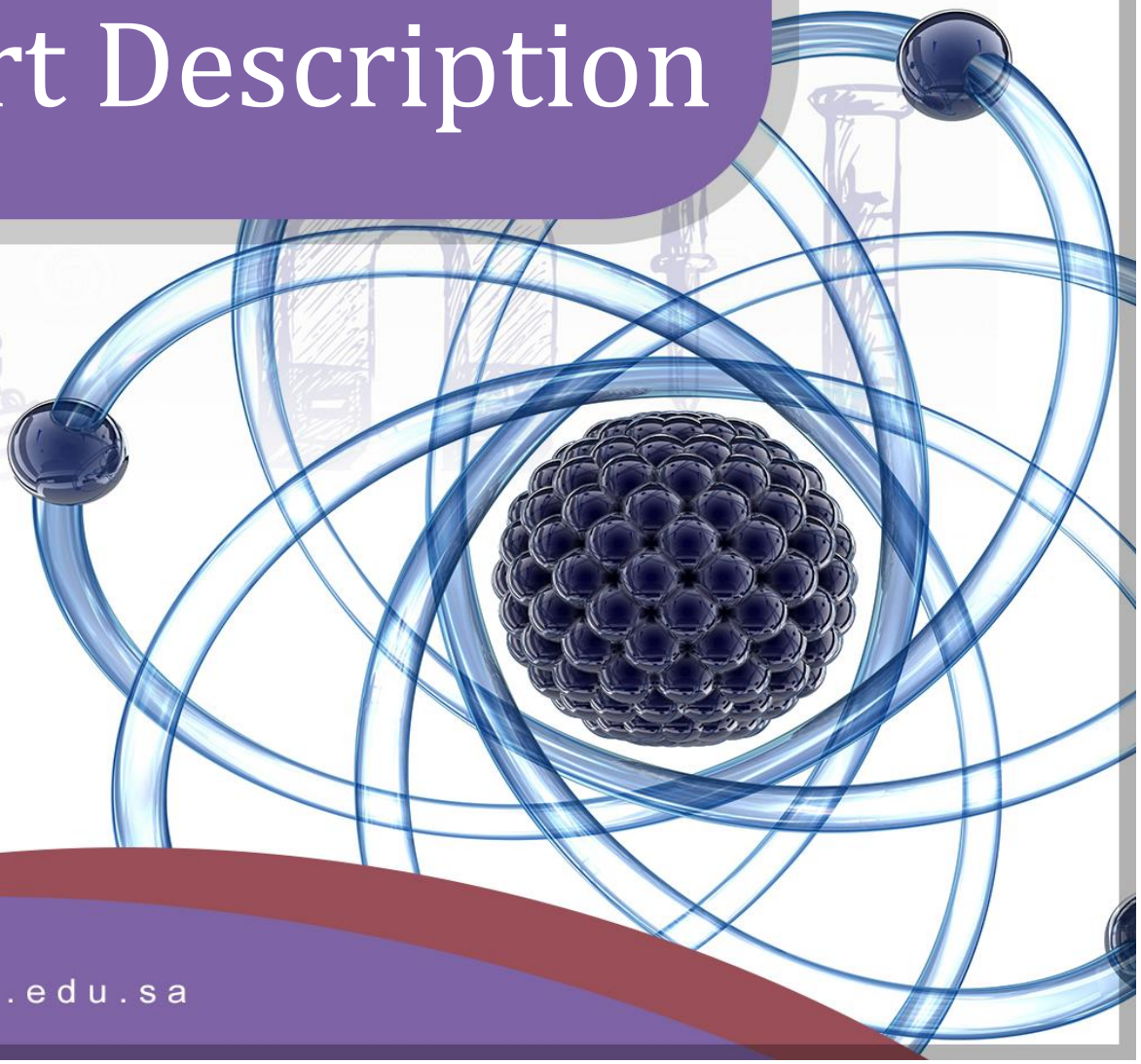
College of Sciences -Al Zulfi	Department of Physics	Physics Program

Ministry of higher education
Majmaah university
College of Science
Department of Physics

وزارة التعليم العالي
جامعة المجمعة
كلية العلوم
قسم الفيزياء

جامعة المجمعة
Majmaah University

Physics Courses Short Description



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Contents

PHYS201: General Physics I

Theoretical part: Physics and measurements, Units and dimensions, Dynamics of particle in one dimension (displacement, average velocity, instantaneous velocity, acceleration, free fall), vector algebra and geometry, Motion in two dimensions, Projectile motion, Uniform circular motion, Tangential and radial accelerations, Newton's first law and inertial frames, Mass and weight, Newton's second law, Newton's third law, Friction, Work and energy, Vector scalar products, Work of variable forces, Kinetic energy and work-energy theorem, Conservative and non-conservative forces and potential energy, Power, Conservation of mechanical energy, The conservation law of linear momentum, Impulse, Collisions, Collision in one and two dimensions, Rotational motion with constant angular acceleration, Angular quantities, Moment of inertia, Torque and angular momentum, Work of rotational motion, Properties of matter: Elasticity, Stress, Strain, Modulus's, Strain energy, Fluid mechanics: Density and relative density, the concept of pressure, Pascal law, Archimedes principle, Fluid flow, Bernoulli's equation and its applications, Viscosity, Surface tension.

Practical part: Error and measurements, Force table, Hook's Law, Free fall, Projectile motion, Inclined planes, Verifying the equations of motion and collisions using air track, Young's Modulus.

PHYS202: General Physics II

Theoretical part: Electric Charge, Insulators and conductors, Coulomb's law, Point charge, The electric field, Electric field of multiple point charges, The electric field of continuous charge distribution, examples of various shapes (disks, rings, spheres, planes), The parallel plate capacitor, Electric dipole, motion of point charge and electric dipole in electric field, Electric flux, Gauss's law, Applications of Gauss's law, Conductor in electrostatic equilibrium, The electric current, Batteries, current density, Conductivity and resistivity, Electric potential, The potential of point charges, The potential of dipole, The electric potential of many charges, Capacitance and capacitors, Energy stored in a capacitor, Fundamental circuits, Ohm's law, Series resistors, Parallel resistors, Kirchhoff's laws, RC circuits, Magnetism and magnetic force, source of magnetic fields, Magnetic field of a current, Magnetic dipoles, Ampere's law and solenoids, The magnetic force on a moving charge, The magnetic force on a current-carrying wire, Forces and torques on current loops, Induced current, Motional emf, Magnetic flux, Lenz's law, Faraday's law, Induced fields and EM waves, Inductors, LC circuits, LR circuits, AC circuits and phasor, Capacitors in AC

circuits, RC filter circuits, Inductor circuits, The RLC circuits, Power in AC circuits, Wave phenomena, Longitudinal and transverse waves, Sound, The nature of light and the laws of geometric optics, Image formation, Interference of light waves, Diffraction patterns and polarization.

Practical part: Verification of Ohm's Law, Metric bridge, Charge and discharge of capacitors, Inductive Reactance, Capacitive Reactance, RCL circuits, Transformers, Speed of sound in air, Refractive Index of a Prism, Focal length of Lenses, Focal Length of Mirrors, Jouls equivalence.

PHYS211: Classical Mechanics

Integration of Newton's equations of motion, motion under a constant force, motion under a force that is a function of time, velocity and position, time varying mass system. **The Lagrangian Formulation of Mechanics,** Generalized Coordinates and constraints, D'Alembert's Principles and Lagrange's Equations, Hamilton's Principle, Integrals of motion, Nonconservative systems,……etc. **Hamiltonian Dynamics,** the Hamiltonian of a dynamical system, Hamilton's Canonical equation, integrals of Hamilton's, phase space and Liouville's theorem, the passage from the Hamiltonian. **General force motion,** The two body problem, general properties of central force motion, effective potential and classification of orbits, general solutions of the problem of motion, Galilean references, Non Galilean references, inverse square law, Kepler's law, application of general force, Newton's law of gravity, stability of circular orbits, the upsides and the advance of perihelion, hyperbolic orbits and Rutherford scattering. Collisions Between Particles**,** Direct impact of two particles, centre of mass coordinate system, scattering cross section in the L and C systems, Scattering by a central force field. **Linear Oscillations,** the simple harmonic oscillator, and harmonic oscillation in two and three dimensions, Damped Oscillations, relaxation time phenomena…… etc. **Nonlinear Oscillation,** Qualitative analysis - energy and phase diagrams, Elliptic integrals and Nonlinear oscillations, Fourier series, the method of perturbation, Ritz method, Methods of successive approximation, chaotic oscillations.

PHYS231: Vibrations and Waves

Periodic motion - Simple harmonic oscillation - Damped oscillation - Forced oscillation - Application of damped and forced oscillations - Superposition of simple harmonic oscillations- traveling waves, standing waves, Beats - Transverse wave in wires -

Longitudinal waves in rods - Application of longitudinal wave in open and closed air columns -Fourier analysis -Doppler effect

PHYS241: Thermodynamics

Fundamental concept in heat and thermodynamics, Thermal Equilibrium and zeroth law of thermodynamics, Ideal gases, First law of thermodynamic, Application of first law of thermodynamic - isothermic and adiabatic processes. Irreveriable process - reversible processes. Carrnot cycle - otto cycle - cleapeyron lattent heat equation - Second law of thermodynamic, Entropy, Thermodynamic functions, Maxwell relation, Third law of thermodynamic, Phase change, Applications on thermodynamic laws.

PHYS291: Thermal physics lab.

Specific Heat of a Solid, Coefficient of Thermal expansion, Surface tension, viscosity coeffcient, Newton's law of cooling, Determination of the Paraffin wax fusion temperature, Boyle's Law, resistivity dependence on temperature.

PHYS303: Mathematical Physics I

Determinants, Matrices, Solving linear equations and differential equations by matrices, Application on the motion of the rotation of the rigid body, Vector Algebra: Vector products, Position, Displacement, Vector transformation, Gradient, The Divergence, The Curl, Laplace operator, Line, Surface, and Volume Integrals, Gauss theorem, Stock's theorem, Green's theorem, Spherical polar coordinates, Cylindrical coordinates, The Dirac delta function.

PHYS221: Electromagnetism I

Review of vector Operations and algebra, Linear and rotational transformation of vectors, Vector field, Review of vector differential calculus: (gradient, the divergence, the curl, product rules, Second Derivatives), Review of integral Calculus: (linear, surface, and volume integrals), The fundamental theorem for: (calculus, gradient, divergence, curl), Curvilinear Coordinates: (spherical polar and cylindrical coordinates), The Dirac delta function in one and three dimension, The divergence of reciprocal square of radial distance, The Helmholtz theorem, Coulomb's law, The electric field, Continuous charge distributions, Divergence and curl of electrostatic fields, Field lines and flux, Gauss's law and its applications, Electric potential, The potential of a localized charge distribution, The work done to move a charge, The energy of a point charge distribution, The energy of a continuous charge distribution, Properties of conductors and induced charges, Surface

charge and the force on a conductor, Capacitors, Poisson's equation, Laplace's equation in one, two and three dimensions, Boundary conditions and uniqueness theorems, Conductors and the second uniqueness theorem, The Method of images and induced surface charge and calculating force and energy, Multipole expansion and approximate potentials at large distances, The monopole and dipole terms, The electric field of a dipole, Polarization, Field of a polarized object, Induced dipole and dielectrics, Polar molecules, Bound charges, The field inside a dielectric and the electric displacement, Gauss's law in the presence of dielectrics, Boundary conditions, Linear Dielectrics: (susceptibility, permittivity, dielectric constant), Boundary value problems with linear dielectrics, Force and energy in dielectric systems, Magnetostatics and the Lorentz law, Magnetic fields and magnetic forces, The Biot-Savart law, The magnetic field of a steady current, The divergence and curl of the magnetic field, Ampere's law and its applications, Magnetic vector potential, Magnetostatic boundary conditions, Multipole expansion of the vector potential, Magnetic fields in matter and the magnetization, Magnetic materials: (diamagnets, paramagnets, ferromagnets), Torques and forces on magnetic dipoles, Effect of magnetic field on atomic orbits, The field of a magnetized object, Bound currents, The magnetic field inside matter and the auxiliary field, Ampere's law in magnetized materials, Boundary Conditions, Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism.

PHYS332: Optics

The nature of light, The superposition of waves, Interference of two-beams of light (division of the wave front & division of amplitude) Interferometers (Young’s, Fresnel's biprism, loyed mirror, Fresnel's double mirrors, wedge interferometer, Newton rings, Michelson interferometer, Jamin & Mach-Zehnder refractometers), Interference of multiple beams, Fabry-Perot interferometer, Applications of interferometry. Diffraction, Fraunhofer diffraction (single slit, two slits, multiple slits) - diffraction grating - Fresnel diffraction (circular aperture & circular Obstacle). Polarization - polarization by absorption, reflection, refraction & double refraction - Optical active materials & polarometer. Interference of polarized light, Analysis of polarized light, Electro-optics (Kerr effect & Pockels effect), Magneto - optics (Faraday effect)

PHYS351: Modern Physics

Special Theory of Relativity: wave propagation - Michelson Morley experiment - Galilean transformation – Lorentz transformations – Relative velocity - Lorentz contraction – Time

Dilation – relativity of mass – Mass and energy – Applications. The particlelike properties of Electromagnetic radiation: Electromagnetic waves – The photoelectric effect – black body radition - The Compton Effect - X-rays. Waveslike properties of particles: De-Broglie hypothesis – Electron diffraction experiment of Davison and Germer – Electronmicroscope – Uncertainity principle, quantum theory. Atomic Structure: atomic properties - The Thomson model - Rutherford Model for atomic nuclei - alpha particle scattering - Atomic Spectra – Bohr theory of the hydrogen atom – Sommerfeld's Model – Failure of the Bohr theory Frank-Hertz experiment – The basic ideas of the Quantum Mechanics

PHYS304: Mathematical Physics II

Complex numbers, Analytic functions - Limits and Continuity – Analyticity - The Cauchy-Riemann Equations, Elementary Functions, Complex Integration – Contours - Independence of path - Cauchy integral theorem - Bounds for analytic Functions, Series representations for analytic functions, Residue Theory. Conformal Mapping- Invariance of Laplace's Equation - Geometric Considerations - Bilinear Transformations - The Schwartz-Christoffel Transformations.

PHYS322: Electromagnetism II

Electromotive force, Ohm's law, Motional electromotive force, Electromagnetic induction, Faraday's law, The induced electric field, Inductance, Energy stored in magnetic fields, The modified Ampere's law, Maxwell's equations in vacuum, Maxwell's equations in matter, Boundary conditions, Conservation laws and the continuity equation, Poynting's theorem, Newton's third law in electrodynamics and momentum, Maxwell's stress tensor, Conservation of momentum, Angular momentum, Electromagnetic waves in one dimension, The wave equation, Sinusoidal waves, Boundary conditions: reflection and transmission, Polarization, Electromagnetic waves in vacuum, Monochromatic plane waves, Energy and momentum in electromagnetic waves, Electromagnetic waves in matter, Propagation in linear media, Reflection and transmission at normal incidence, Reflection and transmission at oblique incidence, Absorption and dispersion, Electromagnetic waves in conductors, Reflection at a conducting surface, The frequency dependence of permittivity, Guided waves and wave guides, TE waves in a rectangular wave guide, The coaxial transmission lines, Electric dipole radiation, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, Radiation reaction with matter.

PHYS392 : Optics Lab

Prism spectrometer (refractive index and dispersion), Grating spectrometer, Fresnel's biprism with He-Ne laser, Fresnel's double mirrors with He-Ne laser, Newton's rings, Michelson interferometer, Mach-Zehnder-interferometer, Diffraction at a single slit, Diffraction at double slits, Diffraction at one-and two-dimensional gratings, Diffraction at a single slit measuring and evaluating with Video Com, Polarimter and optical activity, Abbe's refractometer, Inverse square law of light radiation and absorption coefficient of glass or plastic materials, Polarization of light.

PHYS342: Statistical Physics

Probability, One random variable, Some important probability distributions, Many random variables, Sums of random variables and the central limit theorem, Rules for large numbers, entropy, Kinetic theory of gases, Maxwell's distribution of the velocities of gas molecules and its applications, Distribution function of the energy of molecules, Liouville's theorem, Equilibrium properties, The microcanonical ensemble, Two-level systems, The ideal gas, Mixing entropy and the Gibbs paradox, The canonical ensemble, Canonical examples, The Gibbs canonical ensemblem, The grand canonical ensemble, Quantum statistical mechanics, Maxwell-Boltzmann distribution, Bose Einstein distribution, Fermi-Dirac distribution, Vibrations of a solid, Black-body radiation, Quantum microstates, Quantum macrostates, Ideal quantum gases, Hilbert space of identical particles, Canonical formulation, Grand canonical formulation, The degenerate fermi gas, The degenerate bose gas.

PHYS352: Quantum Mechanics I

Reviews of the fundamental experiments in modern physics, the need for quantum mechanics. Wave packet and uncertainty principle, Schrödinger equation for free particle, Continuity relation, The dynamical variables and calculating the expectation values, Schrödinger equation with a potential in one dimension, Dynamical variables and calculating the expectation values in momentum space, Commutation relations. Hermitian operators, Linear operators, Completeness relation and orthonormality. Schrödinger equation in three dimensions, The fundamental postulates of quantum mechanics, Particle in an infinite well, Spectral expansion theory, The parity, Constants of motion and conservation laws, Momentum eigenfunctions and free body, One-dimensional potentials: The potential step, The finite potential well at scattering and bound states, The potential barrier, The delta-function potential at Scattering and Bound

states, Simple harmonic oscillator, Oscillator eigenfunctions and eigenvalues, Ladder operators and dynamical variables, Schrödinger equation in three dimensions in Cartesian coordinates, Schrödinger equation in three dimension curvilinear coordinate system, Angular momentum and its eigenfunctions and eigenvlaues, The addition of angular momentum, The central potentials.

PHYS393: Electromagnetism Lab

Practical part: Measurement of the electric charge by Millikan oil drop method, measurement of e/m of the electron, Verification of Biot - Savart law, Verification of Faraday's law, Transformers, Measuring the force on current carrying conductors in a homogenous magnetic fields, RLC circuits, Generators, Motors, Magnetic moment of magnetized rod, Helmholtz coils, Magnetic induction.

PHYS494: Modern Physics Lab

The Balmer series of hydrogen and determination of Rydbergs constant, Franck- Hertz experiment, characteristics of microwaves, Fabry – Perot interferometer, Kerr effect, Faraday effect, Pockels effect, Zeeman effect, Planck s constant, Studing X-ray spectra.

PHYS423: Electronics

Analog Electronics: The P-N junction diode and Zener diode with their applications – Junction Field effect transistor - Bipolar junction transistor (Bias and amplifiers: JFET & BJT) – Differential and Operational Amplifiers, Introduction to Feedback Circuits, Multivibrators and Oscillators.

Digital Electronics: Binary and Hexadecimal System, Logic Gates, Karnaugh Maps Flip Flops, Shift Registers, Counters, Memories.

Practical part: P-N junction application (half-wave rectifier, full-wave rectifier, clampers and limiters, Zener regulation) - Transistors JFET & BJT amplifiers. Amplifiers with 741 (Inverting & Non inverting Amplifiers, Active Filters, Wien Oscillator, Astable Multivibrator). Half and Full Adder (7483), Flip Flop (7474-7476), Shift Register (7495-74194), Counters (7493-74193).

PHYS453: Quantum Mechanics II

Dirac notation, Vector space algebra and Hilbert space, Rephrasing wave mechanics and operator methods in abstract view, Angular momentum commutation relations, Raising and lowering operators for angular momentum, Expansion theory in abstract view, Matrix representation of angular momentum operators, General relations in matrix mechanics,

Eigenstates of spin ½, The intrinsic magnetic moment of spin ½ particles, Addition of two spins, Addition of Spin ½ and orbital angular momentum, Time-independent perturbation theory and energy shifts, Degenerate perturbation theory, The Stark effect, Hyperfined splitting, Variational principle and its applications, The WKB approximation, Time-dependent perturbation theory, The interaction of charged particle with electromagnetic field, Two level-system, emission and absorption of radiations, spontaneous emission, Transition rate, selection rule, scattering theory, Partial wave analysis, The Born approximation.

PHYS471: Solid State Physics I

Different states of matter, classification of solids, crystal structure (Bravais lattices & Millor indices), methods of determination of crystal structure (X-ray diffraction, electron and neutron diffraction), crystal defects, crystal binding (interatomic forces, types crystal bonds), lattice dynamics (crystal vibration modes and phonons), thermal properties of insulators (specific heat of insulators: classical model, Einstein's model, Debye model, thermal conductivity of insulators), Dependence of thermal conductivity on temperature, free electron theory (classical model of free electron, Fermi gas of free electrons, Maxwell-Boltzmann distribution, Fermi-Dirac distribution function), band theory (zone theory and tight binding theory).

PHYS481: Nuclear Physics I

Properties of the nucleus: Constituents – determination of nuclear charge, radius and mass – Nuclear binding energy. Natural Radioactivity: Decay law-Nuclear stability-Radioactivity and theory of transformation. Artificial Radioactivity: Discovery of artificial radionuclides – Transuranium elements-Interaction of radiation with matter: Interaction of heavy elements - interaction of light electrons - interaction of gamma rays with matter - interaction of neutrons with matter. Radiation Detectors: Gas detectors - Scintillation detectors - solid state detectors. Nuclear Reactions: Reactions of matter by gamma-rays - reactions by alpha particles - reactions by protons - reactions by neutrons. Nuclear fission: Discovery of Nuclear fission – theory of Nuclear fission. Nuclear fusion: Energy production in stars – control of thermonuclear reactions. Nuclear accelerators

PHYS495: Practical Training

The student carries out a research under the supervision of one of the Staff members in one of the following branches: Theoretical Physics - Nuclear Physics - Solid State Physics -

Fiber Optics – Laser – Plasma. The student learns how to write a report and trains on how to use research equipment's or any necessary software's as a preparation to the project course.

PHYS454: Atomic and Molecular Physics

Introduction: Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum, Atomic emission / absorption spectrophotometry Molecular spectroscopy, Spectroscopy of inner electrons. Zeemen's effect, Sodium spectrum, Effect of magnetic field on the energy levels of atom. Theory of magnetic energy, Anomalous Zeeman's effect and Lande splitting factor. Molecular Spectra of diatomic molecules. Vibrational energy levels in both classical mechanics and quantum mechanics. Rotational spectra of diatomic molecule in gaseous state and rotational energy levels. Molecular spectra; Anharmonic Oscillator- Non Rigid Rotator - Infrared Vibration-Rotation spectra; visible spectrum, IR spectrum, RBS spectra, XRD spectrum - measurements of Absorbance, Transmitting and Reflecting using double beam Spectrophotometers in all ranges of wavelengths (UV-VIS-NIR-IR), Normal modes of vibrations; Natural of infrared absorption, Basic Laser principles, Laser behavior, Properties of laser radiations, Different types of lasers, Laser spectroscopy, The total losses of the laser system, Transmission at the mirrors. Absorption and scattering by the mirrors, Absorption in the laser medium. Diffraction losses at the mirrors, The Ruby Laser - Three Level Laser (Helium-Neon Laser) - Four Level Laser (Carbon dioxide Laser), Laser applications.

PHYS496: Solid State Physics Lab

Studying the characteristics of the solar cell - electron diffraction experiments - characteristics curves of an optical (photo) resistor - the electron spin resonance (ESR) - Calculation of the energy gap of germanium by an electrical method - determination of the thermal coefficient of a noble metal (platinum) by computer - the magnetic susceptibility of some materials and its classification – X-ray spectroscopy and calculation of Planck's constant and Miller indices of crystal planes in NaCl single crystal - Thermoelectric effect in semiconductors (calculation of Seebeck, Peltier and Thomson coefficients) - Superconductivity and determination of the transformation temperature of YBCO specimen by computer – Determination of the absorption coefficient of Aluminum for X-ray, Hall effect, Studying the crystalline structure by using the field effect microscope.

PHYS497: Nuclear Physics Lab

Statistical nature of Radioactive decay law – Determination of the half-life of Thoron isotope Rn^{220} - Rutherford Scattering - Attenuation of gamma radiation - Absorption of beta radiation passing through different materials – Inverse square law in case of gamma-rays - Velocity of alpha particle - Backscattering of beta particles - Alpha spectroscopy of radioactive elements - Determining the energy loss of alpha particles in aluminum and in gold - Recording a beta spectrum with a scintillation counter - Effect of a magnetic field on beta particles motion.

PHYS499: Project

The student carries out a research under the supervision of one of the Staff members in one of the following branches: Theoretical Physics - Nuclear Physics - Solid State Physics - Fiber Optics – Laser – Plasma. The student submit a report about his work, and is evaluated by a committee selected by the department.

Elective Courses

PHYS406: Mathematical Physics III

Series Method for solving linear differential equations, Legendre polynomials, Hermite polynomials, Lagurre polynomials, Bessel Functions, Fourier transformation and its application, Laplace transformation and its application, Eigenvalue problem, Differentional equations of Boundary value problem.

PHYS361: Health physics

Review of the sources of radiation, basic dosimetry, and hazards of ionizing radiation, Radiation safety guides and codes in the environment, industry, medical and nuclear facilities, Techniques for the detection, use, and safe handling of radiation sources, Radiation protection and shielding: monitoring of sources, planning of facilities, waste management, and radiation protection for the public, radiation detection and counting statistics. Radiation laws and regulating agencies.

PHYS362 : Biophysics

Biomechanics Forces effects on our bodies. Vector analysis. Levers and equilibrium of rigid bodies. Stress-strain curve. Young's and Shear modulus for materials and biological tissues. Stress-Strain Curve - Young’s and Shear Modulus for materials and applications. Properties

of Fluid. Viscosity and Surface tension. Bernoulli's Equation and its applications. Effect of gravity and acceleration on blood pressure. Nature of sound and sound intensity level. Ultra-sound, production and its applications in diagnostic and treatment. Nervous system. And electricity within the body. Equilibrium potential and Nernst equation. Factors affecting the propagation of action potential. Action potential measurements of some organs; EGG, EEG and ERG. Nonionizing Radiation, Physical and biological effects.

PHYS355: Laser physics

Absorption and Emission of light, Einstein Relations, Population inversion, Gain coefficient, Optical resonator, Laser Modes, solid state lasers, semiconductor lasers, Gas lasers, Dye lasers, Free electron laser and some new lasers. Laser beam properties, Line width, Divergence, coherence, Brightness, Focusing properties of laser, Q - switching, Frequency doubling, Phase conjugation. Applications: medical, industrial, Military, Scientific, Holography and compunctions.

PHYS473: Semiconductors

Semiconductor Fundamentals: Carrier distribution functions, Carrier densities, Carrier Transport, Carrier recombination and generation, Continuity equation, The drift-diffusion model.

P-N Junctions: Electrostatic analysis of a P-N diode, The P-N diode current, Reverse bias breakdown.

Bipolar Junction Transistors: Structure and principle of operation, Ideal transistor model, Non-ideal effects, Base and collector transit time effects, BJT circuit models, BJT Technology.

MOS Capacitors: Structure and principle of operation, MOS analysis.

MOS Field-Effect-Transistors: Structure and principle of operation, MOSFET models, Threshold voltage, MOSFET Circuits and Technology.

PHYS205: Introduction to Astronomy

Introduction: modern astrophysics – History of astronomy. Laws of motion: Kepler laws, Gravitational law, newton's modified law, Orbits of planets, speed in the orbit, proceeding velocity. Solar system: planets: 1- Earth-like planets: Mercury, Venus, Earth, Mars. 2 - giant planets (like Jupiter): Jupiter, Saturn, Uranus, Neptune. 3 – satellites, the rings, comets, asteroids. Stars: Stars dimensions, Destiny, Luminosity, spectrum types, HR form, double

stars and stars masses. Evolution of stars. Galaxies: Milky Way, types of galaxies, galaxies properties, anomalies galaxies, galaxies crowds, the universe.

PHYS474: Materials Science

States of matter (liquid, crystalline and vitreous); crystal structure of metals; Metallography (reflecting optical microscope, transmission electron microscope) specimen preparations; Mechanical testing (hardness & tensile test); Defects in crystals (point defects and dislocations); Diffusion in solids; (phase transformation and phase diagrams) strengthening mechanisms (alloying, cold work, precipitation & fiber strengthening); heat treatment of steel & T T T curves

PHYS407: Computational Physics

Introduction: Computation and Science, The emergence of Modern Computers, Computer Algorithms and Languages: Applications: Newton and Kepler Laws. Numerical linear Algebra: Systems of linear equations, Eigen values and Eigen vectors. Interpolation, Extrapolation and Data Fitting: Polynomial Interpolation, Data fitting, Least squares fitting. Ordinary differential equations: Initial-value problems, The Euler and Picard methods, The Runge-Kutta method, Chaotic dynamics of the driven pendulum, Boundary -value and eigenvalue problem, The one-dimensional Schrödinger equation.

PHYS485: Neutrons Physics and Reactors

Neutron reactions: cross-sections, attenuation, reaction rate, fission cross-section. Nuclear fission, fission yield, Energy distribution among fission neutrons and fragments, regeneration factor. Thermal neutrons: energy distribution, effective cross section, moderation, average energy loss, Average energy logarithmic decrement, SDP, MR and resonance escape probability. The Nuclear chain reaction: neutron cycle, thermal utilization factor and calculating the four factors formula.

PHYS484: Radiation Physics

Definition of radiation quantities, doses and their units, instruments for measuring personal doses, radiation monitoring and radioactive contamination, biological effects of radiation, external and internal radiation exposure, radiation protection and shielding, recommendations of IAEC, protection against different radiations sources, decontamination, radioactive waste management

PHYS475: Renewable Energy

Energy Fundamentals, Fossil fuels, Renewable energy part 1:- Solar radiation and solar energy (thermal, photvoltaics and electrochemicals) Renewable energy Part II: Alternatives (hydropower, wind power, ocean thermal energy conversion, biomass, geothermal energy, tidal and wave energy), Energy conservation & storage, energy and transportation, air pollution and environment

PHYS456 : Plasma physics

Introduction (Definition of Plasma, Processing Plasmas, Plasma Physics and Plasma Chemistry). Single Particle Motions (Orbits in direct current electric and magnetic fields, Collisions, Transport Phenomena, Chemical Reactions in Plasmas). Plasma Statistical Mechanics (Ensemble Theory, Liouville's Theorem, Particle Distribution Functions, the Boltzmann and Vlasov Equations). Plasma Magnetohydrodynamics (MHD Equilibrium, Magnetic Confinement, Stability). Waves in Cold Plasmas (Wave Equations, Dispersion Functions, The effects of Magnetic Fields). Waves in Hot Plasmas (Acoustic and Magnetoacoustic waves, Landau Damping, Nonlinear Waves). Kinetic Theory and Radiation (Cyclotron emission, Bremsstrahlung). Applications (Fusion, Plasma-Aided Manufacturing).

PHYS483 : Elementary Particle Physics

Elementary particles: properties, classifications and detections. Fundamental forces between elementary particles. Symmetries and their role in studying elementary particle physics.
Strong force. Electromagnetic force. Weak force. Relativistic quantum mechanics. Feynman diagram.

PHYS472 : Solid State Physics II

Semiconductors and its applications (semiconductor materials - Band theory in semiconductor - energy gap in semiconductors – holes - Fermi level in semiconductor - effect of impurities on semiconductors – applications) Magnetism in solid state (magnetic moments - origin of magnetism – diamagnetism – paramagnetism – Ferromagnetism - molecular field theory - exchange energy – Antiferromagnetism – Ferrimagnetism - hystresis loop - magnetic domains - magnetic resonance) Superconductivity Electrical properties of Superconductors - magnetic properties of superconductors - thermodynamic properties of superconductor - electrodynamic properties of superconductor (London theory

- Ginzeberg Landau theory) type I and type II superconductors - cooper pair - microscopic theory of superconductors (BCS theory) Dielectric properties of solids (polarization and dielectric constants, electric damage for insulators - Ferroelectric) Optical properties of solids (Reflection, absorption and emission - optical conductivity)

PHYS482: Nuclear Physics II

The fundamental forces in nature, quark theory and the origin of nuclear force, inter nucleon force, nuclear reactions and reaction cross section (Coulomb scattering, optical model, resonance reactions and Breit-Wigner formula), nuclear models (liquid drop model, shell model, collective model) elementary particles, fundamental symmetries and gauge theory, lepton-hadrons interactions, quantum chromo dynamics, electro-weak interactions, physics of modern accelerators.