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

DEPARTMENT OF PHYSICS

M.Sc. Physics Curriculum

Program Outcomes (POs):

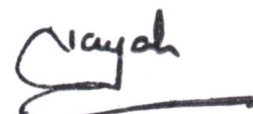|	
PO-1	**Disciplinary Knowledge and Skills:** Acquire the comprehensive and in-depth knowledge of various subjects in sciences such as Physics, Chemistry, Mathematics, Microbiology, Bio-analytical Science, Computer Science, Data Science, Information Technology and disciplinary skills and ability to 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

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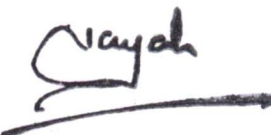Principal
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Program Specific Outcomes (PSOs): PHYSICS

PSO-1	Problem Analysis – Ability to identify and analyze the Physics problems using the basic principles and computational tools.
PSO-2	Acquired skills – Potential to adopt, absorb and develop innovative ideas in the physics and interdisciplinary areas.
PSO-3	Competent to engage themselves in lifelong learning, develop professional ethics and build a team by using their knowledge to serve the society at large with effective communication.

Program Coordinator   **Chairman, BOS**

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COURSE OUTCOMES (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 [3,4] **CO - 2:** understand and calculate matrix Algebra, Eigenvalue and Eigenvector problems, different ways of solving second order differential equations, Green function [2,4]. **CO - 3:** solve the problems based on special functions like Hermite, Bessel, Laguerre and Legendre functions [3]. **CO - 4:** apply and Solve the Fourier transform and Laplace transform theorems and problems [4].
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[4].
PGPH103 Quantum Mechanics	**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 [2,3]. **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 [1]. **CO - 4:** understand the basics of scattering processes invoked due to central potential problems and analyze the corresponding phase shifts [2,4].
PGPH104 Advance Electronics	**CO - 1:** describe the microprocessor's counter, stack and subroutine, Microcontroller 8051's Architecture and Registers, operational amplifier and its application, Types of modulation, Modems, optical fiber's numerical angle, acceptance

	angle, attenuation and dispersion [2]. **CO - 2:** compare the microcontrollers and microprocessors memory devices, bitwise Microcontrollers, Processors, architectures, principle of voltage and current driven inversion, types of power supply, switching voltage regulators, analog and digital transmissions [2]. **CO - 3:** apply the instruction set of 8051 microcontroller for writing an assembly language program, instrumentation amplifier for various applications like IC precision rectifier, active filter, converters, oscillator etc. [3] **CO - 4:** explain the operation and working of time division multiplexing, fiber optic communication system, analog multiplexer, sine wave inverter and square wave inverter [3] **CO - 5:** create the assembly language program on microprocessor and microcontroller 8051 for the application of peripheral devices like DC motor, temperature controller, Single Pan balance IR remote control etc [6].
PGPH105 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 [3, 5]. **CO - 2:** compare and contrast between photons and phonons, analyse quantization of lattice vibrations, and derive Dulong and Petit's law [4,5]. **CO - 3:** differentiate between types of polarization and deduce theories of diamagnetism and ferromagnetism [4,5]. **CO - 4:** calculate effect of temperature external magnetic field on superconductors, differentiate between types of superconductors, explain the theories related to superconductors [4].
PGPH106 Physics of Solar Cells	**CO - 1:** understand the carrier injection by light and its transport phenomena in semiconductors [2, 5]. **CO - 2:** record I-V characteristics and Calculate conversion efficiency of solar cells [5, 6]. **CO - 3:** determine series resistance, shunt resistance, dark and illuminated characteristics of solar cells, ideal properties of photovoltaic solar cells [5]. **CO - 4:** use binary, ternary, tertiary semiconductor compounds for photovoltaic solar cells [3]
PGPH201 Electrodynamics	**CO - 1:** describe the Maxwell equations in analyzing the nature of electromagnetic field due to time varying charge and current distribution [1]. **CO - 2:** understand the nature of electromagnetic waves 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: apply the dynamics of charged particles radiation to localized time varying electro-magnetic sources [3]. 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 [3]. CO - 3: understand and apply Quantum distribution functions [3]. CO - 4: understand Phase Transitions and Critical Phenomenon [2]. CO - 5: Describe Entropy and specific heat of a perfect gas, Entropy and probability distribution [2].
PGPH203 Research Methodology	CO - 1: understand the fundamental concept of research and define appropriate hypothesis. CO - 2: collect data and apply different methods for sampling data CO - 3: analyze data and form report CO - 4 : understand Intellectual Property Rights, patenting and copy right to develop research skill CO - 5: construct project research report
PGPH204 Experimental Physics	CO-1: Analyze the data analysis (Data interpretation and sample handling) obtained from the techniques using various distributions, process of measurements, and errors [4]. CO-2: Analyse the behavior of the thin films by different characterization techniques [4]. CO-3: Understand the concepts of different spectroscopic techniques for Physical and Chemical analysis of the prepared samples [2]. CO-4: Analyze samples by Electron microscopy and understand the recent advancement in microscopic techniques[4].

PGPH205 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 [1]. **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 characteristics [2]. **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].
PGPH206 Nano-science and Nanotechnology	**CO - 1:** understand the fundamentals of nano-science and nanotechnology [2]. **CO - 2:** describe various synthesis methods for nanostructure materials [2]. **CO - 3:** analyse the special Nanomaterials based on the Carbon nanotubes (CNTs) and graphene[4]. **CO - 4:** analyze quantum confinement based nanostructured transistors [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 [3,5]. **CO - 2:** compare and contrast between photons and phonons, analyse quantization of lattice vibrations, and derive Dulong and Petit's law [4,5] . **CO - 3:** differentiate between types of polarization and deduce theories of diamagnetism and ferromagnetism [4,5]. **CO - 4:** calculate effect of temperature external magnetic field on superconductors, differentiate between types of superconductors, explain the theories related to superconductors [4].
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 [1]. **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 atoms and molecules [4]. **CO - 4:** understand the various Atomic spectra with electromagnetic radiation and their interactions [2]. **CO - 5:** understand and apply the various Molecular spectra and Describe different resonance spectroscopic techniques and its applications [3].

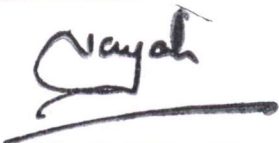|	

PGPHEC01
 	
Fundamentals of Materials and Recent trends
	CO - 1: Analyze 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 [1].

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 [2]. **CO - 4:** study optical absorption in semiconductors, metals and insulators [1] . **CO - 5:** explore applications of optical materials like LED, LCD, solar cells etc [2].

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[1,2].
	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[2].
	CO - 3: differentiate Schottky diode and p-n junction diode[2].
	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)[1].

PGPH402 Nuclear Physics	**CO - 1:** understand and explain the general properties of nuclei, nuclear structure and nuclear models [2]. **CO - 2:** illustrate the structure of nuclei through different nuclear models [1]. **CO - 3:** understand nucleon-nucleon scattering, types of decays and deuteron problem to explain nature of nuclear forces [2]. **CO - 4:** Analyse elementary nuclear particles, and their families, symmetries and conservation laws [4]. **CO - 5:** compare and contrast between Nuclear Detectors & Accelerators and their applications in various fields [3].
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 [5]. **CO - 5:** study various steps in manufacturing components by powder metallurgy process. [2]. **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]

Program Coordinator

Chairman, BOS

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