ISPAT AUTONOMOUS COLLEGE, ROURKELA

Course outcome (CO) for PHYSICS HONOURS under state model (CBCS) syllabus

CORE COURSES	COURSE OUTCOMES
CC 1. MATHEMATICAL PHYSICS -1	**CO1:** To understand the concept of calculus and its application in various fields of physics. **CO2:** Knowledge of vectors and its properties with reference to vector product and scalar product. **CO3:** Understand the different co-ordinate system such as Cartesian, cylindrical and spherical polar coordinates and their suitability. **CO4:** Acquire the operation of gradient, divergence and curl and understand their respective physical interpretation and uses. **CO5:** Understand Dirac-Delta function and its properties with its applications in solving many problems in physics.
CC2. MECHANICS	**CO1:** Understand the concept of center of Mass, its motion and comparison between center of mass frame and laboratory frame.

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	CO2: Understand the dynamics of Rotational Motion such as moment of Inertia, angular momentum its conservation and practical examples. **CO3:** Understand the concept of non-inertial system or frame of reference and the laws of physics in rotating coordinate system. Idea of Coriolis force, its application. **CO4:** Understand the different elastic constants and their relation, torsion of cylinder, bending of beam and cantilever. **CO5:** Learn about fluid motion , surface Tension , Viscosity , Rate of flow of liquid through a capillary tube (Poiseuille's formula with correction) **CO6:** Gain Knowledge about Gravitation, Gravitational Field & potential and the concept of central force problem, its solution, Kepler laws and Global Positioning system. **CO7:** Learn about oscillation with emphasis on damped oscillation and forced oscillation, idea of resonance. **CO8:** Gain idea of special theory of relativity, with reference to Michelson Morley experiment, its outcome, Lorentz

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	Transformation, its consequences, Relativistic Kinematics.
CC3: ELECTRICITY AND MAGNETISM	**CO1:** To acquire knowledge on electric field, electric potential, Electric flux, Gauss law and its application. **CO2:** Concept of Magnetic field, Biot-savart law and Ampere's circuital law with application (Solenoid, Toroid etc.) **CO3:** Understand of Dielectric properties of matter, Dielectric polarization capacitor of different types. **CO4:** Gain idea about Magnetic properties of Matter, such as magnetization, magnetic Intensity, susceptibility, permeability etc. Hysteresis. **CO5:** Understand the phenomenon of electromagnetic induction, Faradays laws and examples of self-Induction, mutual induction. **CO6:** Idea of AC circuits such as LCR series and Parallel circuit. **CO7:** Know about various network theorems such as Thevenin, Norton, Superposition, Reciprocity, maximum power transfer theorem with examples.

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CC4: WAVES AND OPTICS	**CO1:** Understand Fermat's principle, Matrix formulation of Geometrical optics, cardinal points of an optical system. **CO2:** Learn about wave nature of light such as Interference, diffraction with examples. **CO3:** Gain Knowledge about Lissajous figures and their uses.
CC5: MATHEMATICAL PHYSICS -II	**CO1:** Gain Knowledge about expansion of a periodic function in term of Fourier series. Use of Fourier series in solving physics problem related to rectifier circuits. **CO2:** Understand singular points of second order differential equation and power series method of solution using Frobenius Method. **CO3:** Learn about some special function such as Legendre, Hermite, generating function and the corresponding differential equation and their solution. **CO4:** Study of special integrals such as Beta and Gamma function with examples and idea of error function. **CO5:** Learn about solution of partial

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	differential equation by separation of variables and Laplace equation, its use in conducting sphere and dielectric sphere in uniform electric field.
***CC6: THERMAL PHYSICS*.**	**CO1:** Understand reversible and Irreversible process and know about different laws of Thermodynamics. **CO2:** Acquire knowledge about entropy and principle of increase of entropy. Significance of unattainability of absolute zero. **CO3:** Know about different thermodynamics potential, and idea of different phase transitions. **CO4:** Understand Maxwell's thermodynamic Relation and their application in thermal physics. **CO5:** Gain idea of Maxwell Boltzmann's law of distribution of velocities and its experimental verification. **CO6:** Understand the transport phenomena such as viscosity, thermal conductivity and Diffusion of gasses. **CO7:** Study about the behavior of Real gases, idea of critical pressure, critical

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	temperature, critical volume. **CO8:** Know about adiabatic expansion of perfect gas, Temperature of inversion, Joule Thomson Porous plug Experiment.
CC1O: DIGITAL SYSTEM AND APPLICATIONS	**CO1:** Learn integrated circuit (IC), number system and Boolean algebra, idea of different types of logic gates and their uses. **CO2:** Understand product and sum in logical expression, karnaugh map. **CO3:** Gain knowledge about CRO, and its applications. **CO4:** Learn about multiplexers, de-multiplexers, Adders, subtractors, IC 555 timer. **CO5:** Acquire idea of computer organization, RAM, ROM, shift registers and counters.
CC11. QUANTUM MECHANICS AND APPLICATIONS	**CO1:** Understand the properties of wave functions. Interpretations of wave function , Time dependent Schrodinger equation , Gaussian wave packet **CO2:** Learn about different types of

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	operators in quantum mechanics, and their applications. **CO3:** Gain idea of wave packet, wave particle duality, Davisson German experiment, and complementarity. **CO4:** Understand Heisenberg uncertainty principle, using Gamma ray microscope and electron diffraction through slit and its application. **CO5:** Learn about the Nuclear structure and various nuclear models, idea of binding energy, semi empirical mass formula. **CO6:** Acquire knowledge about Radioactivity, laws of radioactivity, nuclear fission and nuclear fusion, and idea of the nuclear reactor.
CC7: ANALOG SYSTEM AND APPLICATIONS	**CO1:** To gain knowledge about p type and n type semiconductors, PN junction diode, its use as rectifier. **CO2:** To study transistor characteristics and Transistor biasing. **CO3:** Understand the principle of Amplifier and the classification of amplifiers, and oscillator etc.

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	CO4: Understand the concept of operational amplifier and its use as inverting and non-inverting amplifier, adder, subtractor, differentiator, integrator etc.
CC8: MATHEMATICAL PHYSICS III	**CO1:** To study complex analysis, Cauchy Riemann equations, analytic function Cauchy's integral formula, Taylor & Laurent series. Contour integration using Cauchy's residue theorem. **CO2:** Understand Fourier transform and gain knowledge about its applications in physics such as wave/diffusion/heat flow equations. **CO3:** Learn about Laplace transform and its applications to solve differential Equation. Damped harmonic oscillator and simple electrical circuits.
	CO1: Learn about the inadequacy of classical physics, Such as in black body radiation, Photo electric effect, Compton effect, atomic spectra etc. **CO2:** Understand Rutherford's alpha particle scattering experiment, and atomic model, Bohr's Atomic Model, Hydrogen spectra.

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CC9: ELEMENT OF MODERN PHYSICS	**CO3:** Learn about time independent Schrodinger equations in 1D, 2D and 3D and solution, Its application to one dimensional problem as square well potential, Harmonic Oscillator, Quantum mechanical tunneling. **CO4:** Understand the concept of space quantization, Electron spin, Angular momentum, Stern-Gerlach experiment LS and J-J coupling , idea of Zeeman effect and Paschen Back effect .
CC12: SOLID STATE PHYSICS	**CO1:** Learn about crystal structure, Miller Indices, Reciprocal lattice and x-ray diffraction. **CO2:** Understand the lattice vibrations, phonons, Einstein & Debye's Theory of specific heat of solids. **CO3:** Gain knowledge of magnetic properties of matter such as dia, para, fero magnetic materials, domain theory Hysteresis and superconductivity. **CO4:** Know about dielectric properties of materials, Clausius Mossotti equation Idea of LASER, Einstein's A and B coefficients Ruby lasers, He-Ne laser.

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	CO5: Gain idea of energy band, Kronig-Penny model, Hall effect and experimental result of superconductivity and BCS theory.
CC13: ELECTROMAGNETIC THEORY	**CO1:** Know about Maxwell's equations Gauge transformations, Poynting theorem and Poynting vector, concept of the electromagnetic field energy. **CO2:** Understand the propagation of electromagnetic waves in dielectric medium, wave impedance, idea of skin, depth plasma frequency, and propagation through ionospheres. **CO3:** Understand Boundary conditions at a plane interface between two dielectric media , Fresnel's formula for perpendicular and parallel polarization total internal reflection , evanescent waves, metallic reflection. **CO4:** Gain idea of polarization of electromagnetic waves, concept of double refractions, Nicol prism,Plane, circulatory and Elliptically polarized light. **CO5:** Know about the quarter wave plate, half wave plate, Babinet's compensator, idea of optical rotation, Fresnel's theory of optical rotation, specific rotation, Polari meter.

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CC-14 STATISTICAL MECHANICS	**CO1:** Learn about microstates and macro states, Ensembles, types of ensembles, Entropy and thermodynamic probability, Maxwell Boltzmann distribution law and partition function. **CO2:** Understand the concept of thermodynamic function of ideal gas, Gibbs paradox, law of equipartition of energy, concept of negative temperature. **CO3:** Know about quantum statistics, Fermi Dirac Distribution law, Bose Einstein Distribution, Bosons, and Fermions. **CO4:** understand Black body radiation, Kirchhoff's laws, Stefan Boltzmann's law, Wien's law, Rayleigh-Jeans law, ultraviolet catastrophe. **CO5:** learn about the experimental verification of Planck's law, its derivation and Wien's law, Rayleigh-Jean law from Planck's law.

Discipline Specific Elective paper (DSE)	
	CO1: Learn the concept of

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DSE-01: CLASSICAL DYNAMICS	generalized coordinates & velocities. Principle of virtual work, D'Alembert's principle and Lagrange's equations. **CO2:** Know about the calculus of variations and its uses, Hamilton's equation of motion. **CO3:** Understand central force problem and knowledge of equation of motion and nature of orbits under central force. **CO4:** Know the basis idea of special theory of relativity with emphasis on Minkowski space, light cole, space time diagram, twin paradox. **CO5:** Introduction of the idea of four vector concept in special theory of relativity and its application in physics such as decay of unstable particles.
	CO1: Learn about the various nuclear properties like nuclear density, binding energy, parity and magnetic moment, electric moment etc. **CO2:** Know about Radioactivity

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DSE-II NUCLEAR AND PARTICLES PHYSICS	with analysis of α, β, ϒ decay Geiger-Nuttall law, Neutrino hypothesis. **CO3:** Study of various nuclear models, such as liquid drop model, Shell Model and their applications to explain magic numbers. **CO4:** Familiarize with the principle & working of detectors for Nuclear radiations, and different particle accelerators. **CO5:** Learn about particle physics, such as different elementary particles, their classification and properties.
DSE-III NANOMATERIALS AND APPLICATIONS	**CO1:** Learn about the different Nano structures in 1D, 2Dand3D along with band structure, use of Schrodinger's equations. **CO2:** Understand the synthesis of Nano structure by different methods. **CO3:** Learn about X-Ray diffraction scanning electron and Transmission electron microscopy. **CO4:** Know about the applications of nanoparticles such as quantum

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	dots, nanowires, thin films etc.
PRACTICAL TOPICS	
PRACTICALS OF CORE COURSES LIKE : **MECHANICS, ELECTRICITY AND MAGNETISM, WAVES AND OPTICS, THERMAL PHYSICS, ANALOG SYSTEM AND APPLICATION, MODERN PHYSICS, DIGITAL SYSTEM AND APPLIACTION, SOLID STATE PHYSICS, QUANTUM MECHANICS, ELECTROMAGNETIC THEORY.**	**CO1:** Students learn different practical experiments based on the topics covered in the respective theory classes. **CO2:** Students perform the practicals, analyse the results and know different experimental techniques as experiments carried out by students help them to understand the underlying concept/principle involved with it.
PRACTICALS BASED ON COMPUTATION AND PROGRAMMING USED IN TOPICS LIKE MATHEMATICAL PHYSICS, QUANTUM MECHANICS AND STATISTICAL MECHANICS.	**CO1:** Learn about the basics of scientific computing, error Analysis, and writing of algorithm. **CO2:** Know about C and C++ programming and their applications. **CO3:** Understand the numerical computation software SCILAB and numerical methods. **CO4:** Use of SCILAB to solve second order differential

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	equations used in physics. **CO5:** Plotting of graphs of the topics covered in statistical mechanics laboratory work using C/C++/SCILAB.
PROGRAMME SPECIFIC OUTCOMES (PSO)	**PSO1:** As physics is essentially a subject which from ancient times has been involved to explain natural phenomena with theoretical and experimental techniques, the students of the department are oriented to create an atmosphere of learning the fundamentals ideas behind various phenomena (both theory and practical). **PSO2:** The various theories or proofs encountered in different topics of physics involves mathematical steps (simple and rigorous). Hence the topic mathematical physics included in the three year degree course helps the student to get acquainted with different mathematical techniques which increase their skills in solving problems and improve their understanding of various complex theories.

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	PSO3: Students learn to perform various types of numerical calculations and use of C/C++/SCILAB help them to solve problems on different topics in physics. **PSO4:** Students of the department enhance their laboratory skills enabling them to perform experiments, make measurements and analyse the results independently thereby can draw valid conclusions.
PROGRAMME OUTCOMES	**After successful completion of the three year degree course in physics the students are able to** **PO1:** Acquire knowledge in various topics of physics through theory and practicals. **PO2:** Analyse and think independently of various existing/upcoming theories or ideas in physics. **PO3:** Solve numerical methods or handle computational physics in future when they pursue carrier in physics.

CORE COURSES	COURSE OUTCOMES
	PO4: Solve problems of interest to physicist (both seen and unseen problems) having the mathematical expertise gained through the course. **PO5:** Participate in innovative research & teaching thereby contributing to the development of society and instill scientific temper among people. **PO6:** Handle sophisticated instruments /equipments due to their experimental skills and prepare themselves for cutting edge research activity both in theoretical and experimental groups.