

JUPEB PHYSICS SYLLABUS

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.

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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 of conversion and measurements, Methods of measuring	Revision of types of motion: translational, random, oscillatory, and rotational, linear motion: distance, displacement, uniform

	Length, Mass and Time. Basic and Derived units, Dimensional Analysis (L.M.T only)	velocity and uniform acceleration are required.
Vectors	Vector representation, Addition and Subtraction of vectors (geometrical method only), Resolution of vectors. Vector multiplication, vectors in Cartesian, Coordinate system.	<p>The following suggested experiments will enhance the students understanding of the topics covered in this course:</p> <ol style="list-style-type: none"> 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. 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 and capillarity.
Particle Kinetics	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. Motion in inclined planes, frictional forces.	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, Conservation and Conservation of Energy, Power, the Kilowatt hour, principle of mechanical Energy Conservation	
Circular and oscillatory motions.	Angular Displacement, Angular Velocity,	

	<p>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.</p>	
Elasticity	<p>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.</p>	
Hydrostatics	<p>Matter (Solid, Liquid and Gases), Density, Pressure in Fluids, Change of phases, Archimedes' principle. Principle of Floatation, Stoke's law, Terminal velocity. Bernoulli's</p>	

	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.	

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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 of ideal gas;
2. Explain the concept of Heat, temperature and modes 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 Gas, Kinetic Energy of a molecule.	Revision of Rectilinear propagation of light, laws of reflection and refraction, reflection on plane and curved mirrors, refraction at plane 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
Temperature and Thermometry	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 Isothermal and Adiabatic Processes'.	

Electromagnetic Waves	Electromagnetic spectrum. Applications of Components of the Electromagnetic Spectrum.	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. 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.
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.	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. 13. Measurement of the refractive index of a liquid and a solid. 14. Measurement of the focal length of a converging lens.
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.	

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.	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.
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:
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.	<ol style="list-style-type: none"> 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.

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 semi-conductors 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 and moving charge	Force on a current-carrying conductor, Force 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.	
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PHY 004: Modern physics (3 Units)

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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 interaction of radiation with matter
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, Milikan's Experiment, Cathode Ray electroscope, Types of spectrum, hydrogen Spectrum, Spectra Series	<p>The following suggested experiments will enhance the student's understanding of the topics covered in this course;</p> <ol style="list-style-type: none"> 1. Experiments on alpha particles, beta particles and gamma rays. 2. Measurement of long and short half-life. 3. Greiger-Marsden experiment 4. Experiment with mass spectrometer 5. Milikan's oil Drop Experiment – determination of e/m ratio. <p>Simple application and operation of some conductors is required</p>
Elements of modern physics	Defect of the wave theory, the Ultraviolet 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.	
X-rays	Nature and properties of X-rays, Crystal Definition, Bragg's Law, moseley's Law, X-ray, Absorption spectra.	
Wave-Particle Duality	Electron Diffraction, de Broglie Formula. Momentum and Energy, Duality , Compton Effect. Heisenberg's Uncertainty principle	
	Radioactivity, Mass Excess and nuclear binding Energy. Nuclear 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	