



Vidyasagar College for Women

Department of Physics
PO & CO Manual (CBCS 2018)



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PROGRAMME OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO) and COURSE OUTCOMES (CO): PO-PSO-CO

Programme: 3 Year B.Sc. **Honours in Physics (CBCS 2018)** under University of Calcutta

Inception of CBCS Curriculum: **2018**

Duration of the Course: **3 year comprising of 6 Semesters**

- Program Outcomes (PO) of 3 year B.Sc. Physics Honours under CBCS 2018 of University of Calcutta:**

3 Year B.Sc.(Hons.) (Bachelor of Science) Programme **in Physics** under CBCS 2018 offers theoretical as well as practical knowledge about different subject areas of basic sciences including Physics as Core subject with 2 General Elective subjects from *Mathematics* and *Chemistry* or *Electronics*. This programme is most beneficial for students who have a strong interest and background in Science and Mathematics. A well planned study programme is followed for holistic development of the students.

- **Following are the various Programme Outcomes (PO) for 3 year Physics Honours under CBCS 2018 of University of Calcutta:**

Sl. No	Program Outcome
PO 1	Understanding dynamics of nature and acquire strong foundation of physics and mathematics for a successful career in academia and industry
PO 2	Ability to use modern techniques, sophisticated instruments, and to handle different types of electrical and electronic circuits and optical instruments
PO 3	Develop laboratory skill and utilize Cognitive idea of experimentation in day to day experiences with the theoretical knowledge acquired
PO 4	Cognitive development of Mathematical & physical Problem-Solving Skill and computational acumen to develop Simulation Based Learning Skill
PO 5	Identify , formulate and analyze complex scientific problems reaching substantiated conclusions
PO 6	Develop communication ability by designing and writing scientific documentation for effective presentations as the foundation of Higher studies and Research

- **3 year B.Sc. Physics Honours Program Specific Outcome (PSO) of CBCS 2018 under University of Calcutta:**

- **PSO 1:** Providing deep knowledge in Physics so that students are able to analyse and apply the knowledge of Physics in an innovative, dynamic and challenging environment for design and development of new products (**Understand, Apply**).
- **PSO 2:** Making students capable to solve practical, design and analysis problems to complete the challenge to fabricate, test and develop the products with more innovative technologies (**Analyse, Understand and Apply**)
- **PSO 3:** Design solutions for complex Physics problems and design systems that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (**Understand and apply**).
- ❖ **Following are the various Course Outcomes (CO) for 3 year Physics Honours under CBCS 2018 of University of Calcutta:**

Semester-1 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-1-1-TH	Mathematical Physics-I (Theory)	CO 1: Acquire knowledge of calculus which are integral part of any branch of physics. (CO 2: Understand divergence, gradient and curl and their physical interpretation which are very important for theories of electricity and magnetism to be taught later. (Understand) CO 3: Understand basics of matrices and determinants i.e. inverses, adjoint, linear vector spaces, basis, basis transformations, how to calculate eigenvalues, eigenvectors. solve simple problems with physics-oriented application. (Remember, Understand, Apply) CO 4: Develop the problem-solving capability. (Apply, Analyze)
PHSA-CC-1-1-P	Mathematical Physics-I (Practical)	CO 1: Learn basics of programming in Python and plotting data using gnuplot. (Understand) CO 2: Foundation of application of computational technique in problem solving. (Apply)
PHSA-CC-1-2-TH PHSG-CC-1-1-TH	Mechanics (Theory) Mechanics (Theory)	CO 1: Recall Newtonian Mechanics to describe motion of objects, planetary motions, gravitation etc. and understand the motion of objects in different frame of references. (Remember, Understand, Apply) CO 2: Study work, develop potential energy concept and conservative forces and know how to apply the conservation principle and symmetry of a system. (Remember, Apply) CO 3: Comprehend projectile motion, simple harmonic oscillator, rocket motion, elastic and inelastic collisions. (Understand, Apply) CO 4: Understand the dynamics of rotating objects i.e. rigid bodies, angular velocity, the moment of inertia and related examples involving the centrifugal force and coriolis force. (Understand) CO 5: Understand the application of central force to the stability of circular orbits, Kepler's laws of planetary motion. (Understand, Apply) CO 6: Comprehensive study of fluid dynamics. (Understand)
PHSA-CC-1-2-P PHSG-CC-1-1-P	Mechanics (Practical) Mechanics (Practical)	CO 1: Experimentally determine various physical quantities e.g, moment of inertia of a bar about the axis passing through its center of gravity, elastic constants of a material, and (Apply, Analyze) CO 2: Determine physical quantity like acceleration due to gravity. (Apply)

Semester-2 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-2-3-TH PHSG-CC/GE-2-2-TH (For Semester 1 other Hons.)	Electricity and Magnetism (Theory) Electricity and Magnetism (Theory)	CO 1: Recall and comprehend basic concepts of electrical charges and currents and their properties. (Remember, Understand) CO 2: Understand the concept of conductors, dielectrics, inductance and capacitance, and electrical image charge. (Remember, Understand) CO 3: Gather knowledge on the nature of magnetic materials and study of magnetostatics. (Understand) CO 4: Identify and develop problem solving skill in electrostatics and magnetostatics by analysing the problem. (Analyse, Apply) CO 5: Understand electromagnetic induction and Faraday's law and its applications. (Understand, Apply)
PHSA-CC-2-3-P PHSG-CC/GE-2-2-P (For Semester 2 other Hons.)	Electricity and Magnetism (Practical) Electricity and Magnetism (Practical)	CO 1: Familiarise various electrical components and learn electrical circuits to measure current, voltage using classic instruments like potentiometer, Carey-Foster bridge, ammeter, voltmeter. (Understand, Apply)
PHSA-CC-2-4-TH PHSG-CC/GE-3-3-P (For Semester 3 other Hons.)	Waves and Optics (Theory) Waves and Optics (Theory)	CO 1: Learn and understand various types of waves and their propagation, superposition of waves and solve wave equations for different types of vibrations. (Remember, Understand, Apply) CO 2: Basic understanding of physical optics. (Understand) CO 3: Provide a knowledge of various optical phenomena, for example interference, diffraction, and optical instruments. (Understand)and)
PHSA-CC-2-4-P PHSG-CC/GE-3-3-P (For Semester 3 other Hons.)	Waves and Optics (Practical) Waves and Optics (Practical)	CO 1: Gain expertise in Handling sophisticated optical instruments. (Understand, Apply) CO 2: Analyse wave phenomena and verify laws of optics. (Analyse, Apply) CO 3: Determine wavelength of light through interference and diffraction techniques. (Apply)

Semester-3 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-3-5-TH	Mathematical Methods- II (Theory)	CO 1: Understand how to expand a function in a Fourier series. (Understand, Apply) CO 2: Solving differential equation using power law expansion (so called Frobenius method). learn about various special functions i.e. Legendre, Bessel functions, generating functions and their properties. (CO 3: Study Fourier integral and its properties and application to signal analysis and also in quantum mechanics. (Understand, Apply) CO 4: Application of probability and various distribution functions in physics. (Apply) CO 5: Learn to solve partial differential equation and apply for various physical systems. (Understand, Apply)
PHSA-CC-3-5-P	Mathematical Methods- II (Practical)	CO 1: Introduce various packages e.g <i>numpy</i>, <i>scipy</i>, <i>matplotlib</i> in Python. (Understand) CO2: Using the add-on packages in Python to solve various numerical problems and plot results graphically. (Apply)
PHSA-CC-3-6-TH PHSG-CC/GE-4-4-TH (For Semester 4 other Hons.)	Thermal Physics (Theory) Thermal Physics (Theory)	CO 1: Understand kinetic theory of gases. (Remember, Understand) CO 2: Understand the basic principle and laws of thermodynamics. (Remember, Understand) CO 3: Develop the concepts of entropy, various thermodynamic potentials and their applications in various systems. (Remember, Understand, Apply) CO 4: Understand and develop the knowledge of heat conduction. (Understand, Apply)
PHSA-CC-3-6-P PHSG-CC/GE-4-4-P (For Semester 4 other Hons.)	Thermal Physics (Practical) Thermal Physics (Practical)	CO 1: Develop experimental skill on the fundamentals of heat and calorimetry learned so far. (Understand, Apply)

PHSA-CC-3-7-TH	Modern Physics (Theory)	CO 1: Foundation of quantum mechanics studying black body radiation and its nature, old quantum theory, concept of wave-particle duality and de Broglie hypothesis. (Remember) CO 2: Introduction to Schrodinger equation and its application, probabilistic interpretation of quantum mechanics, commutation relation and their meaning. (Understand, Apply) CO 3: Students learn about nuclear structure and various models. (Understand) CO 4: Understanding of interaction within and with nucleus. gamma, beta decay. nuclear fission and fusion. (Analyse, Understand) CO 5: Learn working principle of laser and its applications. (Understand)
PHSA-CC-3-7-P	Modern Physics (Practical)	CO 1: Gain expertise in handling sophisticated instruments. (Understand, Apply) CO 2: Develop experimental skill in data acquisition and performing experiments in modern physics. (Understand, Apply, Analyse)
PHSA-SEC-A-1 (Theory & Project)	Scientific Writing Skills (LaTeX)	CO 1: Introduce the students with the scientific document preparation system using a free state-of-the art publishing software. (Understand) CO 2: Develop the skill of writing research article, project report using LaTeX. (Apply)

Semester-4 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-4-8-TH	Mathematical Methods- III (Theory)	CO 1: Introduce complex analysis and study Cauchy Riemann conditions, analyticity, Cauchy integral formula, Laurent and Taylor series expansion and definite integrals using contour integration. (Remember, Understand) CO 2: Learn variational calculus, optimization theory. Lagrangian and Hamiltonian formulation, Euler-Lagrange equation and solving dynamical variables, use of symmetry and conservation laws. (Understand, Apply) CO 3: Understand special theory of relativity and relativistic dynamics and solve problems. length contraction, time dilation, mass-energy relation etc. CO 4: Understand tensor calculus and develop in solving relativistic problems. (Understand)
PHSA-CC-4-8-P	Mathematical Methods- II (Practical)	CO 1: The students will learn some advanced level programming with Python to handle numerical integration and solving differential equations, special functions. (Apply) CO 2: Develop skill in simulation based theoretical research in physics. (Apply, Analyse)
PHSA-CC-4-9-TH	Analog Electronics (Theory)	CO 1: Motivate the students to apply the principles of electronics in their day-to-day life. (Understand, Apply) CO 2: Learn various network theorems, diodes and their application. (Understand, Apply) CO 3: Develop basic concepts of semiconductor physics and devices. (Understand, Analyse)
PHSA-CC-4-9-P	Analog Electronics (Practical)	CO 1: Develop experimental skill on the fabrication of electronic circuits with components. (Understand, Apply) CO 2: Acquire knowledge in handling sophisticated electronic instruments experimental skill on the fabrication of electronic circuits with components. (Understand, Apply) CO 3: Develop foundation in experimental research in electronics. (Apply)

PHSA-CC-4-10-TH	Quantum Mechanics (Theory)	CO 1: Application of the foundation course in quantum mechanics learnt earlier. (Apply) CO 2: Introduction to atomic physics based on quantum mechanics. (Understand, Apply) CO 3: Students learn the behaviour of atoms in magnetic and electric fields. (Understand) CO 4: Learn working principle of laser and its applications. (Understand)
PHSA-CC-4-10-P	Quantum Mechanics (Practical)	CO 1: Students will learn advanced computational techniques applying them to solve various problems related to quantum mechanics using Python in this course. (Analyse, Apply)
PHSA-SEC-B1 (Theory & Project)	Arduino (Technical skill)	CO 1: Introduce Arduino environment and its applications. (Understand, Apply) CO 2: Understanding Arduino programming with c++. (Understand) CO 3: Able to design smart systems applications. (Apply) CO 4: The students will be able to demonstrate real life applications using Arduino IDE and Arduino UNO R3 Board. This course will help the students to gain hands on training on software-hardware interfacing techniques. (Understand, Apply)

Semester-5 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-5-11-TH	Electromagnetic Theory (Theory)	CO 1: Student will develop a training in Electromagnetic theory learn maxwell's equations, gauge transformations, pointing vector, electromagnetic field energy density, momentum density etc. CO 2: Comprehend propagation of electromagnetic wave through medium. (Understand) CO 3: Describe various optical phenomena based on the knowledge of electromagnetic theory. (Understand, Apply)
PHSA-CC-5-11-P	Electromagnetic Theory (Practical)	CO 1: The students will get hands on training on the topics covered in CC 11 (theory). (Apply) CO 2: The students will experimentally verify classical laws of reflection, refraction, polarization. (Apply, Analyse)
PHSA-CC-5-12-TH	Statistical Physics (Theory)	CO 1: The students will understand how to study the gross behaviour of a system. (Understand) CO 2: Establishes laws of thermodynamics which are the fundamental rules of nature. (Understand, Apply)
PHSA-CC-5-12-P	Statistical Physics (Practical)	CO 1: The students will use Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers including Monte Carlo integration. (Analyse, Apply) CO 2: Extended study of different distributions in statistical mechanics. (Analyse, Apply)
PHSA-DSE-A1(b)	Laser and Fiber Optics (Theory+Tutorial)	CO 1: Students will know theory of laser, its basic properties. (Understand) CO 2: Learn about resonators, transient effect, many laser systems and practical use of laser. (Understand, Apply)

		CO 3: Understand fiber optics, holography and introductory nonlinear optics. (Understand) CO 4: Learn working principle of laser and its applications. (Understand, Apply) CO 5: Develop skill for independent thinking for progressing in higher studies in this advanced area of theoretical and experimental research. (Analyse, Apply)
PHSA-DSE-B1(b)	Nuclear and Particle Physics (Theory+Tutorial)	CO 1: Students will learn general properties of nuclei, various nuclear models, radioactivity. (Remember, Understand) CO 2: Understand nuclear reactions and interaction of nuclear radiation with matter. (Understand) CO 3: Students will acquire knowledge about the detectors for nuclear radiations and particle accelerators. (Understand) CO 4: Learn and understand fundamentals of particle physics. (Understand) CO 5: Develop skill for independent thinking for progressing in higher studies in this modern area of theoretical. (Analyse, Apply)

Semester-6 (CBCS 2018)

Course Code	Course Name	Course Outcomes
PHSA-CC-6-13-TH	Digital Systems and Applications (Theory)	CO 1: Learn integrated circuits (IC), number system and Boolean description, introduction to digital logic. (Understand) CO 2: Understanding product and sum in logical expression, conversion between truth table and logical expression, Karnaugh map. (Understand) CO 3: To learn how to implement different circuits: adder, subtractor, idea of multiplexer, demultiplexers, encoder, decoder. (Understand, Apply) CO 4: To know registers and counters, computer organization, data conversion. (Understand)
PHSA-CC-6-13-P	Digital Systems and Applications (Practical)	CO 1: This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs. (Apply)
PHSA-CC-6-14-TH	Solid State Physics (Theory)	CO 1: Learn fundamentals of solid state physics with crystal structure, lattice dynamics. (Understand) CO 2: Understand quantum properties of matter like magnetic property, dielectric property. (Understand) CO 3: Understand elementary band theory of solids. (Understand) CO 4: Develop understanding of superconductivity – one of major breakthrough in modern science. (Understand, Apply)
PHSA-CC-6-14-P	Solid State Physics (Practical)	CO 1: Investigation of electrical and magnetic properties of solids. (Understand, Apply) CO 2: Gain expertise in handling sophisticated measuring instruments and data acquisition in laboratories. (Apply)

PHSA-DSE-A2(a)	Nano Materials and Applications (Theory+Tutorial)	CO 1: Develop foundational knowledge of nanotechnology, including the history, significance, and unique properties of materials at the nanoscale. (Understand) CO 2: Gain theoretical knowledge of the various physical, chemical, and biological methods for synthesizing nanomaterials, including top-down and bottom-up approaches. (Understand) CO 3: Acquire theoretical knowledge about the advanced techniques such as X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Atomic Force Microscopy (AFM) for characterizing nanomaterials. (Understand, Apply) CO 4: Understand the diverse applications of nanomaterials in fields of medicine, electronics, environmental science, and energy storage. (Understand, Apply)
PHSA-DSE-B2(a)	Communication Electronics (Theory+Tutorial)	CO 1: Introduce students to basics of electronic communication. (Understand) CO 2: Understanding modulations of analog and digital pulse and how to modulate digital pulse. (Understand, Apply) CO 3: Learn communication and navigation system applicable in modern times. (Understand)

- **Mapping/Co-relation Program Outcome (PO) & Course Outcome (CO)**

Semester	Paper/Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
SEM-1	PHSA-CC-1-1 Mathematical Physics-I	✓			✓		
	PHSA-CC-1-2 Mechanics PHSG-GE/CC-1-1 Mechanics	✓	✓	✓	✓	✓	
SEM-2	PHSA-CC-2-3 Electricity & Magnetism	✓	✓	✓	✓	✓	
	PHSG-GE/CC-2-2 Electricity & Magnetism	✓	✓	✓	✓	✓	
	PHSA-CC-2-4 Waves and Optics	✓	✓	✓			
SEM-3	PHSA-CC-3-5 Mathematical Physics-II	✓			✓		
	PHSA-CC-3-6 Thermal Physics-II	✓	✓	✓			
	PHSA-CC-3-7 Modern Physics-II	✓	✓	✓		✓	
	PHSA-SEC-A1 Scientific Writing (LaTeX)				✓		✓
	PHSG-GE/CC-3-3 Thermal Physics & Statistical Mechanics	✓	✓	✓			
SEM-4	PHSA-CC-4-8 Mathematical Physics-III	✓			✓		
	PHSA-CC-4-9 Analog Electronics	✓	✓	✓			
	PHSA-CC-4-10	✓			✓	✓	

	Quantum Mechanics						
	PHSA-SEC-B1 (Arduino)			✓	✓		
	PHSG-GE/CC-4-4 Waves and Optics	✓	✓	✓			
SEM-5	PHSA-CC-5-11 Electromagnetic Theory	✓	✓	✓		✓	
	PHSA-CC-5-12 Statistical Physics	✓			✓	✓	
	PHSA-DSE-A1(b) Laser and Fiber Optics	✓	✓			✓	✓
	PHSA-DSE-B1(b) Nuclear and Particle Physics	✓	✓			✓	✓
SEM-6	PHSA-CC-6-13 Digital Systems and Applications	✓	✓	✓			
	PHSA-CC-6-14 Solid State Physics	✓	✓	✓	✓		
	PHSA-DSE-A2(a) Nanomaterials and Applications	✓	✓			✓	✓
	PHSA-DSE-B2(a) Communication Electronics	✓	✓			✓	✓