Department of Physics, Rajeev Gandhi Govt. Post Graduate College, Ambikapur-497001, Chhattisgarh, India

CROSS CUTTING ISSUES

M.Sc. (Physics)

Programme Name	Course Code	Course Name	Description	Cross cutting issues			
				Gender	Human Values	Professional ethics	Environment & Sustainability
M.Sc. I Sem. (Physics)	MSP 101	Mathematical Physics	• Complex Variables & Matrix analysis • Linear Differential equations • Laplace and Fourier transforms • Vector and Tensor Analysis • Group Theory & probability theory			✓	
	MSP 102	Classical Mechanics	• Dynamics of a Rigid Body • Langragian Dynamics • Hamiltonian Dynamics • Canonical transformation • Hamilton Jacobi Theory and transition to Quantum Mechanics • Small Oscillation and Normal Modes			✓	✓
	MSP 103	Quantum Mechanics-I	• Basic formalism • Applications • General formalism: • Approximation methods • Angular momentum and identical particles			✓	
	MSP 111	LAB-A	•			✓	
	MSP 112	LAB-B	•			✓	✓
	MSP S01	SOCIAL OUTREACH,ENTERPRENEURSHIP & INTERSHIP		✓	✓	✓	✓
	MSP AO1	CONSTITUTIONALISM & INDIAN POTITICAL SYSTEM	• CONSTITUTION • CONCEPT OF STATE AND CITIZENSHIP • UNION EXECUTIVE AND STATE EXECUTIVE • PARLIAMENT OF INDIA • INDIAN DEMOCRACY • CONTROLLER &ACCOUNTANT GENERAL OF INDIA	✓	✓	✓	
	MSP AO2	Electronic Devices and Applications	• Fabrication of IC and logic families • Opto electronic devices • Timer and applications • Op-amp applications • Pulse and digital Communication		✓	✓	✓
	MSP AO3	Condensed Matter Physics - I	• Phase transformation and alloys • High temperature superconductors and GMR/CMR materials • Novel organic materials • Polymers			✓	✓

			• Structural characterization and electron structure determination				
	MSP AO4	High Energy Physics - I	• Elementary particles • Bound states. • Symmetries • Quark and Antiquark states • Feynman diagrams	✓		✓	✓

Programme Name	Course Code	Course Name	Description	Cross cutting issues			
				Gender	Human Values	Professional Ethics	Environment & Sustainability
M.Sc. II Sem. (Physics)	MSP 201	Electronics	• Operational Amplifiers • Oscillators • Wave Shaping Circuits • Digital Electronics • Sequential Logic		✓	✓	
	MSP 202	Atomic and Molecular Physics	• Perturbation method • Indistinguishability and exchange symmetry, • Spectroscopy • Laser cooling and trapping of atoms		✓	✓	
	MSP 203	Quantum Mechanics II	• Scattering Theory • Perturbation Theory • Relativistic Quantum Mechanism • Dirac equation • Particle in potential well		✓	✓	
	MSP 211	LAB-A	•		✓	✓	
	MSP 212	LAB-B	•		✓	✓	
	MSP 204	RESEARCH METHODOLOGY & COMPUTER APPLICATION: BASICS	• CONCEPT OF RESEARCH • TOOLS OF RESEARCH • METHODS OF RESEARCH • TREATMENT OF DATA • COMPUTER FUNDAMENTAL • OPERATING SYSTEM • OFFICE SOFTWARE PACKAGE		✓	✓	
	MSP B01	ENVIRONMENTAL AND FOREST LAWS	• EVOLUTION OF FOREST AND WILD LIFE LAWS • FOREST PROTECTION AND LAW • WILDLIFE PROTECTION AND LAW • BASIC CONCEPTS • INTRODUCTION TO LEGAL SYSTEM • LEGISLATIVE FRAMEWORK FOR • POLLUTION CONTROL LAWS • LEGISLATIVE FRAMEWORK FOR ENVIRONMENT PROTECTION • ENVIRONMENTAL CONSTITUTIONALISM		✓	✓	
	MSP B02	Electronic Instrumentation	• Transducers • Digital Instrumentation • Analytical Instrumentation • Bio-Medical Instrumentation • Computer Peripherals			✓	
	MSP B03	Condensed Matter Physics – II	• Disordered systems • Nanomaterials • Different methods of preparation of nanomaterials • Films and surfaces • Experimental techniques		✓	✓	
	MSP B04	High Energy Physics – II	• Moller scattering • Structure of Hadrons • QCD		✓	✓	

			• Weak Interactions • Gauge Symmetries				

Programme Name	Course Code	Course Name	Description	Cross cutting issues			
				Gender	Human Values	Professional ethics	Environment & Sustainability
M.Sc. III Sem. (Physics)	MSP 301	Solid State Physics	• Crystal Physics • Lattice dynamics • Theory of metals and semiconductors • Magnetism • Super conductivity			✓	✓
	MSP 302	Nuclear and Particle Physics	• Nuclear Structure And Models • Nuclear Interactions • Nuclear reactions • Nuclear decay • Particle Physics			✓	✓
	MSP 303	Classical Electro Dynamics	• Electrostatics • Boundary Value Problems in Electrostatics • Magnetostatics • Time varying fields • Lorentz transformations of space and time			✓	
	MSP 311	LAB-A	•			✓	
	MSC 312	LAB-B	•				
	MSP SO2	INTELLECTUAL PROPERTY LAW	• INTRODUCTION,NATURE,BASIC CONCEPTS AND INTERNATIONAL CONVENTION • LAW OF COPYRIGHT • LAW OF PATENTS • LAW OF TRADEMARK • DESIGN AND OTHER FORM OF GEOGRAPHICAL INDICATION (GI)			✓	✓
	MSP CO1	TRIBAL STUDIES	• TRIBAL STUDIES • SCHEDULED TRIBE IN INDIA • SOME MAJOR TRIBES IN INDIA • SOME MAJOR TRIBES IN CENTRAL INDIA • ILITERACY • PROBLEM OF HEALTH AND SANITATION WELFARE-CONCEPT, CHARACTERISTICS TRIBAL DEVELOPMENT PROGRAMS FOR SCHEDULED TRIBES • TRIBAL WELFARE & ADVISORY AGENCIES IN INDIA			✓	✓
	MSP CO2	Microwave Electronics	• Waveguides and components • CIRCUIT THEORY OF WAVE GUIDES • ANTENNAS • APPLICATIONS OF MICROWAVES • FERRITES			✓	
	MSP CO3	Nano Science	• Introduction to Nanoparticles • Nanocrystals • Characteristics of Nanomaterials • Nanotubes • Applications of Nanomaterials			✓	

	MSP CO4	High Energy Physics - III	• Local gauge invariance and Yang-Mills fields • Unified models of weak and electromagnetic interactions • Quark and lepton mixing • CKM quark mixing matrix • QCD confinement			✓	

Programme Name	Course Code	Course Name	Description	Cross cutting issues			
				Gender	Human Values	Professional ethics	Environment & Sustainability
M.Sc. IV Sem. (Physics)	MSP 401	Materials Science and Laser Physics	• Phase Diagram • Defects • Optical Properties, Dielectric Properties and Ferro Electrics • Elastic Behaviour, Polymer and Ceramics • Laser Physics			✓	
	MSP 402	Spectroscopy	• Microwave spectroscopy • Infrared spectroscopy • Raman Spectroscopy • NMR and NQR Techniques • ESR and Mossbauer Spectroscopy			✓	✓
	MSP 403	Statistical Physics	Canonical and Grand Canonical ensembles Partition functions and Statistics Identical particles and symmetry requirement Theory of Metals			✓	
	MSP 411	LAB-A	•			✓	
	MSP 412	LAB-B	•		✓		
	MSP 421	DISSERTATION	• Introduction • Review of Literature • Materials and Methods • Results and Discussions • Summary • Bibliography		✓	✓	✓
	MSP DO1	Energy Physics	• Introduction to Energy Sources • Energy from the oceans • Basic Principles of wind energy conversion • Energy from Biomass • Solar radiation and its measurements			✓	
	MSP DO2	Satellite Communication and Remote Sensing	• Principle of Satellite Communication • Satellite Analog Communication • Digital Satellite transmission • Concept and Foundations of Remote Sensing • Microwave Remote Sensing Tools			✓	✓
	MSP DO3	Crystal Growth & Thin film Physics	• Nucleation and Growth Nucleation • Growth Techniques Solution Growth Technique • Melt and Vapour Growth Techniques Melt technique • Thin Film Deposition Techniques Thin Films • Characterization Technique X – Ray Diffraction		✓	✓	✓
	MSP DO4	Renormalization and Super-symmetry	• The renormalization group • Phase transitions. • Renormalization of Yang-Mills theories • Applications of the renormalization group of quantum chromo dynamics		✓	✓	

			• Perturbation theory anomalies. • Applications to particle phenomenology Grand unification, • The super symmetric Standard Model				

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CROSS CUTTING ISSUES

B.Sc. (Physics)

Programme Name	Course Code	Course Name	Description	Cross Cutting Issues			
				Gender	Human Values	Professional Ethics	Environment & Sustainability
B. Sc. I Year/ I Sem. (Physics)	PHY101	Mechanics, Oscillations and Properties of Matters	Cartesian, Cylindrical and Spherical coordinate system, Inertial and non-inertial frames of reference, uniformly rotating frame, Coriolis force and its applications. Motion under a central force, Kepler's laws. Effect of Centrifugal and Coriolis forces due to earth‟s rotation, Center of mass (C.M.), Lab and C.M. frame of reference, motion of C.M. of system of particles subject to external forces, elastic, and inelastic collisions in one and two dimensions, Scattering angle in the laboratory frame of reference, Conservation of linear and angular momentum, Conservation of energy			✓	
			Rigid body motion, rotational motion, moments of inertia and their products, principal moments & axes, introductory idea of Euler's equations. Potential well and Periodic Oscillations, case of harmonic small oscillations, differential equation and its solution, kinetic and potential energy, examples of simple harmonic oscillations: spring and mass system, simple and compound pendulum, torsional pendulum.			✓	✓
			Bifilar oscillations, Helmholtz resonator, LC circuit, vibrations of a magnet, oscillations of two masses connected by a spring. Superposition of two simple harmonic motions of the same frequency, Lissajous figures, damped harmonic oscillator, case of different frequencies. Power dissipation, quality factor, examples, driven (forced) harmonic oscillator, transient and steady states, power absorption, resonance. .			✓	
			E as an accelerating field, electron gun, case of discharge tube, linear accelerator, E as deflecting field- CRO sensitivity, Transverse B field, 180o deflection, mass spectrograph, curvatures of tracks for energy determination, principle of a cyclotron. Mutually perpendicular E and B fields: velocity selector, its resolution. Parallel E and B fields, positive ray parabolas, discovery of isotopes, elements of mass spectrography, principle of magnetic focusing lens.			✓	✓
			Elasticity: Strain and stress, elastic limit, Hooke‟s law, Modulus of rigidity, Poisson‟s ratio, Bulk modulus, relation connecting different elastic- constants, twisting couple of a cylinder (solid and hallow), Bending moment, Cantilever, Young modulus by bending of beam. Viscosity: Poiseulle‟s equation of liquid flow through a narrow tube, equations of continuity. Euler's equation, Bernoulli‟s theorem, viscous fluids, streamline and turbulent flow. Poiseulle's law, Coefficient of viscosity, Stoke‟s law, Surface tension and molecular interpretation of surface tension, Surface energy, Angle of contact, wetting.			✓	
			Repeated integrals of a function of more than one variable, definition of a double and triple integral. Gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field, and their geometrical interpretation, line, surface and volume integrals, flux of a vector field. Gauss's divergence theorem, Green's theorem and Stoke‟s theorem and their physical significance.Kirchoff's law, Ideal Constant-voltage and Constant-current Sources.Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem and Maximum Power Transfer theorem.			✓	
			Coulomb‟s law in vacuum expressed in Vector forms, calculations of E for simple distributions of charges at rest, dipole and quadrupole fields. Work done on a charge in a electrostatic field expressed as a line integral, conservative nature of the electrostatic field. Relation between Electric potential and Electric field, torque on a dipole in a uniform electric field and its energy, flux of the electric field. Gauss's law and its application: E due to (1) an Infinite Line of Charge,				

B. Sc. I Year/ II Sem. (Physics)	PHY201	Electricity, Magnetism and Electromagnetic Theory	(2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge and Two Parallel Charged Sheets, capacitors, electrostatic field energy, force per unit area of the surface of a conductor in an electric field, conducting sphere in a uniform electric field.				
			Dielectric constant, Polar and Non Polar dielectrics, Dielectrics and Gauss‟s Law, Dielectric Polarization, Electric Polarization vector P, Electric displacement vector D. Relation between three electric vectors, Dielectric susceptibility and permittivity, Polarizability and mechanism of Polarization, Lorentz local field, Clausius Mossotti equation, Debye equation, Ferroelectric and Paraelectric dielectrics, Steady current, current density J, non-steady currents and continuity equation, rise and decay of current in LR, CR and LCR circuits, decay constants, AC circuits, complex numbers and their applications in solving AC circuit problems, complex impedance and reactance, series and parallel resonance, Q factor, power consumed by an a AC circuit, power factor.			✓	✓
			Magnetization Current and magnetization vector M, three magnetic vectors and their relationship, Magnetic permeability and susceptibility, Diamagnetic, paramagnetic and ferromagnetic substances. B.H. Curve, cycle of magnetization and hysteresis, Hysteresis loss. Biot-Savart‟s Law and its applications: B due to (1) a Straight Current Carrying Conductor and (2) Current Loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).Ampere‟s Circuital law (Integral and Differential Forms).			✓	
			Electromagnetic induction, Faraday's law, electromotive force, integral and differential forms of Faraday's law Mutual and self inductance, Transformers, energy in a static magnetic field. Maxwell's displacement current, Maxwell‟s equations, electromagnetic field energy density. The wave equation satisfied by E and B, plane electromagnetic waves in vacuum, Poynting's vector.			✓	✓
	PHY202	Physics Lab-I				✓	
B. Sc. II Year/ III Sem. (Physics)	PHY301	Thermodynamics, Kinetic Theory and Statistical Physics	The laws of thermodynamics: The Zeroth law, first law of thermodynamics, internalenergy as a state function, reversible and irreversible change, Carnot's cycle, carnottheorem, second law of thermodynamics. Claussius theorem inequality.Entropy, Changeof entropy in simple cases (i) Isothermal expansion of an ideal gas (ii) Reversibleisochoric process (iii) Free adiabatic expansion of an ideal gas.Concept of entropy,Entropy of the universe.Entropy change in reversible and irreversible processes, Entropyof Ideal gas, Entropy as a thermodynamic variable, S-T diagram, Principle of increase ofentropy.The thermodynamic scale of temperature, Third law of thermodynamics,Concept of negative temperature.			✓	✓
			Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb'sfree energy, Maxwell's thermodynamical equations and their applications, TdS equations,Energy and heat capacity equations Application of Maxwell's equation in JouleThomson cooling, adiabatic cooling of a system, Van der Waals gas, Clausius- Clapeyronheat equation. Blackbody spectrum, Stefan-Boltzmann law, Wien's displacement law,Rayleigh-Jean's law, Planck's quantum theory of radiation.			✓	✓
			Maxwellian distribution of speeds in an ideal gas: Distribution of speeds and velocities,experimental verification, distinction between mean, rms and most probable speed values. Doppler broadening of spectral lines. Transport phenomena in gases: Molecularcollisions mean free path and collision cross sections. Estimates of molecular diameterand mean free path.Transport of mass, momentum and energy and interrelationship,dependence on temperature and pressure. Behaviour of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation.Andrew's Experiments on CO2 Gas.Critical Constants.			✓	✓
			The statistical basis of thermodynamics: Probability and thermodynamic probability,principle of equal a priori probabilities, statistical postulates. Concept of Gibb'sensemble, accessible and inaccessible states.Concept of phase space, γ phase space and μ phase space.Equilibrium before two systems in thermal contact, probability and entropy,Boltzmann entropy relation. Boltzmann canonical distribution law and its applications,law of equipartition of energy.Transition to quantum statistics: ' h' as a natural constant and its implications, cases ofparticle in a one-dimensional box and one- dimensional harmonic oscillator.			✓	✓
			Indistinguishability of particles and its consequences, Bose-Einstein & Fermi- Diracconditions, Concept of partition function, Derivation of Maxwell-Boltzmann, BoseEinstein and Fermi-Dirac Statistics, Limits of B-E and F-D statistics to M-B statistics.Application of B-E statistics				

			to black body radiation, Application of F-D statistics to freeelectrons in a metal.				
B. Sc. II Year/ IV Sem. (Physics)	PHY401	Waves, Acoustics and Optics	Waves in media: Speed of transverse waves on uniform string, speed of longitudinalwaves in a fluid, energy density and energy transmission in waves. Waves over liquidsurface: gravity waves and ripples. Group velocity and phase velocity and relationshipbetween them. Production and detection of ultrasonic and infrasonic waves andapplications. Reflection, refraction and diffraction of sound: Acoustic impedance of a medium,percentage reflection & refraction at a boundary, impedance matching for transducers,diffraction of sound, principle of a sonar system, sound ranging.			✓	✓
			Fermat's Principle of extremum path, the aplanatic points of a sphere and otherapplications. Cardinal points of an optical system, thick lens and lens combinations.Lagrange equation of magnification, telescopic combinations, telephoto lenses.Monochromatic aberrations and their reductions; aspherical mirrors and Schmidtcorrector plates, aplanatic points, oil immersion objectives, meniscus lens.Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, commontypes of eyepieces. (Ramsdon and Hygen's eyepieces).			✓	
			Interference of light: The principle of superpositions, two slit interference, coherence requirement for the sources, optical path retardations, Conditions for sustainedinterference, Theory of interference, Thin films. Newton's rings and Michelsoninterferometer and their applications its application for precision determinations ofwavelength, wavelength difference and the width of spectral lines.Multiple beaminterference in parallel film and Fabry-Perot interferometer.Rayleigh refractometer,Twyman-Green interferometer and its uses.			✓	✓
			Diffraction, Types of Diffraction, Fresnel's diffraction, half-period zones, phasordiagramand integral calculus methods, the intensity distribution, Zone plates, diffraction due tostraight edge, Fraunhofer diffraction due to a single slit and double slit, Diffraction at NParallel slit, Plane Diffraction grating, Rayleigh criterion, resolving power of grating,Prism, telescope. Polarized light and its mathematical representation, Production of polarized light byreflection, refraction and scattering. Polarization by double refraction and Huygen˝stheory, Nicol prism, Retardation plates, Production and analysis of circularly andelliptically polarized light. Optical activity and Fresnel's theory, Biquartzpolarimeter.			✓	
			Laser system: Basic properties of Lasers, coherence length and coherence time, spatialcoherence of a source, Einstein's A and B coefficients, Spontaneous and induced emissions, conditions for laser action, population inversion, Types of Laser: Ruby and, He-Ne laser and. Applications of laser: Application in communication, Holography andBasics of non linear optics and Generation of Harmonic			✓	✓
	PHY402	Physics Lab-II				✓	
B. Sc. III Year/ V Sem. (Physics)	PHY501	Relativity, Quantum Mechanics, Atomic, Molecular and Nuclear Physics	Reference systems, inertial frames, Galilean invariance propagation of light, Michelson-Morley experiment, search for ether. Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition, variation of mass with velocity, mass-energy equivalence, particle with zero rest mass.			✓	
			Origin of the quantum theory : Failure of classical physics to explain the phenomena such as black-body˝ spectrum,˝ photoelectric effect, Compton effect, Wave-particle duality, uncertainty principle, de Broglie's hypothesis for matter waves, the concept of Phase and group velocities, experimental demonstration of matter waves. Davisson and Germer's experiment.Consequence of de Broglie's concepts, Bohr˝s complementary Principle, Bohr˝s correspondence principle, Bohr˝s atomic model, energies of a particle in a box, wave packets.Consequence of the uncertainty relation, gamma ray microscope, diffraction at a slit.			✓	✓
			Quantum Mechanics: Schrodinger's equation, Statistical interpretation of wave function, Orthogonality and normalization of wave function, Probability current density, Postulatory basis of quantum mechanics, operators, expectation values, Ehrenfest˝s theorem, transition probabilities, applications to particle in a one and three dimensional boxes, harmonic oscillator in one dimension, reflection at a step potential, transmission across a potential barrier.			✓	
			Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. Discrete set of electronic energies of moleculers, quantisation of vibrational and rotational energies, determination of inter-nuclear distance, pure rotational and rotation vibration spectra. Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration			✓	

			spectra. Raman effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy.				
			Structure of nuclei:- Basic Properties of Nuclei: (1) Mass_(2) Radii, (3) Charge, (4) Angular Momentum, (5) Spin, (6) Magnetic Moment (μ). (6) Stability and) Binding Energy, Nuclear Models:~ Liquid Drop Model, Mass formula, Shell Model, Types of Nuclear reactions, laws of conservation, Q-value of reactions, Interaction of Energetic particles with matter, Ionization chamber, GM Counter, Cloud Chambers, Fundamental Interactions, Classification of Elementary Particles, Particles and Antiparticles, Baryons, Hyperons, Leptons, and Mesons, Elementary Particle Quantum Numbers: Baryon Number, Lepton Number, Strangeness, Electric Charge, Hypercharge and Isospin, introductory idea of discovery of Higg‟s Boson.			✓	✓
B. Sc. III Year/ VI Sem. (Physics)	PHY601	Solid State Physics, Solid State Devices and Electronics	Amorphous and crystalline solids, Elements of symmetry, Seven crystal system, Cubic lattices, Crystal planes, Miller indices, Laue's equation for X-ray diffraction, Brage‟s Law, Bonding in solids, classification. Cohesive energy of solid, Madelung constant, evaluation of Parameters, Specific heat of solids, classical theory (Dulong-Petit‟s law), Einstein and Debye theories, Vibrational modes of one dimensional monoatomic lattice, Dispersion relation, Brillouin Zone.			✓	✓
			Free electron model of a metal, Solution of one dimensional Schrodinger equation in a constant potential, Density of states, Fermi Energy, Energy bands in a solid (Kronig- Penny model without mathematical details), Difference „between Metals, Insulator and Semiconductors, Hall effect, Dia, Para and Ferromagnetism, Langevin's theory of dia and para-magnetism, Curie-Weiss's Law, Qualitative description of Ferromagnetism (Magnetic domains), B-H curve and Hysteresis loss.			✓	✓
			Intrinsic and_ extrinsic semi conductors, Concept of Fermi level, Generation and recombination of electron hole pairs in semiconductors, Mobility of electrons and holes, drift and diffusion currents, p-n junction diode, depletion width and potential barrier, junction capacitance, I-V characteristics, „Tunnel diode, Zener diode, Light emitting diode, solar cell, Bipolar transistors, pnp and npn transistors, characteristics of transistors, different configurations, current amplification factor, FET and MOSFET Characteristics.			✓	✓
			Half and fall wave rectifier, rectifier efficiency ripple Factor, Bridge rectifier, Filters, Inductor filter, L and 1 section filters, Zener diode, regulated power supply using zener diode, Applications of transistors, Bipolar Transistor as amplifier, h-parameter, h- parameter equivalent circuit, Transistor as power amplifier, Transistor as oscillator, principle of an oscillator and Bark Hausen‟s condition, requirements of an oscillator, Wein-Bridge oscillator and Hartley oscillator			✓	✓
			Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gate, De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Digital to Analog Converter, Analog to Digital Converter.			✓	✓
	PHY 602	Physics Lab-III					✓

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CROSS CUTTING ISSUES

B.Sc. Physics (NEP)

Programme Name	Course Code	Course Name	Description	Cross Cutting Issues			
				Gender	Human Values	Professional Ethics	Environment & Sustainability
B. Sc. I Sem. Physics (NEP)	DSCPHY-01	DSC-Physics: Mechanics	**Fundamentals of Dynamics:** Reference frames, Inertial frames, Non-inertial frames and their characteristic properties, fictitious forces. Uniformly rotating frame. Centrifugal force and its applications, Coriolis force and its applications. Galilean transformations, Galilean invariance, Impulse.			✓	
			Rotational Dynamics: angular momentum of a rigid body , Angular momentum of a particle and system of particles. Physical significance of angular momentum, Relation between angular momentum and Torque, Relation between moment of inertia and angular momentum, Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, physical significance of moment of inertia , theorem of parallel and perpendicular axes related to moment of inertia, Kinetic energy of rotation.			✓	✓
			Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial mass, gravitational mass and their characteristic properties, Potential and field due to spherical shell and solid sphere **Motion of a particle under a central force field:** Central force and its characteristic properties , Two-body problem, its reduction to one- body problem. Kepler's Laws. Satellite in circular orbit,			✓	
			Oscillations: Definition and characteristic properties of SHM, Types of Oscillation, Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values,.			✓	✓
		DSC-LAB-I: Mechanics				✓	
	GECPHY-01	GEC-PHYSICS: GENERAL PROPERIES OF MATTER	**Recapitulation of Vectors and Ordinary Differential Equation:** Vector algebra, scalar and vector product, gradient of a scalar field, divergence and curl of vectors field.**:**			✓	
			Elasticity : Concept of stress and strain, Hooke's law, twisting torque on a wire, tensile strength, relation between elastic constants, Poisson's ratio,			✓	
			Gravitation and Central Force Motion: Law of gravitation. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere **Motion of a particle under a central force field:** Two-body problem, its reduction to one- body problem, Kepler's Laws. Satellite in circular orbit,			✓	
			Special Theory of Relativity: Postulates of Special Theory of Relativity, Lorentz transformation, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass, mass-energy equivalence			✓	✓
		GEC-LAB: GENERAL PROPERTIES OF MATTERS				✓	
			Electric Field and Electric Potential: Coulomb‟s law in vacuum expressed in Vector forms, dipole and Quadrupole, Gauss's law and its application: E due to (1) an Infinite Line of Charge, (2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge. **Dielectric Properties of Matter**: Dielectric , types of dielectrics , Polarization Vector P, Displacement vector **D**. Relations between **E**, **P** and **D**, Gauss' Law in dielectrics, Classisus Mossotti Equation,			✓	✓

B. Sc. II Sem. Physics (NEP)	DSCPHY-02	DSC-Physics: Electricity and Magnetism	**Magnetic Field**: Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole), Ampere‟s Circuital law (Integral and Differential Forms), Torque on a current loop in a uniform Magnetic Field.			✓	✓
			Electrical Circuits: Kirchhoff's Current Law& Kirchhoff's Voltage Law for AC circuits. power consumed by an a AC circuit, power factor. **Electromagnetic Induction**: Faraday's Law, integral and differential forms of Faraday's law, Transformers,			✓	
			Network theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem.			✓	✓
		DSC-LAB-II: Electricity and Magnetism				✓	
	GECPHY-02	GEC-PHYSICS: Mathematical Physics	**Fourier series:** Periodic functions. Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Fourier Cosine Series and Fourier Sine Series			✓	
			Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of integrals in terms of Gamma Functions			✓	
			Partial Differential Equations: Multivariable functions, Partial derivatives, Functions Solutions to partial differential equations, using separation of variables:			✓	✓
			Complex Analysis: Functions of complex variable, Analytic function, Cauchy-Riemann equations, singular points, Cauchy Residue Theorem, Cauchy's Integral Formula, Residues, Cauchy's Residue Theorem.			✓	
		GEC-LAB: Mathematical Physics				✓	
B. Sc. III Sem. Physics (NEP)	DSCPHY-03	DSC-Physics: Thermal Physics	**Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, , Zeroth Law of Thermodynamics & Concept of Temperature, First Law of Thermodynamics and its differential form, Internal Energy, Work Done during Isothermal and Adiabatic Processes, **Second Law of Thermodynamics:** Carnot's Cycle, Carnot Engine & efficiency, 2nd Law of Thermodynamics: Kelvin Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.			✓	
			Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics			✓	✓
			Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb‟s Free Energy. Their Definitions, Properties and Applications. Clausius Clapeyron Equation and Ehrenfest equations. **Maxwell's Thermodynamic Relations**: Derivation of Maxwell‟s thermodynamic Relations and their applications, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Value of Cp-Cv, (3) Tds Equations, (4) Energy equations.,			✓	
			Real Gases: Deviations from the Ideal Gas Equation. Andrew‟s Experiments on CO2 Gas, Virial Equation. Critical Constants.. van der Waal‟s Equation of State for Real Gases. Values of Critical Constants.. Free Adiabatic Expansion of a Perfect Gas. Joule- Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and vander Waal Gases. Temperature of Inversion. Joule-Thomson Cooling			✓	✓
		DSC-LAB-III: Thermal Physics				✓	✓
		DSE-PHYSICS: Digital System and Applications	**Digital Circuits:** Difference between Analog and Digital Circuits, Examples of linear and digital ICs, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers, AND, OR and NOT Gates (realisation using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.			✓	
			Boolean algebra: De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms and Maxterms, Conversion of Truth			✓	

	DSEPHY-01		table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **Data processing circuits:** Multiplexers, De-multiplexers, Decoders, Encoders.				
			Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement, Half and Full Adders, Half & Full Subtractors, 4-bit binary Adder/Subtractor. **Sequential Circuits:** SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip- Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip- Flop.			✓	✓
			Timers: IC 555 block diagram and applications: Astable multivibrator and Monostable multivibrator. **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel- in- Parallel-out Shift Registers (only up to 4 bits). **Counters (4 bits):** Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.			✓	
		DSE-I Lab Digital system and Applications				✓	✓
B. Sc. IV Sem. Physics (NEP)	DSCPHY-04	DSC-Physics: Waves and Optics	**Wave Motion:** Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. **Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle.			✓	✓
			Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities Normal Modes of Stretched Strings. Open and Closed Pipes**.**			✓	✓
			Interference: Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism.. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index, .**Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5)Visibility of Fringes. Fabry-Perot interferometer**.**			✓	
			Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Diffraction grating. Resolving power of grating. **Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave.. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral,. Straight edge, a slit and a wire.			✓	✓
		DSC-LAB-IV: Waves and Optics				✓	
	DSEPHY-02	DSE-PHYSICS: Mathematical Physics-II	**Complex Analysis:** Euler's formula, De-Moivre's theorem, Roots of Complex Numbers. and Cauchy-Riemann Equations. Examples of analytic functions. Singularities: poles, removable singularity, essential singularity, Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application of Contour Integration in solving Definite Integrals.			✓	
			Fourier Transforms:). Fourier Transform (FT). Examples: FT of single pulse, trigonometric, exponential and Gaussian functions. FT of derivatives, Inverse FT, Convolution theorem. Properties of FT s (translation, change of scale, complex conjugation, etc.). Solution of one-dimensional Wave Equation using FT. Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT)..			✓	✓
			Laplace Transforms: Laplace Transform Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations,			✓	
			Dirac delta function: Definition and properties. Representation of Dirac delta function as a Fourier Integral. Laplace and Fourier Transform of Dirac delta function			✓	
		DSE-II Lab Mathematical Physics-II				✓	
			Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Probability. Wave amplitude and wave functions.			✓	✓

B. Sc. V Sem. Physics (NEP)	DSCPHY-05	DSC-Physics: Elements of Modern Physics	Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. energy eigenvalues, eigenfunctions and their normalization;			✓	✓
			Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, N-Z graph, Liquid Drop model: semi-empirical mass formula and binding energy.			✓	✓
			Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay: Fission and fusion: mass deficit, Fission: nature of fragments and emission of neutrons. Fusion and thermonuclear reactions driving stellar evolution (brief qualitative discussions).			✓	✓
		DSC-LAB-V: Elements of Modern Physics				✓	
	DSEPHY-03	DSE-PHYSICS: Quantum Mechanics	Basic Postulates of Quantum Mechanics. Interpretation of the eigenvalues eigenfunctions, expectation values, orthonormality, completeness, Dirac bra and ket notation. Dirac δ function.			✓	
			Commuting operators, Unitary transformation. Matrix representation of operators. Time evolution and Schrodinger equation. The Schrodinger and Heisenberg pictures.			✓	
			Operator algebra method of finding energy eigenvalues and eigenstates of the linear harmonic oscillator. System of identical particles. Symmetric and antisymmetric wave functions. Pauli's exclusion principle. Slater determinant.			✓	✓
			Angular momentum in Quantum Mechanics: Commutation relations of angular momentum operators. Relativistic quantum Mechanics: Klien- Gordon and Dirac equation. Properties of Dirac matrices. Free particle solution of Dirac equation.			✓	
		DSE-III Lab Mathematical Physics-II				✓	
B. Sc. VI Sem. Physics (NEP)	DSCPHY-06	DSC-Physics: Solid State Physics-I	**Crystal Structure and Elementary Lattice Dynamics:** Amorphous and Crystalline Materials. Lattice with a Basis. Unit Cell. Types of Lattices. Miller Indices. Reciprocal Lattice. Diffraction of X- rays by Crystals. Bragg's Law.			✓	✓
			Elementary band theory: Band Gap. Conductors, Semiconductors and insulators. P and N- type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.			✓	✓
			Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferro- magnetic materials. Classical Langevin Theory of dia– and Para- magnetic Domains.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **Applications:** Piezoelectric, Pyroelectric, Ferroelectric, Ferromagnetic materials.			✓	✓
			Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability.Clausius Mossotti Equation. Classical Theory of Electric Polarizability. **Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors			✓	✓
		DSC-LAB-VI: Solid State Physics-I				✓	
	DSEPHY-04	DSE-PHYSICS: Analog System and Applications	**Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea) Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode.			✓	✓
			Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell,Qualitative idea of Schottky diode and Tunnel diode.			✓	✓
			Operator algebra method of finding energy eigenvalues and eigenstates of the linear harmonic **Bipolar Junction transistors:** n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical			✓	

			Mechanism of Current Flow..				
			Feedback in Amplifiers: Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators			✓	✓
		DSE-IV Lab Analog System and Applications				✓	