Rayat Shikshan Sanstha's
KARMAVEER BHAURAO PATIL COLLEGE, VASHI, NAVI MUMBAI
[AUTONOMOUS COLLEGE]

DEPARTMENT OF PHYSICS

M.Sc. Physics Curriculum

Program Outcomes (POs):

PO-1	**Disciplinary Knowledge and Skills:** Acquire the comprehensive and in-depth knowledge of various subjects in sciences such as Physics, Chemistry, Mathematics, Microbiology, Bio-analytical Science, Computer Science, Data Science, Information Technology and disciplinary skills and ability to apply these skills in the field of science, technology and its allied branches.
PO-2	**Communication and Presentation Skills:** Develop various communication skills including presentation to express ideas evidently to achieve common goals of the organization.
PO-3	**Creativity and Critical Judgement:** Facilitate solutions to current issues based on investigations, evaluation and justification using evidence based approach.
PO-4	**Analytical Reasoning and Problem Solving:** Build critical and analytical attitude in handling the problems and situations.
PO-5	**Sense of Inquiry:** Curiously raise relevant questions based on highly developed ideas, scientific theories and its applications including research.
PO-6	**Use of Digital Technologies:** Use various digital technologies to explore information/data for business, scientific research and related purposes.
PO-7	**Research Skills:** Construct, collect, investigates, evaluate and interpret information/data relevant to science and technology to adapt, evolve and shape the future.
PO-8	**Application of Knowledge:** Develop scientific outlook to create consciousness against the social myths and blind faith.
PO-9	**Moral and Ethical Reasoning:** Imbibe ethical, moral and social values to develop virtues such as justice, generosity and charity as beneficial to individuals and society at large.
PO-10	**Leadership and Teamwork:** Work cooperatively and lead proactively to achieve the goals of the organization by implementing the plans and projects in various field-based situations related to science, technology and society at large.

PO-11	**Environment and Sustainability:** Create social awareness about environment and develop sustainability for betterment of future.
PO-12	**Lifelong Learning:** Realize that pursuit of knowledge is a lifelong activity and in combination with determined efforts, positive attitude and other qualities to lead a successful life.

Program Coordinator   **Chairman, BOS**   **Principal**

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COURSE OUTCOMS (COs):

Course Code	Course Outcomes: Students should be able to ….
PGPH101 Mathematical Methods	**CO - 1:** analyse and Solve numerical on Complex Variables, Limits, Continuity, Derivatives, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, Taylor and Laurent series, Residues and Residue theorem [4]. **CO - 2:** understand and calculate matrix Algebra, Eigenvalue and Eigenvector problems, different ways of solving second order differential equations, Green function [5]. **CO - 3:** solve the problems based on special functions like Hermite, Bessel, Laguerre and Legendre functions [5]. **CO - 4:** apply and Solve the Fourier transform and Laplace transform theorems and Problems [3].
PGPH102 Classical Mechanics	**CO - 1:** understand the fundamental concepts of planetary motion in a central force field and its applications [2]. **CO - 2:** understand the dynamic motion of classical mechanical system using Lagrangian, and Hamiltonian Formalism [2]. **CO - 3:** apply the classical background of mechanics to Canonical Transformations & Hamilton-Jacobi theory [3]. **CO - 4:** execute the Classical approach to Special theory of relativity, various transformations and Lagrangian and Hamiltonian of a relativistic particle [5].
PGPH103 Quantum Mechanics – I	**CO - 1:** interpret the physical significance of wave function and apply mathematical tools & operators to obtain information about states of the system and corresponding dynamical variables [3]. **CO - 2:** analyze one dimensional potential problem and utilize the concepts and mathematical formulation of angular momentum and Pauli spin matrices to various physical systems [4]. **CO - 3:** identify and apply suitable approximation methods among variational method, WKB, perturbation theory and adiabatic approximation to various potential problems and calculate the corresponding ground state energies [3]. **CO - 4:** understand the basics of scattering processes invoked due to central potential problems and analyze the corresponding phase shifts [4].
PGPH104 Advance Electronics	**CO - 1:** practice simple programs related to counters and time delay, stack and sub-routines on microprocessor kit, compare and contrast between microprocessor and microcontroller, and embedded systems and external memory devices [5]. **CO - 2:** diagrammatically explain the working principle of different types of inverters, higher order filters with multiple feedback filters, compare ADC and DAC converters [4]. **CO - 3:** discuss the working principle of optical fiber and its types, analyse attenuation, dispersion and slicing and fiber connectors, draw and explain the block diagram of fiber optic communication system [4] **CO - 4:** construct Microprocessors/ Microcontrollers based D C motor speed controller, temperature controller, design electronic weighing single pan balance using strain gauge/ load cell and demonstrate optical analog communication system using fiber link [6].

PGPH201 Electrodynamics	**CO - 1:** describe the Maxwell equations in analyzing the nature of electromagnetic field due to time varying charge and current distribution [2]. **CO - 2:** understand the nature of electromagnetic wave and its propagation through different Media [2]. **CO - 3:** understand the covariant formulation of Electrodynamics with the concept of retarded time and analyze the radiation systems dipole [4] **CO - 4:** understand the dynamics of charged particle radiated from localized time varying electro-magnetic sources [2]. **CO - 5:** analyse the idea of electromagnetic wave propagation through space and wave Guides [4].
PGPH202 Statistical Mechanics	**CO - 1:** understand and think critically Basic concepts, Statistical Equilibrium and thermodynamic Laws and Functions [2]. **CO - 2:** describe and solve numerical Statistical Ensembles Theory [2]. **CO - 3:** understand and apply Quantum distribution functions [3]. **CO - 4:** understand Phase Transitions and Critical Phenomenon [2]. **CO - 5:** understand Entropy and specific heat of a perfect gas, Entropy and probability Distribution [2].
PGPH203 Quantum Mechanics - II	**CO - 1:** explain basic principle of variation method and apply it to simple potential problems, describe Wentzel,- Kramers - Brillouin (WKB) approximation, analyse quantization conditions and their applications [3]. **CO - 2:** compare and contrast between Time dependent and independent perturbation theory, deduce first order and second order corrections to the energy eigenvalues and eigen functions [4]. **CO - 3:** compare Laboratory and centre of mass frames, calculate partial wave analysis and phase shifts, analyse the optical theorem, S-wave scattering from finite spherical attractive and repulsive potential wells, justify Max Born's approximation [4]. **CO - 4:** deduce the Klein Gordon and Dirac equations, Dirac matrices, spinors, illustrate quantum mechanics of lasers, quantum phase, SQUIDS, Josephson's effect, solve problems on particles and anti-particles [5].
PGPH204 Experimental Physics	**CO - 1:** describe the production of low pressure via different pumps and its measurement techniques [2]. **CO - 2:** examine the behavior of the thin films by different characterization techniques [5]. **CO - 3:** understand the concepts of different spectroscopic techniques for Physical and Chemical analysis of the prepared samples [4]. **CO - 4:** analyze samples by Electron microscopy and understand the recent advancement in microscopic techniques [4].
PGPH301 Solid State Physics	**CO - 1:** derive Bragg's condition for direct and reciprocal lattices, evaluate scattered wave amplitude, and illustrate different X-ray diffraction methods [5]. **CO - 2:** compare and contrast between photons and phonons, analyse quantization of lattice vibrations, and derive Dulong and Petit's law [4]. **CO - 3:** diffrentiate between types of polarization and deduce[5] theories of diamagnetism and ferromagnetism [4]. **CO - 4:** evaluate the effect of temperature external magnetic field on superconductors, diffrentiate between types of superconductors, explain the theories related to superconductors [5].

PGPH302 Atomic and Molecular Physics	**CO - 1:** remember the one and two electron atoms using the Schrödinger equation and analyze the properties of vector atom model [4]. **CO - 2:** understand atomic spectra with different coupling interactions under electric and magnetic fields [2]. **CO - 3:** analyze the classical/quantum description of electronic spectra of atom and Molecules [4]. **CO - 4:** understand the various Atomic spectra with electromagnetic radiation and their Interactions [2]. **CO - 5:** understand the various Molecular spectra and Describe different resonance spectroscopic techniques and its applications [3].
PGPHEC01 Fundamentals of Materials and Recent trends	**CO - 1:** classify different types of materials and different types of atomic and molecular bonding [4]. **CO - 2:** understand the plastic deformation of metal single crystals - polycrystalline metals and its recovery and recrystallization [2]. **CO - 3:** draw phase diagram of pure substances, compounds with Intermediate Phases and ternary compounds [6]. **CO - 4:** explore recent trends in material science like nano materials, smart materials, novel materials and modern semiconducting materials [6].
PGPH304 Properties of Materials	**CO - 1:** analyze the factors affecting on mechanical properties of materials [4]. **CO - 2:** understand different kinds of dielectric polarization [2]. **CO - 3:** classify dia, para, ferro, antiferro and ferrimagnetism [4]. **CO - 4:** explain optical absorption in semiconductors, metals and insulators [5]. **CO - 5:** explore applications of optical materials like LED, LCD, solar cells etc [6]
PGPH401 Solid State Devices	**CO - 1:** state the fundamental properties of semiconductors and types of semiconductors and distinguish between metals, semiconductors and insulators on the basis of band theory [4] **CO - 2:** explain how p-n junction diode is formed and its operations under forward and reverse biased conditions and understand the depletion region, depletion capacitance, and its C-V characteristic [5]. **CO - 3:** differentiate Schottky diode and p-n junction diode [4]. **CO - 4:** understand construction and working of Metal-semiconductor field effect transistor (MESFET)- device structure, principles of operation, Current voltage (I-V) characteristics, High frequency performance. Modulation doped field effect transistor (MODFET) [2].
PGPH402 Nuclear Physics	**CO - 1:** understand and explain the general properties of nuclei, nuclear structure and nuclear models [5]. **CO - 2:** illustrate the structure of nuclei through different nuclear models [3]. **CO - 3:** understand nucleon-nucleon scattering, types of decays and deuteron problem to explain nature of nuclear forces [2]. **CO - 4:** enlist elementary nuclear particles, and their families, symmetries and conservation laws [2]. **CO - 5:** compare and contrast between Nuclear Detectors & Accelerators and their applications in various fields [4].

PGPH403 Material Processing	**CO - 1:** analyse different material processes like casting, forging, spinning, extrusion, rolling etc. [4]. **CO - 2:** understand different surface treatment processes such as laser cladding, nitriding, shock hardening, carburization [2]. **CO - 3:** evaluate the effect of tempering temperature on mechanical properties [5]. **CO - 4:** differentiate between normalized and annealed components [4]. **CO - 5:** analyze various steps in manufacturing components by powder metallurgy process [4]. **CO - 6:** understand different finishing processes [2].
PGPHEC02 Thin Film Physics and Devices	**CO - 1:** understand simple, cost effective chemical methods of thin film deposition [2]. **CO - 2:** distinguish different physical methods of thin film deposition [4]. **CO - 3:** describe in detail atomistic model of nucleation [2]. **CO - 4:** evaluate dielectric and optical properties of thin films [5]. **CO - 5:** illustrate different applications of thin films like sensors, solar cells, super capacitors, mirrors, detectors etc. [3].

Names and Signatures of the Course Coordinators

Course Code	Name of the Course Coordinator	Signature
PGPH101	Dr. Gaikar P. S.	
PGPH102	Dr. Chandekar K. V.	
PGPH103	Dr. Chavan A. U.	
PGPH104	Dr. Suryavanshi U. B.	
PGPH201	Dr. Chandekar K. V.	
PGPH202	Dr. Gaikar P. S.	
PGPH203	Dr. Chavan A. U.	
PGPH204	Dr. Pujari V. B.	
PGPH301	Dr. Patil B. B.	
PGPH302	Dr. Yadav S. P.	
PGPHEC01	Dr. Suryavanshi U. B.	
PGPH304	Dr. Patil B. B.	
PGPH401	Dr. Chavan A. U.	
PGPH402	Dr. Yadav S. P.	
PGPH403	Dr. Suryavanshi U. B.	
PGPHEC02	Dr. Pujari V. B.	