# RAJA PEARY MOHAN COLLEGE

## Department of Physics

### B.Sc. Honours in Physics

Programe Specific Outcome, Course Outcome, Programe Outcome

(PSO, CO, PO)

CO, PSO and PO for Physics Honours for the new CBCS program Physics Dept., RPMC

| Core Courses | Course Outcomes (CO) |
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| CC1 Mathematical Physics I | CO1: To acquire knowledge of calculus which are integral part of any branch of Physics<br>CO2: Understand divergence, gradient and curl and their physical interpretation which are very important for theories of electricity and magnetism to be taught later.<br>CO3: 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.<br>CO4: To develop the problem-solving capability |
| CC 2 Mechanics | CO1: Students learn accurately how to describe motion of objects, planetary motions, gravitation etc. Understand the motion of objects in different frame of references.<br>CO2: Know how to apply the conservation principle and symmetry of a system.<br>CO3: Understand laws of motion, reference frames, and its applications i.e. projectile motion, simple harmonic oscillator, Rocket motion, elastic and inelastic collisions.<br>CO4: Understand the idea of conservation of angular momentum, central forces effective potential.<br>CO5: Understand the application of central force to the stability of circular orbits, Kepler's laws of planetary motion.<br>CO6: 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.<br>CO7: Learn about Fluid motions, Archimedes Principle, Euler equation, Bernoulli's, Pascals Law etc. |
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| CC3 Electricity and Magnetism | CO1:To learn about basic concepts of electrical charges and currents and their properties<br>CO2: Enhance problem solving capability based on various realistic situation<br>CO3: Understand the concept of conductors, dielectrics, inductance and capacitance, and electrical image charge.<br>CO4: Gather knowledge on the nature of magnetic materials.<br>CO5: Understand the concept of static field and potential.<br>CO6: Gain knowledge on electromagnetic induction and Faraday's law and its applications |
| CC4 Waves and Optics | CO1: Student learn about various types of waves and their propagation, superposition of waves.<br>CO2: To provide a basic understanding of physical optics<br>CO3: To provide a knowledge of various optical phenomena, for example interference, diffraction, and optical instruments. |
| CC5 Mathematical Physics II | CO1: Understand how to expand a function in a Fourier series.<br>CO2: 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.<br>CO3: Fourier integral and its properties and application to signal analysis and also in quantum mechanics<br>CO4: Application of probability and various distribution functions in Physics.<br>CO5: Learn to solve partial differential equation which is very important in all branches of physics. |
| CC6 Thermal Physics | CO1: To understand the principle of calorimetry<br>CO2: Understand the basic principle and laws of Thermodynamics<br>CO3: Understand the concepts of Entropy, various thermodynamic potentials and their applications in various systems.<br>CO4: Understanding of first and second order phase transition with examples.<br>CO5: Gain knowledge about microscopic behavior of systems in explaining pressure, transport properties, viscosity, diffusion etc. |
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| CC7 Modern Physics | CO1: Black body Radiation and its nature, old quantum theory, concept of wave-particle duality and de Broglie hypothesis.<br>CO2: Introduction to Schrodinger equation and its Application, probabilistic interpretation of quantum mechanics, commutation relation and their meaning.<br>CO3: To inculcate basic understanding in Quantum Mechanics.<br>CO4: Students learn about Nuclear structure and various models. CO5: Understanding of Interaction within and with nucleus. Gamma, Beta decay. Nuclear Fission and Fusion.<br>CO6: To know about working principle of LASER and its applications. |
| CC8 Mathematical Physics III | CO1: To study complex analysis, Cauchy Riemann conditions, Analyticity, Cauchy Integral formula, Laurent and Taylor series expansion and definite integrals using contour integration.<br>CO2: To learn about variational calculus, optimization theory. Lagrangian and Hamiltonian formulation, Euler-Lagrange equation, Use of symmetry and conservation laws.<br>CO3: To understand special theory of relativity, length contraction, time dilation, mass-energy relation etc.<br>CO4: Relativistic dynamics, Minkowski Space-time, Proper time etc.<br>CO5: Introduction to Tensor calculus, Covariant and Contravariant tensors, Metric tensor, relativity in 4-vector notation. |
| CC9 Analog Electronics | CO1: To motivate the students to apply the principles of electronics in their day-to-day life.<br>CO2: Learn various network theorems, diodes and their application<br>CO3: Study various theory and working principles of ansistors, FET, regulated power supply, amplifiers, concept of edback, OPAMP, Multivibrators and Oscillators |
| CC10 Quantum Mechanics | CO1: Students solve various various quantum mechanical features by solving various potentials: example, Finite well, Harmonic oscillator<br>CO2: Learn Quantum theory of Hydrogen atoms, solution of Schrodinger equation under central force, Orbital angular momentum and spin angular |

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| | momentum<br>CO3: To know generalized angular momenta, Electron's magnetic moment, Energy of a magnetic dipole, Stern-Garlach experiment<br>CO4: To study Fine structure of hydrogen atoms, atoms in presence of electric and magnetic fields-- application of Quantum mechanics for atomic systems<br>CO5: To learn Many electron atoms, identical particles, Pauli Exclusion principle. |
| CC11 Electromagnetic Theory | CO1: Learn Maxwell's equations, gauge transformations, Pyonting vector, Electromagnetic field energy density, momentum density etc.<br>CO2: Propagation of electromagnetic wave through medium<br>CO3: Polarization in uniaxial crystals and rotatory polarization. |
| CC12 Statistical Mechanics | CO1: To understand statistical properties of matter, connections with thermodynamics<br>CO2: To use these theory in practical systems (ideal gas, Bose and Fermi systems), Identical particles<br>CO3:To learn Bose-Einstein statistics, and its application, Fermi-Dirac statistics and its application<br>CO4: Quantum theory of radiation. |
| CC13 Digital systems and applications | CO1:To learn integrated circuits(IC), number system and Boolean description, introduction to logic systems, various Gates<br>CO2: To understand product and sum in logical expression, conversion between truth table and logical expression, Karnaugh map<br>CO3: To learn how to Implement different circuits: adder, subtractor, idea of multiplexer, demultiplexers, encoder, decoder<br>CO4: To know registers and counters, computer organization, data conversion. |
| CC14 Solid State Physics | CO1: To learn crystal structure, lattice dynamics<br>CO2: To understand quantum properties of matter like magnetic and dielectric properties.<br>CO3: To understand elementary band theory<br>CO4: Superconductivity, Meissner effect and introduction to BCS theory. |

| Discipline Specific Elective Subjects (DSE) | Course outcomes |
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| DSEA1(a) Advanced Mathematical Methods | CO1: To learn Linear Algebra and vector space<br>CO2: To understand tensors and tensor algebra<br>CO3: To know group theory and its application |
| DSEA1(b) Laser and Fiber Optics | CO1: To know theory of laser, its basic properties<br>CO2: To learn about resonators, transient effect, many laser systems and practical use of laser<br>CO3: To understand Fiber optics, Holography and introductory nonlinear optics. |
| DSEB1 (a) Astronomy and Astrophysics | CO1: Gain knowledge on various tools of astronomy, basic introduction of starts, galaxies, interstellar medium, mass and length scales of astronomy<br>CO2: To learn observational tools of astronomy<br>CO3: To understand star and other stellar systems, formation and evolution of stars<br>CO4: To know about the galaxies and its components<br>CO5: To learn basics of cosmology, redshift, field equations and accelerating universe |
| DSEB1 (b) Nulcear and Particle Physics | CO1: To learn general properties of nuclei, various nuclear models, radioactivity<br>CO2: To understand nuclear reactions and interaction of nuclear radiation with matter<br>CO3: To know about the detectors for nuclear radiations and particle accelerators<br>CO4: To learn and understand fundamentals of particle physics. |
| DSEA2 (a) Nano Materials and applications | CO1: To learn about nanoscale systems, their band structures, application of Schrodinger equation for such nano structures<br>CO2: To know how to synthesis nano materials and how to characterize them<br>CO3: To know various properties of nano materials, e.g. optical and electrical (transport) properties |
| DSEA2(b) Advanced Classical Dynamics | CO1: To understand calculus of variation<br>CO2: To learn about small oscillations<br>CO3: To understand about rigid body motion<br>CO4: To know about non-linear dynamics |

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| DSEB2(a) Communication Electronics | CO1: To introduce students to basics of electronic communication.<br>CO2: To learn analog modulations and to modulate analog pulse.<br>CO3: To learn how to modulate digital pulse.<br>CO4: Students are introduced to communication and navigation system, which has many modern day applications. |
| DSEB2(b) Advanced Statistical Mechanics | CO1: To review classical statistical mechanics<br>CO2: To understand Quantum Statistical Mechanics<br>CO3: To learn ideal Bose and Fermi systems<br>CO4: To learn Ising model and non-equilibrium statistical mechanics |

| Skill Enhancement Courses (SEC) | Course outcomes (CO) |
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| SEC A-1 Scientific Writing | CO1: Students learn Latex, a program system to write scientific papers and documents,<br>CO2: To learn how to insert various mathematical symbols in a document<br>CO3: To learn how to insert a figure or a table in a report or article. |
| SEC A-2 Renewable energy and Energy Harvesting | CO1: Students learn about fossil fuels and its hazards<br>CO2: Need for alternative energy sources, how to harvest energy from various non-conventional energy sources.<br>CO3: Know about Piezoelectric Energy and Electromagnetic Energy harvesting, Fuel cell. |
| SEC B-1 Arduino | CO1: Students learn Arduino, which is basically an open-source electronics proto-type which itself can be used as a circuit<br>CO2: Arduino programming, interfacing. |
| SEC B-2 Electrical Circuits and Network Skills | CO1: Students know about various electrical instruments (generators, transformers, AC motor etc).<br>CO2: Single phase and three phase ac devices,<br>CO3: Measurements and faults distribution system. |

| Practical Topics | Course outcomes |
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| Practicals of Mechanics, Thermodynamics, Electricity and Magnetism, Waves, Optics, Modern Physics | 1) Various theories which students learn in theory lesson are verified in practical classes.<br>2) Students learn various practical situation, how to handle tools and instruments, measurement techniques, graph plotting, statistical/error estimations etc.<br>3) Physics is essentially a practical based subject, knowledge of proving/disproving a certain theory is important. Practicals bridge between theoretical knowledge and real-life situation |
| Practicals based on Computation and Programming (Python language) | 1) Understand how to write an algorithm, iteration techniques<br>2) Various numerical methods to solve many problems numerically. e.g. finding solution of a equation, integration and differentiation etc.<br>3) Plotting different kinds of graphs, how to label them etc. |
| Program Specific Outcome (PSO) | PSO1: Physics deals with a wide variety of systems, from microscopic level (atoms, nucleus) to Astronomical level (Sun, galaxy). Basic principles are more-or-less same used by physicists at every level. Each of these theories are experimentally verified in a number of ways and found to be a sufficiently appropriate description of nature. Students get oriented along this line of thinking and earn enough proficiency to use Physical Principles/concepts to explain various phenomena.<br>PSO2: Physics uses mathematics as a medium to organize and formulate experimental results. Students gather handsome knowledge on mathematics required for formulating and solving problems.<br>PSO3: Students learn to perform various types of numerical calculations.<br>PSO4: Students have learned laboratory skills, enabling them to take measurements in a physics laboratory and analyze the measurements to draw valid conclusions.<br>PSO5: Students will develop good oral and written scientific communication skill.<br>PSO6: Students learn to think critically and work independently. |

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| Program Outcome (PO) | PO1: This programme helps to develop scientific aptitude among the students and thus can be highly beneficial for the society and for nation building.<br>PO2: This programme helps to develop critical thinking, creativity, analytical and problem-solving skills among the students.<br>PO3: The main cognitive outcome of the program is that the student should be able to explain an otherwise unknown situation/problem on their own based on what they have learnt.<br>PO4: The students will be able to learn necessary computational skill, and use of ICT required for an effective learning experience and further progress to higher studies.<br>PO5: The mathematical skill and theoretical principles learnt during the three-year program, help them motivate and contribute to the society by actively participating in innovative research, teaching. Also, they can induce rational thinking to the society.<br>PO6: After completion of this programme the students will be eligible to pursue higher studies in basic sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher education in India and abroad, and then choose research career for the welfare of mankind and society.<br>PO7: Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.<br>PO8: The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement. |

PRINCIPAL
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