BHADRAK AUTONOMOUS COLLEGE, BHADRAK

POSTGRADUATE DEPARTMENT OF PHYSICS

PROGRAMME - Undergraduate

COURSE - B. Sc. PHYSICS (Honours)

Programme Outcomes	PO-1	Develop a broader vision of life
	PO-2	Master skills for higher learning
	PO-3	Generate motivation for achieving specific goals
	PO-4	Evolve an open-minded approach to understand phenomena
	PO-5	Gain leadership, technical and creative skills
	PO-6	Imbibe ethics, discipline and a sense of responsibility
	PO-7	Acquire all graduate attributes
Programme specific Outcomes	PSO-1	Develop ability to solve problems
	PSO-2	Attain maturity in understanding
	PSO-3	Hone analytical and mathematical skills
	PSO-4	Acquire programming skills and soft skills
	PSO-5	Cultivate aspiration for higher studies in Physics

COURSE CODE AND TITLE	COURSE OUTCOMES
CC-I: Mathematical Physics-I	Plot functions and graphs of all kinds Solve simple differential equations Learn the method of Lagrange multipliers for maximization Use differential operators and learn vector calculus for physics problems Formulate and solve problems of Interest using mathematical techniques learnt Write C and C++ programs for arithmetic and algebraic computations
CC-II: Mechanics	Learn transformation of variables between CM and Lab frames Calculate moments of inertia of different objects Apply Coriolis force to understand phenomena in non-inertial frames Acquire deeper knowledge of properties of solids and liquids Understand central force problems and reduce to one-body problem Apply concepts of gravitational field and potential to planets, satellites and astronauts Study damped and forced vibrations and application of resonance Develop basic understanding of special relativity and its consequences
CC-III: Electricity and magnetism	Learn about electric and magnetic fields and their properties in vacuum and in media Acquire knowledge of electric and magnetic properties of materials Study the laws and applications of Electromagnetic induction Learn electric circuit theorems and their applications to solve problems of interest
CC-IV: waves and Optics	Ability to solve problems of geometrical and wave optics Understanding principles of reflection, refraction, diffraction and polarization Acquire skills of optical instruments such as interferometers, polarizers, spectrometers, telescopes and microscopes
CC-V: Math. Physics-II	Ability to solve problems using Fourier series Finding Series solutions of Bessel, Legendre and Hermite differential equations and their applications to physical problems Learn the properties and applications of Special functions Ability to solve Laplace equation by separation of variables in physical situations Programming with SCILAB for plotting graphs, solving systems of equations Advanced SCILAB programming to solve differential equations and applications to Physics Problems
CC-VI: Thermal Physics	Learn the laws of thermodynamics and their applications in problem solving Understanding concepts of entropy and the thermodynamic potentials Acquire skill in applications to phase transitions and other physical problems Applications of Maxwell-Boltzmann distribution and transport phenomena Acquire understanding of Real gases and deviations from Ideal gases

CC-VII: Analog Systems and Applications	Understanding PN junction diode and application to regulation and rectification
	Learn about Filters, Zener diode, Photo diode and solar cell
	Acquire knowledge of transistor operation and load line analysis
	Learn about Class A, B and C power amplifiers and Push-pull (Class-B) amplifier
	Study of RC-coupled amplifier; feedback in Phase shift, Hartley and Colpitts oscillators
	Theory and design of OP-AMPs and their circuits, operations and applications
CC-VIII: Math Phys.-III	Learn about analytic functions, poles and residues and Taylor and Laurent series
	Ability to use Fourier Transforms and their applications to solve differential equations
	Acquire mastery of Laplace transforms and their properties and applications
	Learn Evaluation of definite integrals using SCILAB and Fast Fourier Transfoms(FFT)
	Summing Infinite series and least square fitting using SCILAB
CC-IX: Elements of Modern Physics	Learn the inadequacies of classical Physics and the advent of Quantum Theory
	Understand the Applications and illustrations of the uncertainty principle
	Acquire basic understanding of Nuclear forces, decays and Nuclear fission and fusion
	Master Laboratory skills with Tunnel diode, solar cell, LEDs and LASERS
CC-X: Digital Systems and Applications	Learn IC fabrication techniques SSI, MSI, LSI and VLSI
	Master Boolean algebra and Logic gates and their uses in digital circuits
	Ability to form SOP and POS and Karnaugh maps from given logic expressions
	Learn the theory and practical applications of adders and subtractors
	Acquire knowledge of IC555 timers as astable and monostable multivibrator
	Learn computer memory organization, RAM, ROM and shift registers
CC-XI: Quantum Mechanics & Applications	Learn about Schrodinger equation and its time-independent form
	Learn probability interpretation of wave function
	Solve Schrodinger equation in various one-dimensional problems
	Acquire knowledge of Operators, eigenvalues and eigenvectors and hermiticity
	Learn properties of wave function and its Fourier transform in momentum space
	Applications of QM in quantum dots, Stark, Zeeman and Paschen-Back effects
	Programming in SCILAB for creating wave packets, plotting R and T for 1-D potentials
	Plotting of wave functions of infinite potential well and harmonic oscillator in SCILAB
	Acquire knowledge of crystal structure and crystal binding

CC-XII: Solid State Physics	Study of Thermal, electric and magnetic properties of solids using lattice dynamics Learn the Theory and Applications of LASERS Learn band theory of Solids and Kronig-Penny Model Learn Theory of Hall effect and Measurement of Hall coefficient Study of Type-I and Type-II superconductivity and Meissner effect Determination of B-H curve and study of hysteresis Determination of dielectric constant, electric and magnetic susceptibility
CC-XIII: Electromagnetic Theory	Learn Maxwell's equations, gauge transformations and boundary conditions on fields Learn about electromagnetic energy density in fields and the continuity equation Solve Maxwell's equations in dielectrics and conductors & apply in physical situations Study Laws of reflection, refraction, polarization of light using Maxwell's equations Master Laboratory skills with polarized light in polarimeter, Babinet's compensator
CC-XIV: Statistical Physics	Master Classical statistical physics and derive thermodynamics of classical ideal gas Master Quantum statistics and derive thermodynamics of ideal Fermi and Bose gases Study of laws of thermal blackbody radiation and their significance SCILAB Plotting MB, FD and BE distribution functions versus temperature SCILAB Plotting of specific heats of solids as per Debye's and Einstein's theories
DSE-1: Classical Dynamics	Learn Lagrangian and Hamiltonian dynamics and their applications to problem solving Master special theory of Relativity with Lorentz transformations and applications Learn space-time diagrams in Minkowski space-time and use of four vectors
DSE-2: Nuclear and Particle Physics	Learn general properties of nuclei and learn in depth nuclear reactions and decays Master Liquid drop and shell models for understanding nuclear binding Study particle detectors and accelerators Learn basics of Particle physics with classification, symmetries and conservation laws
DSE-3: Nano-materials and Applications	Learn new ideas of nanoscale physics and quantum confinement effects in 1D, 2D, 3D Study various methods of synthesis and characterization of nanomaterials Learn about Applications of nanoscience in LEDs, nanostructure devices, CNts. MEMS and NEMS
	Learn the art of scientific writing, typesetting mathematical symbols,

DSE-4: Project	equations, plots
	Formating a project with title, abstract, literature review, chapterization and references
	Collecting materials for a project and citation methods
	Use of internet resources for project writing
	Making simple powerpoint presentations with animations

BHADRAK AUTONOMOUS COLLEGE, BHADRAK

POSTGRADUATE DEPARTMENT OF PHYSICS

PROGRAMME - Postgraduate

COURSE - M. Sc. PHYSICS

Programme Outcomes	PO-1	Develop a professional outlook
	PO-2	Master skills for research and higher learning
	PO-3	Generate aspiration for achieving perfection
	PO-4	Develop an open-minded approach to investigate phenomena
	PO-5	Hone leadership, management and technical skills
	PO-6	Develop morality, virtues and a sense of duty towards Nation
Programme specific Outcomes	PSO-1	Develop ability to score well in Professional Entrance Tests
	PSO-2	Apply scientific understanding with its limitations
	PSO-3	Enhance analytical and mathematical skills
	PSO-4	Acquire programming skills and soft skills
	PSO-5	Cultivate skills for employability and entrepreneurship
	PSO-6	Develop positive attitude, optimism and adventurousness

COURSE CODE and TITLE	COURSE OUTCOMES
PHY-101: Classical Mechanics	Learn symmetries and conservation laws in Lagrangian formulation Learn Legendre transformation to Hamiltonian formulation and Routhian formulation of mechanics Study of canonical transformations, Lagrange and Poission Bracket formulations and their applications to problems Study of Hamilton-Jacobi Formulation and normal modes in problems of Small oscillations Study of Caley-Klein parameters and Euler's angles in rigid body dynamics and applications to heavy symmetrical top
PHY-102: Mathematical Methods-I	Acquire in-depth knowledge of vector spaces and matrices Solve problems in diagonalization, eigenvalues and eigen vectors of matrices and solve systems of linear equations using matrix method Learn partitioning and commutativity of matrices, Algebra of Pauli spin matrices and transformations of matrices Solve problems using calculus of variations and Euler-Lagrange equations Gain expertise in Lorentz transformations and 4-vector algebra and its application to find Lagrangian of charge in EM field
	Learn LVS formalism of QM, Bra-ket algebra and operator algebra

PHY-103: Quantum Mechanics-I	Study representations of vectors and operators of LVS as matrices and find eigenvalues and eigenvectors of operators Learn time-evolution in Schrodinger, Heisenberg and Dirac pictures Learn and solve problems in angular momentum algebra and composition of angular momenta
PHY-104: Electronics-I	Learn theory and operation of various semiconductor devices measuring instruments Learn different types of Timers, multivibrators, oscillators and OPAMPs In-depth Study of radio and television communication and fiber optic communication technologies Applications to problem solving in Electronics and instrumentation
PHY-105: Modern Physics And Computational Physics-I	Laboratory work on modern physics and corresponding programming tasks to calculate results and plot graphs with error bars Learn basic FORTRAN programming Do Loop, algorithm, flow charts, input-output commands, subroutine
PHY-201: Quantum Mechanics-II	Learn non-degenerate and degenerate perturbation theory and their applications to problems of interest Learn variational and WKB approximation methods and their applications to different problems Study the regions and conditions of validity of different approximation methods
PHY-202: Mathematical methods-II	Gain expertise in evaluating contour integrals of all kinds Study of Cartesian tensors and their algebra, types and applications Learn the concept of covariant derivative and applications in GTR Solve Bessel, Legendre, Laguerre, associated Legendre and Associated Laguerre and Hermite equations and study their polynomials Solve Hypergeometric and confluent hypergeometric differential equations and Study properties of their solutions Learn Green's function technique for solving differential equations and solve problems of physical interest. Learn Group theory and irreducible representations of SU(2), SU(3), O(3), SO(3,1) groups
PHY-203: Statistiscal Mechanics	Formulations and application of classical statistics in various ensembles Density matrix formulation of quantum statistics and study of Fermi and Bose gas Applications of FD statistics to white dwarf stars, Chandrasekhar Limit Applications of BE statistics to photon gas and BE Condensation Learn Statistical mechanics of Phase transitions and 1D ISING Model
PHY-204: Basic Condensed Matter Physics	Learn crustal binding, lattice vibrations and thermal properties Study of free electron Fermi gas and applications to metals Learn Band theory in crystals and apply to physics of semiconductors Study of superconductivity and BCS theory, Josephson effects and SQUID

	Learn current status of research in High Tc Superconductors
PHY-205: (Practical)Modern Physics and Optics/Computational Methods in Physics-II	Gain hands on training in laboratory on condensed matter systems Learn applications to different semiconductor devices Explore new experiments by taking apart and re-assembling kits Learn curve fitting within error bars of a given data set Gain Advanced computational skills with data analysis softwares
PHY-301: Classical Electrodynamics	Learn solutions of Maxwell wave equations using Green's functions Master the covariant formulation of electrodynamics with problems Study propagation of plane EM waves in dielectric and conducting media Learn radiation from moving charges, dipole and quadrupole radiation
PHY-302: Quantum Mechanics-III	Master solutions of bound state problems in 3D for central potentials Learn the time dependent perturbation theory and its applications Gain knowledge of scattering theory and its applications in QM Learn partial wave analysis and expansion of plane waves with applications
PHY-303: Electronics-II	Gain deeper understanding and applications of digital systems Learn about encoders, decoders, multiplexers and ADCs Applications of circuit theorems and reduction of complicated circuits using star and delta connections Learn linear wave shaping with applications to different pulse types Learn nonlinear wave shaping with clippers, comparators and clampers
PHY-304: Advanced Condensed Matter Physics-I	Set up the Hamiltonian for lattice vibrations in Born-Oppenheimer approximation and find quantized phonon modes Study the Second-quantized electron-phonon interaction Hamiltonian Learn nearly free electron model, tight binding approximation and the mean filed technique Study the interacting electron systems and applications Learn electronic and lattice defects and their applications Learn QHE and Giant magneto-resistance
PHY-305: Modern Physics And Computational Physics-III	Setting up of amplifier circuits and testing their operations Tasking apart and re-assembling given circuit models Study of microwave interferometer Advanced experiments with oscillators and multivibrators Learn advanced programming with FORTRAN 77 and applications
PHY-401: Advanced Quantum Mechanics	Learn relativistic QM with KG equation and Dirac equation Mastery of nonrelativistic reduction and free particle solutions Study of Lorentz group, Poincare group, isometries and representations Study of symmetries of Dirac equation and bilinear covariants Learn symmetries and conservation laws in Classical field theories Second quantization of EM, KG and Dirac fields and applications
	Study the two-nucleon problem with electric and magnetic properties Learn liquid drop model explanation of fission and shell model

PHY-402: Nuclear and Particle Physics	predictions Deeper study of nuclear reactions, decays and resonances Learn standard model of elementary particles and fundamental forces
PHY-403: Advanced Condensed Matter Physics-II	Study theories of ferromagnetism, antiferromagnetism and ferroelectricity Learn preparations and applications of multiferroics Study quantum confinement effects in 1D, 2D, 3D nanostructures Learn techniques of STM, SEM, AFM, TEM and XRD in characterization Study applications of nanoelectric and nanomegnetic systems
PHY-404: Advanced Condensed Matter Physics (Practical)	Study the techniques with nano-interferometer Determine Hall coefficient, Stefan's and Boltzmann's constants Determine band gap in semiconductors Use CRO for wave form analysis Learn Advanced programming and computational techniques
PHY-405: Project	Develop research acumen and motivation with new ideas Formulate research question and write projects Collaborate with others, collect and Review literature in a chosen topic Write word document and LATEX document with tables, figures and equations Learn and use widely-followed referencing and citation styles of journals Learn and do plagiarism checking of project report Prepare and present powerpoint with advanced techniques