Department of Physics, Seth AnandramJaipuria College

PO-PSO-CO: Programme Outcomes (PO), Program Specific Outcomes (PSO) and Course Outcomes (CO)

Programme Name: B.Sc. (Honours) under CBCS curriculum in Physics

Curriculum framed by: University of Calcutta

Curriculum Delivered by: Department of Physics, Seth AnandramJaipuria College

Programme Outcomes (PO) :

Under-Graduate HonourseProgrammes in the stream of science offers theoretical as well as practical knowledge in different branches of basic science and social science. These subject areas include Physics, Chemistry, Mathematics, Botany, Zoology, Computer Science, Statistics, Psychology and Economics depending on the Honours subject a student opts. This programme is most beneficial for the learners who have a strong interest and background in Science and Mathematics. The programme is also beneficial for those who wish to pursue multi and inter-disciplinary science careers in future. A well planned programme is to be followed for holistic development of the students. Apart from imparting in-depth knowledge over the respective subject, the aim of the programme is also to make the students responsible citizens with good moral and ethical values.

Following are the Programme Outcomes of various Under-Graduate HonourseProgrammes:

PO1 :: Scientific knowledge &Aptitude: Ability to develop scientific knowledge & aptitude, highly beneficial for the society and for the development of the nation.

PO2 :: Critical Thinking: Ability to develop critical and logical thinking with creativity and scientific view, analytical and problem solving skills.

PO3 :: Sense of inquiry: Capability for asking relevant/appropriate questions relating to the issues and problems in the field of science, and planning, executing and reporting the results of a theoretical or experimental investigation.

PO4 :: Team working: Capable of working effectively in diverse teams in both classroom, laboratory, workshop and in industry and field-based situations.

PO5 :: Digitally Efficient: Capability of using computers for simulation/computation in scientific problems and appropriate software for numerical and statistical analysis of data, and employing modern e-library tools to locate, retrieve, and evaluate scientific information.

PO6 :: Communication Skill: Ability to transmit complex technical/Scientific information in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.

PO7 :: Ethical/environmental awareness / reasoning: Ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, and adopting objectives, unbiased and truthful actions in all aspects of work, ablilty to appreciate the impact of science in social, economic, and environmental issues.

PO8 ::Orientation for Higher Studies: Ability to pursue higher studies in basic sciences/social sciences or in different applied science/ technical courses.

PO9 :: Job Orientation: Ability for being eligible for getting different jobs in India and abroad both in private and public sectors.

PO10 :: Lifelong Learning: Ability to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

Program Specific Outcomes (PSO):

Programme Specific Outcomes of Under-graduate HonourseProgramme in Physics under the CBCS curriculum of the University of Calcutta is that at the end of the programme the learners will be able to

PSO1 :: Acquire a scientific knowledge of the fundamental principles of Physics through study of Mathematical methods in Physics, Classical Mechanics, Electromagnetic Theory, Optics, Heat and Thermodynamics, Statistical Mechanics, Solid State Physics, Nuclear Physics, Modern Physics, Quantum Mechanics, Relativity and other areas of Physics.

PSO2 :: Use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

PSO3 :: Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics

PSO4 :: Recognize the importance of mathematical modeling, simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

PSO5 :: Demonstrate the communication skills involving the ability to listen carefully, to read texts and research papers analytically and present complex information in a concise manner to different groups/audiences of technical or popular nature.

PSO6 :: Demonstrate the personal skills such as the ability to work both independently and in a group.

PSO7 :: Students will get academic exposure through the various Internships offered by reputed National Research Institutes during their UG tenure. They will be able to utilize the small summer/ winter recesses through their involvement in small projects under careful guidance of reputed faculties and may get the flavor of the current trend of research.

PSO8 :: Demonstrate professional behavior such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior; (ii) the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

Course Outcome (CO):

Course Outcomes of different courses of Under-Graduate Honours (CBCS) Programme in Physics is given below. The syllabus of the courses is framed by the University of Calcutta and introduced in the Academic Year 2018-19

Semester	Course Code	Course Name	Course Outcome (CO)
			(After going through the course, the student should be able to)
Semester-1	PHSA-CC1	Mathematical Physics I (Credits: 06, Theory-04, Practical-02)	Develop the basic mathematical skills in vectors, matrices and calculus which are extremely essential in solving problems in various branches of theoretical and experimental physics. (In the practical component) learn the basics of graph plotting in *Gnuplot* and programming in *Python*& their applications in solving simple physical problems involving simple physical problems involving root finding, sorting, ODE solving and simple matrix operations to build the foundation of application of computational techniques in any branch of theoretical and experimental physics.
	PHSA-CC2	Mechanics (Credits: 06, Theory-04, Practical-02)	Develop/understand the foundations of classical Newtonian mechanics and their applications by studying fundamentals of dynamics, work & energy, rotational dynamics, non-inertial systems, gravitation and central force motion and fluid motion and apply the knowledge to solve related mechanical problems. (In the practical component) familiar with the basic mechanical instruments and apparatus used in physics laboratory, learn the basic laboratory techniques & practices, perform experiments to verify different laws of classical Newtonian mechanics and to determine related physical quantities
Semester-2	PHSA-CC3	Electricity and Magnetism (Credits: 06, Theory-04, Practical-02)	Learn the fundamental properties of charged particles and electric, understanding of the phenomena of electricity, magnetism, electromagnetic induction, electrical circuits and dielectric and magnetic properties of materials and solve related problems/applications. (In the practical component) familiar with various electrical and magnetic components, power supply, multimeter and various other measuring instruments, perform experiments on various topics of electricity and magnetism
	PHSA-CC4	Waves and Optics (Credits: 06, Theory-04, Practical-02)	Gain basic knowledge about vibrations, wave motion and wave theory of light and use the principles of wave motion and superposition to explain the physics of interference and diffraction, understand the working of selected optical instruments like biprism, interferometer, diffraction grating etc. (In the practical component) gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light, resolving power of optical equipment, different optical parameters be learnt firsthand.

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			(After going through the course, the student should be able to)
Semester-3	PHSA-CC5	Mathematical Physics II (Credits: 06, Theory-04, Practical-02)	learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability
			(In the practical component) learn more advanced computational techniques using different packages of Python like numpy, scipy, matplotlibetc, various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting.
	PHSA-CC6	Thermal Physics (Credits: 06, Theory-04, Practical-02)	Comprehend the basic concepts of thermodynamics as the fundamental laws of nature and related problems, kinetic theory of gases, heat transport phenomenon etc.
			(In the practical component) perform different experiments on heat and thermodynamics to enrich their experimental skill regarding theories learned so far.
	PHSA-CC7	Modern Physics (Credits: 06, Theory-04, Practical-02)	Know main aspects of the inadequacies of classical mechanics and understand the historical developments of quantum mechanics, the theory of quantum measurements, wave packets and uncertainty principle, understand the central concepts of quantum mechanics, learn the basics of nuclear structure, radioactivity, nuclear fission & fusion, fundamental principle of Laser and its applications.
			(In the practical component) perform some advanced level experiments and learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of e/m of electron and behavior of tunnel diode.
	PHSA-SEC-A1 (Technical Skill)	Scientific Writing (Project type) (Credits: 02, Theory-01, Project-01)	Learn how to prepare a scientific article containing figures, tables and mathematical equations in a presentable form through open source scientific writing software LaTex in this technical skill enhancement course.
			(In the project component) perform different kind of projects (scientific articles/reports) in real world using the knowledge acquired in the theory component.
	PHSA-SEC-A2 (Knowledge Skill)	Renewable energy and Energy Harvesting (Theory) (Credits: 02, Theory-02)	Learn about fossil fuels and its hazards and need for alternative energy sources, how to harvest energy from various non-conventionalenergy sources like solar energy, wind energy, ocean, geothermal , hydro, piezoelectric and electromagnetic energy.

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Semester-4	PHSA-CC8	Mathematical Physics III (Credits: 06, Theory-04, Practical-02)	Learn the mathematical tools required for study of some advanced topics of theoretical physics, like complex analysis, variational calculus and its application which results in the famous Lagrangian and Hamiltonian formulation of classical mechanics and the revolutionary concept of special theory of relativity, understanding the physical world beyond Newtonian mechanics.
			(In the practical component) perform some advanced level programming with Python to handle advanced theoretical and computational physics like Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients.
	PHSA-CC9	Analog Systems and Applications (Credits: 06, Theory-04, Practical-02)	Learn the basics of electronics, understand the basic concepts of semiconductor physics & its application; the operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators, working of amplifier and regulated power supply.
			(In the practical component) handle some essential laboratory equipments like CRO/DSO, function generator, regulated power supply etc., design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator acquiring basic skills required for higher studies or research in experimental Physics.
	PHSA-CC10	Quantum Mechanics (Credits: 06, Theory-04, Practical-02)	Learn the quantum theory formulation through Schrodinger equation after an exposition of inadequacies of classical mechanics, interpretation of wave function, understand the behavior of quantum particle encountering different potentials/barriers, solve non-relativistic hydrogen atom, study of influence of electric and magnetic fields on atoms.
			(In the practical component) learn some advanced computational techniques using python and applying them to solve various problems related to quantum mechanics
	PHSA-SEC B1 (Technical Skill)	Arduino (Project type) (Credits: 02, Theory-01, Project-01)	Learn about microcontrollers and hardware software interfacing techniques using open source hardware Arduino with its inbuilt IDE, learn some basic features of C++, fabrication/programming techniques to use/controls devices/sensors.
			(In the project component) perform/demonstrate demonstrate real life applications using Arduino IDE and Arduino UNO R3 Board increasing their technical skill
	SEC B -2 (Knowledge Skill)	Electrical Circuits and Network skills (Theory) (Credits: 02, Theory-02)	Acquire necessary skills/ hands on experience /working knowledge on multimeters, voltmeters,ammeters, electric circuit elements, dc power sources, ac/dc generators, inductors, capacitors, transformers, single phase and three phase motors, interfacing dc/ac motors to control and measure, relays and basics of electrical wiring.

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Semester-5	PHSA-CC11	Electromagnetic Theory (Credits: 06, Theory-04, Practical-02)	Lear electromagnetic theory as one of the fundamental component of classical physics, the important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, and its applications, explain polarization and related optical aspects from this theory. (In the practical component) perform different experiments to verify laws electromagnetic theory, especially, refraction/defraction/polarization etc.
	PHSA-CC12	Statistical Physics (Credits: 06, Theory-04, Practical-02)	Get an entry into the world of mechanics comprising of a collection of particles and understand how to study the gross behavior of a system with classical and quantum statistical mechanics. (In the practical component) Use Python programming to study aspects of statistics through generation of Random numbers and Time scale, application of Random numbers including Monte Carlo integration, visualize different statistical models/distributions by plotting of different statistical
	PHSA-DSE A1(a)	Advanced Mathematical Methods (Theory) (Credits: 06, Theory-05, Tutorial-01)	Learn the advanced abstract mathematical concepts like Linear Algebra and Vector Space, tensors and group theor, a required skill for research in theoretical physics.
	PHSA-DSE A1(b)	Laser and Fiber Optics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Learn the topics of Laser &Fibre Optics which finds many applications in different spheres starting from industry to medical fields; the study of many well known devices for the generation of LASER and their controlling tools, the topic of Fiber Optics and applications in communication.
	PHSA-DSE B1(a)	Astronomy and Astrophysics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Comprehend astronomical scales and understand basic concepts of positional astronomy, understand basic parameters of stars, astronomical techniques, physics of sun and solar system, physics of stars and sun, role of gravitation in astrophysics;acquire basic knowledge of galaxies and Milky Way, learn about the large scale structure and expanding universe.
	PHSA-DSE B1(b)	Nuclear and Particle Physics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Learn and gain knowledge about the properties of a nucleus, about the nuclear models and their roles, the process of radioactivity, the basic aspects of nuclear reactions, some basic aspects of interaction of nuclear radiation with matter, the detectors of nuclear radiations, the principles and basic constructions of particle accelerators, basic aspects of particle Physics, quantum numbers of particles and the conservation laws associated with them.

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Semester-6	PHSA-CC13	Digital Systems and Applications (Credits: 06, Theory-04, Practical-02)	Comprehend the digital world, starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in extended to implementation of different combinational and sequential logic circuits, learn the basics of hardwire, Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization. (In the practical component) performexperiments (design, fabrication and implementation) to analyze of the basic electronic components like different Gates and Flip-Flops, Shift Registers, Multiplexers using standard ICs.
	PHSA-CC14	Solid State Physics (Credits: 06, Theory-04, Practical-02)	Learn and understand the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state, semiconductors and solid state electronics; Superconductivity. (In the practical component) perform experiments related to investigation of fundamental and electrical and magnetic properties of solids; the determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc.
	PHSA-DSE A2(a)	Nano Materials and Applications (Theory) (Credits: 06, Theory-05, Tutorial-01)	Get the entry into the Nano World; learn the basic physics of nanoparticles and their synthesis following different methodology, the important characteristic features like optical properties, electron transport phenomena; be familiar in both the theoretical prospects of development and application of nano science in different fields.
	PHSA-DSE A2(b)	Advanced Classical Dynamics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Learn the calculus of variations as the advanced analytical tool of classical mechanics, small oscillations with examples, rigid body motion, and non-linear dynamics.
	PHSA-DSE B2(a)	Communication Electronics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Have an idea/concept of the basics of Electronic Communication; electromagnetic spectra and different frequency bands, modulation, different types of modulation and receivers; concept of sampling, sampling theorem and multiplexing; digital transmission, encoding and decoding; satellite communication; mobile communication/telephony
	PHSA-DSE B2(b)	Advanced Statistical Mechanics (Theory) (Credits: 06, Theory-05, Tutorial-01)	Learn the advanced topics of Statistical Physics with an emphasis on Density matrix formalism, Ising Model and the introduction of non equilibrium statistical mechanics.