

CHM 001: GENERAL CHEMISTRY (3 UNITS)

Specific Objectives

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

1. determine scientific quantities and units;
2. apply terms relative atomic, isotopic, molecular and formula masses, based on ^{12}C scale in Chemistry
3. define the term mole in terms of Avogadro constant;
4. determine empirical and molecular formulae, using combustion data;
5. discuss the development of the modern atomic structure;
6. state the electronic configuration of atoms and ions given the proton number;
7. explain qualitatively the variation in atomic radius and ionic radius;
8. describe chemical bonding (ionic, covalent, coordinate metallic, etc.);
9. explain the shapes of, and bond angles in molecules using the valence shell electron pair repulsion theory.

Course Content

S/N	Topic	Sub-topic	Detail
1	Measurement	Units of Measurement	Basic S.I. Units, derived units, conversion of units, significant figures, precision and accuracy, errors (systematic and random errors). Exact numbers.
2	Nature of matter	States of Matter	Solid, liquid, and gaseous states, properties, and inter-conversion.
3	Atomic Masses	Relative Atomic Mass, Relative Molecular Mass	Definitions and calculations of molar masses of atoms and molecules based on ^{12}C scale, use of mass spectrometry in the determination of Relative Atomic Mass and Relative Molecular Mass.
4	Atomic Structure	Dalton's Atomic Theory Discovery of Subatomic Particles	Dalton's atomic theory. Various experiments that led to the discovery of neutrons, protons, electrons and nucleus (cathode ray, Millikan's oil drop, Rutherford and Thompson's experiments), calculations of

			relative abundances and isotopic mass;
		Planck's Theory	Black body radiation, photoelectric effect, quantization energy;
		Bohr's Theory	Bohr's assumption, atomic spectra of hydrogen (no derivation is required) and determination of spectra lines, determination of ionization energy from line spectra (when n=∞);
		Wave Theory of Atom	Particle wave duality.
		Electronic Configuration of Atoms and Ions	Atomic orbitals, quantum numbers (n, l, m, s), electronic energy levels, the degeneracy of atomic orbitals, shapes of atomic orbitals (s, p, and d orbitals)
			Aufbau principle, Pauli's exclusion principle, Hund's rule, (n+1) rule.

5	Periodicity	Periodic Table Atomic Properties	Development of the modern periodic table, building up periods, identifying blocks and groups of elements, Periodic law. Trends of atomic size, ionization potential, electron affinity, electronegativity and ionic radii, isoelectronic species.
6	Mole Concept	Mole and Avogadro's Constant Empirical and Molecular Formulae Stoichiometry Solution Stoichiometry	Various ways of defining the mole, Avogadro's constant, molar mass. Definition and calculations of Empirical and Molecular formulae from percentage composition by mass and combustion data. Balancing chemical equations, calculations based on stoichiometric coefficients, a reaction that involves limiting reactants, calculation of actual and percentage yields. Calculation of molarity and gram concentration,

			preparation of standard solutions, serial dilution.
7	Types of chemical reactions	Neutralization	Definition, identification of Neutralisation reactions. Prediction solubilities. Various definitions of oxidation and reduction reaction with emphasis on the definition of terms of electron transfer, calculation of oxidation numbers, balancing of redox reactions by oxidation state and half-reaction method (both in acidic and basic media).
8	Chemical Bonding	Electrovalent/Ionic Bonding	Describe ionic bonding using some ionic compounds e.g. NaCl, energy considerations of ionic bonding, the definition of lattice energy (no derivation), properties of ionic compounds.
		Covalent Bonding	Describe covalent bonding using simple covalent compounds e.g. CO_2 coordinate/dative covalent bonding e.g. in ammonium ion (NH_4^+), Al_2Cl_6 molecule, bond energy, bond length, and bond

		Intermolecular Forces Metallic Bonding Bonding and Physical Properties	polarity (Fajan's rule), properties of covalent compounds, hybridization concept (sp, sp^2, sp^3), shapes of molecules using the valence-shell electron-pair repulsion theory e.g. H_2O, NH_3, CH_4, etc. Van der Waals forces, permanent and induced dipoles, hydrogen bonding. Describe metallic bonding in terms of a lattice of positive ions surrounded by delocalized electrons. The effect of different types of bonding on the physical properties of substances (e.g. unusual high boiling point of water, miscibility of water and ethanol, nylon, polyester).

CHM 001 Practicals

1. The sensitivity of weighing equipment, Graduation of measuring equipment, and determination of significant in readings;
2. Preparations of standard solutions: Serial dilution;

3. Volumetric analysis: Practice in volumetric analysis, acid-base, redox, precipitation titrations. Acid-base titrimetry involving NaOH, oxalic acid, HCl and Na_2CO_3, Determination of percentage composition of iron using $KMnO_4$ (redox Titrimetry), Titrimetric analysis of mixtures, NaOH/$NaHCO_3$ and Na_2CO_3/ $NaHCO_3$; and
4. Introduction to the statistical analysis of data: Use of Applied data to illustrate elements of simple statistics.

CHM 002: PHYSICAL CHEMISTRY (3 UNITS)

Specific Objectives

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

1. state the assumptions of the kinetic theory for ideal gases;
2. state and derive Raoult's law;
3. use of colligative properties of the solution to obtain experimentally determined molar masses;
4. apply Hess' Law to construct simple energy cycles and carry out calculations involving such cycles;
5. define the terms, standard electrode potential, and standard cell potential.
6. use the redox equation to construct an electrochemical cell using relevant half equations;
7. construct and use rate equations to deduce the order of reactions.
8. define acids and bases in terms of Arrhenius, Bronsted-Lowry, and Lewis concept; and
9. identify acids/bases in a chemical reaction, giving the basis for the classification.

Course Content

S/N	Topic	Sub-topic	Detail

1.	Kinetic Molecular Theory of Gases	Gas Laws Ideal and Real Gases	Statement of and calculations involving Boyle's, Charles', Dalton's, Graham's laws, and Avogadro's hypothesis. Ideal gas equations, Kinetic theory of gases (assumptions only), real gas deviation from ideal gas behavior, Van der Waal's equation. PV=nRT in calculations, including relative molecular mass determination.
2.	Solutions	Phase and Phase Diagram Ideal and Non-Ideal Solutions Colligative Properties	Interpretation of phase diagram for a one-component system. Definition of ideal and non-ideal solutions, Raoult's Law. Lowering of vapor pressure, depression of freezing, the elevation of boiling point, and osmotic pressure. Determination of molar mass using osmotic pressure. (The derivation not required).
3.	Thermochemistry	Enthalpy Change	Exothermic and endothermic changes, Definition of enthalpy changes for processes

			(combustion, neutralization, hydration, formation, solution, atomization) under standard conditions.
		Hess' Law	State Hess' law and construct energy cycles based on Hess' law.
			Use of bond energy to calculate energy changes.
		Introduction of Chemical Thermodynamics	Definition of entropy and Gibb's free energy change for reactions using $\Delta G=\Delta H-T\Delta S$. Predicting the spontaneity of reactions.
4.	Electrochemistry	Electrolysis	Faraday's first and second laws of electrolysis and calculations based on them.
		Electrochemical Cells	Identify the substances liberated during electrolysis based on the state of electrolyte, position in electrochemical series, the concentration of electrolyte, and the nature of electrodes.
		Fuel Cells and Batteries	Definitions of electrode potential, standard electrode potential, cell potential. Calculations of e. m. f of a cell.

			Application of the Nernst equation. Use of cell potential to predict the feasibility of reactions. Industrial uses of electrolysis. H_2O/O_2 fuel cell, rechargeable batteries.
5.	Chemical Kinetics	Rate Equations Activation Energy Catalysis	Definition of the rate of reaction and reaction mechanism. Factors affecting the rate of reaction. Orders of reaction, rate constants, and molecularity. Calculations of the order of reaction from experimental data. Simple collision theory. Definition of activation energy. Arrhenius equation. Homogeneous and Heterogeneous catalysis.

6.	Equilibrium State	Mass Action	Equilibrium changes, reaction quotient (Q), equilibrium expressions (homogeneous and heterogeneous equilibria). Calculations of equilibrium constants in terms of concentration (K_c) and partial pressure (K_p). Relationship between K_c and K_p.
		Le-Chatelier's Principle	Statement and Application of Le-Chatelier's principle to deduce the effects of changes in temperature, pressure, and concentration on a system at equilibrium.
		Acid-Base Equilibria	Definitions of acid and base in terms of; Arrhenius, Bronsted-Lowry, and Lewis concept. Auto-ionisation of water.
		Ionic Equilibria in Aqueous System	Acid strengths, Ph of acids, buffer solution, Indicator theory. Solubility product, common ion effect. Selective precipitation of ions.

7.	Nuclear Chemistry	Radioactivity	History of Radioactivity. Types of radiations. Radioactive disintegration. Nuclear equations, half-life, radioactive carbon dating. Detectors and applications of radioactivity.

CHM 002 Practicals

1. Experiments to calculate enthalpy changes.
2. Determination of molecular mass using freezing point depression.

CHM 003: INORGANIC CHEMISTRY (3 UNITS)

Specific Objectives

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

1. describe the extraction of groups 1, 2, and 13 metals;
2. describe the physical properties of elements and variation down a Group;
3. discuss gradation in properties across the period from metal through metalloid to non-metals;
4. describe and explain the relative stability of oxides, hydrides, and chloride of Group 14 elements;
5. explain what a transition element is in terms of d-block elements; and
6. describe the tendency of transition metals to form variable oxidation states and write their electronic configuration.

Course Content

S/N	Topic	Sub-topic	Detail
1.	Periodicity of Elements	General Trends in Properties of Elements	Nature of elements, trends in physical and chemical properties of elements.
2.	Chemistry of Hydrogen	Hydrogen	Occurrence, isotopes, preparation, and reactions, hydrides.

3.	s-block Elements	Group 1 Group 2	Physical and chemical properties, extractions of group 1 metals e.g. Sodium, trends in properties of their compounds. Uses of group 1 metals. Physical and chemical properties, extraction of group 2 metals e.g. Calcium, trends in properties of their compounds. Uses of group 2 metals Boron and Aluminium.
4.	p-block Elements	Group 13 Group 14 Group 15 Group 16	Occurrence and extraction, trends in properties of their compounds with oxygen, chlorine, and hydrogen. Occurrence, allotropic forms, physical and chemical properties of oxide, hydrides, halides. Greenhouse effect. Use of group 14 elements. Occurrence, allotropic forms, physical and chemical properties, simple oxides and nitrides, environmental impacts of NO_x. Use of group 15 elements.

		Group 17	Occurrence, allotropic, physical and chemical properties, trends in properties of oxides, hydrides, and halides. Environmental impact of Sox. Uses of group 16 elements. Occurrence, physical and chemical properties, hydrogen halides, metal halides, and interhalogen compounds. Uses of group 17 elements.
5.	d-block Elements	First Row Transition Elements Introduction to Coordination Chemistry	Definition of transitions element, electronic configuration, atomic radii, ionization potential, variable oxidation states, the formation of the metal complex. Definition of metal complex and ligands. Bonding in metal complexes (chain theory and its limitations, Werner's theory). Valence bond theory and hybridization concept. Study of structure and magnetic properties of octahedral and

			tetrahedral complexes. Nomenclature of coordination compounds

CHM 003 Practicals

Qualitative Inorganic Practical

1. Flame tests and systematic analysis of mixtures containing two salts.
2. Identification of anions; preliminary test for anions, preparations of Na_2CO_3 extracts, and confirmatory tests.
3. Identification of cations group I – VI: Group separation and analysis of ions within a group (group analysis).

CHM 004: ORGANIC CHEMISTRY (3 UNITS)

Specific Objectives

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

1. interpret and use nomenclature and general formulae of alkanes, alkenes, alkynes, arenes, aldehydes, ketones, alcohols, alkyl halides, and carboxylic acids and their derivatives;
2. describe the synthetic routes to simple organic compounds and the reactions of the above classes of compounds
3. describe the formation of the polymer by addition and condensation polymerization;
4. identify the monomer present in a given section of a polymer molecule
5. relate chemical principles to industrial processes; and
6. explain the various types of isomerism exhibited by organic compounds.

Course Content

S/N	Topic	Sub-topic	Detail
1.	Structure and Bonding in Organic Compounds	Hybridization Classes of Organic Compounds Nomenclature	Tetravalency and hybridization of carbon. Functional groups, homologous series, determination of molecular formula from an empirical formula.

			The naming of organic compounds; alkanes, alkenes, alkynes, aldehydes, ketones, alcohols, alkyl halides, arenes, carboxylic acids, amines.
2.	Purification	Purification of Organic Compounds Determination of Elements	Determination of melting point, crystallization, and recrystallization, simple distillation, liquid extraction, sublimation. Various methods of C, H, N, S, and halogens in organic compounds, Sodium fusion test.
3.	Organic Reactions	Covalent Bond Cleavage Types of Reactions Electronic Concepts in Organic Chemistry	Homolytic and heterolytic fission, free radical reaction Nucleophiles, and electrophiles. Addition, Substitution, Elimination, Hydrolysis, Condensation. Inductive, steric, and electrometric effects.
4.	Isomerism in Organic Compounds	Isomerism in Organic Compounds	Constitutional, chain, position, and functional group isomerism. Tautomerism, stereoisomerism, geometric and optical isomerism.

5.	Organic Compounds	Alkanes, Alkenes and Alkynes	Nomenclature, structure, synthesis, properties, and reactions.
		Alcohols	Nomenclature, structure, synthesis, properties, and reactions (combustion, substitution to give halogenoalkanes, reaction with Na, oxidation to carbonyl compounds and carboxylic acids, dehydration to alkenes, the formation of esters by esterification with carboxylic acids and acyl chlorides). Classes of alcohol.
		Alkyl halides	Distinguishing tests for alcohols (Lucas and Jones reagents)
		Carbonyl Compounds (Aliphatic and Aromatic)	Nomenclature, structure, synthesis, properties, and reactions.
		Carboxylic Compounds and their Derivatives	Nomenclature, structure, synthesis, properties, and reactions (reduction, reaction with HCN, NaCN, reaction with aqueous I_2). Tests for aldehydes
		Primary Amines	
		Introduction to Aromatic Compounds	

			and ketones using 2,4-dinitrophenylhydrazine. Nomenclature, properties, preparation from alcohols, aldehydes, and nitriles. Reactions of carboxylic acids with reactive metals, reduction to alcohols using $LiAlH_4$. Hydrolysis of esters by acid and base Hydrolysis of acyl chlorides, Preparation of alkylamines. Basicity of amines in terms of their structure. Reactions of amines (formation of diazonium salt). Aromaticity, Kekule structures.
6.	Macromolecules	Carbohydrates Proteins Polymers	Classes of carbohydrates, simple tests. Amino acids, the formation of peptide bonds in peptides. A simple description of electrophoresis. Types of polymerization reactions and their differences. Simple structures of polymers. Uses of polymers.

7.	Biotechnology	Biotechnology	Biotechnology and its application in food and drugs.
8.	Petroleum	Petrochemicals	Constituents of crude oil, refining, cracking. Chemicals derived from crude oil.

CHM 004 Practicals

1. Reactions of simple functional groups: Simple organic tests, solubility, sodium fusion test, functional group identification (with emphasis on ketones, aldehydes, and carboxylic acids).
2. Recrystallization and determination of the melting point of organic compounds.

RECOMMENDED TEXTS

1. E. N. Ramsden: *A-Level Chemistry*, 4th Edition (2000), Stanley Thornes (Pub) Ltd. ISBN 0748752994.
2. Philips Matthews: Advanced Level Chemistry.

3. Basic Organic Chemistry by B. A. Osuntogun, O. B. Familoni and B. I. Alo; 3rd Edition (2012) University to Lagos Press.
4. AQA Chemistry by Ted Lister and Janet Renshaw (2009) Nelson Thornes Ltd. (Pub.).
5. *Understanding Advanced Physical Inorganic Chemistry*: The Learner's Approach by Jeanne Tan, Kim Seng Chan (2009) World Scientific (Pub.).
6. *Chemistry*: The Central Science by Theodore E. Brown, Theodore Lawrence Brown, H. Eugene H. LeMay, Bruce E. Bursten, Catherine Murphy, Patrick Woodward 12th Edition (2012) Pearson Education (Pub.)
7. Martin S. Silverberg (2010). *Principles of General Chemistry, Inorganic, and Physical.* Y. C. Wong, C. T. Wong, S. O. Onyiruka, and L. E. S. Akpanisi. Africana FEP Publishers Ltd. (2002).