COURSE OUTCOME OF

THREE-YEAR UNDERGRADUATE PHYSICS PROGRAM

UNDER THE UNIVERSITY OF CALCUTTA

SYLLABUS: CBCS, 2019

After completion of the undergraduate program in Physics (Hons.), students will be able to

CO 1 [CC-1: Mathematical Methods-1]: review essential mathematical concepts of calculus; learn in details vector analysis and matrices; write simple computer codes using Python programming language and plot graphs using graphical software like Gnuplot.

CO 2 [CC-2: Mechanics]: review fundamental concepts of dynamics like Newton's laws of motion, work,energy and power; analyze motions of systems consisting of many particles, assimilate simple concepts of gravitation and central force motion; learn to analyze a physical system from a rotating frame of reference, know the equations of fluid dynamics; perform experiments for determining different mechanical quantities like Young's modulus, moments of inertia, rigidity modulus, acceleration due to gravity.

CO 3 [CC-3: Electricity & Magnetism]: grasp basic phenomena of electrostatics and magnetostatics, have ideas of electric fields and potential, dielectric materials, electrostatic energy, magnetic fields, magnetic materials and electromagnetic induction; learn to analyze electrical circuits; develop problem-solving ability for different charge distributions and current distributions; carry out simple laboratory experiments to investigate LCR circuit, RC circuit, verify Thevenin and Norton theorems, etc.

CO 4 [CC-4: Wave & Optics]: learn in detail about wave motion and superposition of waves; fundamental optical phenomena like interference and diffraction; application of these concepts to the study of holography; acquire the capacity to determine different physical quantities like refractive index, wave length, width of grating element using different optical instruments.

CO 5 [CC-5: Mathematical Methods-2]: build working knowledge about Fourier series and Fourier transforms and their applications to physical situations, develop the concept of special functions and their utility in solving differential equations, build introductory concepts of probability; acquire skill in solving different partial differential equations; write simple Python programs to solve differential equations, fit curve to data; interpolate and extrapolate given set of data.

CO 6 [CC-6: Thermal Physics]: learn about work, energy in the context of thermodynamics, heat capacity, specific heat, latent heat and enthalpy; compute entropy for simple systems; identify the physical phenomena related to conduction of heat; explain properties of ideal gases using kinetic theory of gases; perform experiments in the laboratory related to simple thermal phenomena like linear expansion, determination of temperature coefficient. thermal conductivity, etc.

CO 7 [CC-7: Modern Physics]: understand blackbody radiation, wave-particle duality; apply the theoretical knowledge related to radiation in experiments; know the basic concepts of quantum mechanics and its applications; know nuclear structure and interaction with and within nucleus, radioactivity; understand concept and operation of laser; know special theory of relativity; construct simple set-ups in the laboratory to determine Planck's constant, Stefan's constant, e/m ratio, study photoelectric effect, etc.

CO 8 [SEC-A1: Scientific Writing]: use LATEX to write and present in a visually appealing manner scientific writings such as articles, research papers, reports, etc.

CO 9 [CC-8: Mathematical Methods-3]: acquire in-depth knowledge of complex analysis; impart idea about variational calculus and also special theory of relativity; write advanced Python codes for calculating Fourier series, special functions and Dirac delta function; acquire expertise in solving numerically PDE's and also ODE's using Python packages.

CO 10 [CC-9: Analog Electronics]: analyze circuits with semiconductor diodes, amplifiers in CE, CB, CC mode, FET, regulated power supply, feed back amplifiers and OPAMP, multivibrator and oscillators; fabricate using bread board or discrete components Zener diode, power supply, Wein Bridge oscillator, etc.

CO 11 [CC-10: Quantum Mechanics]: understand physical phenomena which are incompatible with classical physics and which required the development of quantum theory; interpret the wave function and apply operators; solve the Schrodinger equation; understand the uncertainty principle, angular momentum and spin; spectra of hydrogen atom and atoms in electric and magnetic fields; write advanced Python codes to find out wave-functions and energy eigenvalues for particle confined in different potentials; write computer programs to explore time-dependent phenomena and tunneling;

CO 12 [SEC-B1: Arduino]: acquire skills to use Arduino programming in LED blinking and fading, measurement of voltages, interfacing 7 segment display etc.

CO 13 [CC-11: Electromagnetic Theory]: understand the basic mathematical concepts related to electromagnetic vector fields; know Maxwell equations; EM wave propagation in bounded and unbounded media and concept of polarization and it's applications; perform experiments related to simple electromagnetic phenomena, determining Brewster angle, verifying Fresnel's law, Malus' law, etc.

CO 14 [CC-12: Statistical Physics]: develop the phenomenological results of thermodynamics from a probabilistic examination of the underlying microscopic systems; distinguish classical and quantum statistics and apply the statistical distribution functions to solve problems; write computer programs in Python language to visualize the distribution functions, specific heats, random walk problem, etc.

CO 15 [DSE-A1.2: Laser & Fiber Optics]: know basic properties of laser, its types and uses; also know the characteristics and applications of fiber optics and holography; get the concept of nonlinear optics.

CO 16 [DSE-B1.2: Nuclear Physics]: understand nuclear reactions, interaction of nuclear radiation with matter; know about detectors for nuclear radiations, particle accelerators and gain basic concepts of particle physics with fundamental particles and quark structure.

CO 17 [CC-13: Digital Electronics]: understand and implement integrated circuit, number system, digital circuits,sequential circuits,registers and counters, data conversion. Design different gates, flipflops, registers, multiplexers, etc.

CO 18 [CC-14: Solid State Physics]: acquire knowledge on theoretical description of crystal and electronic structure, lattice dynamics and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors) based on the classical and quantum physics principles. Experimentally study BH loop, Hall voltage, dielectric constant, magnetic susceptibility, etc.

CO 19 [DSE-A2.1: Nanomaterials]: understand nano-scale systems, synthesis of nanostructure materials, optical properties, electron transport and applications of nanomaterials.

CO 20 [DSE-B2.2: Advanced Statistical Mechanics]: learn and understand statistical mechanics in advanced level starting with review of classical statistical mechanics; learn quantum statistical mechanics; ideal Bose system and Fermi systems, Ising model and non-equilibrium statistical mechanics.