Dharmabad Shikshan Sanstha's

LAL BAHADUR SHASTRI MAHAVIDHYALAYA, DHARMABAD

PROFORMA FOR PROGRAM AND COURSE OUTCOMES (2.6.1)

Academic Year : 2020-21

Name Of the Teacher:- Mr. D S Waghmare

Department :- Physics

Program :- M.Sc I sem II Subject : Physics **Course Code** :- PHY 101

Paper Title :- Mathematical methods in physics

Unit No	Unit Name	Topics	Unit wise outcome
I	Vector spaces and matrices	Linear dependence and independence of vectors, Inner product, Schmidt's orthogonalization method. Matrices Inverse, Orthogonal, Hermitian and unitary matrices, Transformation of vectors and matrices, System of linear equations, eigenvalues and eigenvectors of square matrix, diagonalisation of a matrix, rotation matrix.	Students will able to undustand matrices
II	Special functions	i) Legendre equation, Rodrigues formula for Pn(x), generation functions and recurrence relation, Associated Legendre polynomial. ii) Bessel equation, Bessel function of first kind, generating functions and recurrence relation, Associated Legendre polynomial. iii) Hermite Equation, generating function and recurrence relation for Hermite polynomial. iv) Leguerre equation, generating function and recurrence relation, Rodrigue formula, Associated Lagurre polynomials.	Special functions Are going to be introduced deeply
III	Fourier Series and Integral Transform	Fourier series: General properties of Fourier series, Simple applications, properties of Fourier series, convergence, integration, differentiation. Fourier Transform, Laplace Transforms, Properties of Fourier and Laplace transforms (Linearity, first shifting and second shifting property), Fourier sine and cosine transforms, Fourier and Laplace transform of derivatives, elementary Laplace transform, Inverse Fourier and Laplace transforms, shifting theorm, step function, Solution of simple differential equation using Laplace Transform technique.	Fourier series is useful in physics for acoustic And optics Etc.
IV	Complex function and	Definition of complex function, exponential function and properties, circular function and	Student learn

	Calculus of Complex function	properties, hyperbolic function and properties, Inverse hyperbolic function, logarithmic function, limit of a complex function, continuity, derivative (theorm), anlytic functions, harmonic functions, complex integration, Cauchy's theorm, Cauchy's integral formula, Series of complex term-Taylor's series, Laurentz series. Zeros of an analytical function, Singularities of an analytical function (isolated, removable, poles and essential singularity), Residue Theorm-Calculus of residues	complex number

Specify Course outcome : After completion of this course students are capable of using the learned mathematical techniques to solve problems in physics such as the use and applications of matrices, the differential equations, the special functions, Fourier series and integral transform and complex functions. Students can apply these learned techniques not only to physics related problems but can extend the use and their applications to Engineering Science and Technology, Biotechnology, Biophysics etc.

Program outcome : Objective of the course is to introduce the students to various mathematical methods that are needed for understanding and deriving various aspects of the core and applied courses of Physics. This course is also aimed to develop knowledge in mathematical physics and its applications, to develop expertise in mathematical methods required in the study of Physics, to develop critical thinking and problem solving skill, to enable the students to formulate, interpret and draw inferences from mathematical solution.

Signature of Teacher

Name Of the Teacher:- Mr. P G Hore

Department :- Physics

Program : M.Sc I sem II **Subject** : Physic **Course Code** : PHY 102

Paper Title :- Classical Mechanics

Unit No	Unit Name	Topics	Unit wise outcome
I	Elementary Principles	Review of Newtonian mechanics, Inertial reference frame; Galilean transformations; Motion of a charged particle in electromagnetic field; Conservative and non-conservative forces; Mechanics of a single particle; Mechanics of a System of particles; Motion in a resistive medium; Constraints and its types; Generalized coordinates, cyclic coordinates and degrees of freedom; Virtual displacement and virtual work; D' Alembert's principle	To introduce the newtons laws of motions
II	Lagrangian Formulation	Lagrangian equation of motion from D' Alembert's principle, procedure for formation of Lagrange's equation; Variation technique; Generalized momenta and cyclic coordinates; Kinetic energy in terms generalized coordinates; Jacobi integral; Jacobi integral in terms of kinetic energy; Rayleigh's dissipation function; Gauge transformation for Lagrangian; Symmetry properties and conservation laws; Invariance of Lagrangian equations under Galilean transformation; Variational principle; Derivation of Lagrangian equation from Variational principle.	Equations of motions are learned by lagrangian
III	Hamiltonian Formulation and Central Force Hamiltonian Formulation	Transformation from Lagrangian to Hamiltonian; Derivation of Hamiltonian equations of motion from Hamiltonian principle; Δ Variation technique; Principle of least action; Canonical transformation; Condition for a transformation to be Canonical; Poisson brackets; Properties of Poisson's bracket; Poisson's bracket of Canonical variables; Jacobi identity; Poisson's theorem; Invariance of Poisson's bracket under canonical transformation; Hamilton-Jacobi method.	Equations of motions are learned by Hamiltonian
IV		**Central Force** Reduction of two-body problem into one-body problem; equation of motion under Central force; equation of Orbit; inverse square law; Kepler's laws of planetary motion; Virial theorem; Scattering in a central force field; Rutherford scattering cross section.	Students able to understand Keplers laws of motions

Specify Course outcome After completion of the course the students shall be able to apply Newton's laws of motion to solve complicated problems involving multiple bodies and use the concepts of classical mechanics to the classical rigid bodies.The knowlede acquired through this course will enable the students to lay the foundation of application of the classical dynamics, space dynamics and also for modern physics.

Program outcome The main objective of this course is to introduce the students to apply mathematical formulation of mechanics problems and to interprete the solutions physically, to apply the concepts of classical mechanics to the rigid systems and to develop the skill of critical thinking and problem solving.

Signature of Teacher

Name Of the Teacher: Mr. H N Lakhamawad

Department :- Physics

Program : M.Sc I sem I Subject : Physics **Course Code** : PHY 103

Paper Title : Atomic and Molecular Physics (Core-3)

Unit No	Unit Name	Topics	Unit wise outcome
I	Atomic structure and atomic spectra Spectra of Monovalent atoms	Quantum mechanical results of hydrogen atom, Atomic spectra of Hydrogen, Quantum numbers and their role, atomic orbitals, orbital and spin angular momenta., spin orbit interaction, vector atom model, spectroscopic terms and their notations, Fine structure in hydrogen energy levels, spectra of alkali elements, different series in alkali spectra. The doublet fine structure. **Spectra of Divalent atoms** Coupling scheme, L-S and j-j coupling, Building up principle: the Aufbau principle, Equivalent and non-equivalent electrons: Pauli's exclusion principle, Hund's rules. spectral terms, Breit's scheme **Magnetic and electric field effects** Normal and anomalous Zeeman effect, Lande g factor, Interaction energies's, Paschen Back effect, interaction energy, co-relation between Zeeman and Paschen Back effects, Stark effect with weak and strong field, Hyperfine structure.	Students will understand the atomic structure and models
II	Microwave Spectroscopy of Molecules	Preliminaries, Types of molecules Diatomic molecules -Rotational spectra of diatomic molecule, Rigid rotator and Non-rigid rotator, energy levels, selection rules and resulting spectra, the effect of isotopic substitution, Intensities of spectral lines in rotational spectra, Polyatomic molecules - Linear molecules, determination of inter-atomic distances using isotopic substitution, Symmetric top molecules: calculation of energy, selection rule, spectra. Microwave spectrometer, problem solving	Spherical top molecule have no net dipole moment
III	Infrared and Electronic spectroscopy of molecules Vibrational spectroscopy of diatomic molecules	Vibrational energy of diatomic molecule, the simple harmonic oscillator model energy The anharmonic oscillator, Morse potential curve, Energies, selection rules, spectra, frequencies of fundamental and overtones and hot band The diatomic vibrating rotator with and without Born-Oppenheimer approximation, energy levels, selection rules, P, Q and R branches. **Polyatomic molecules** Fundamental vibrations and their symmetry, CO_2 and H_2O molecules, techniques and	It is applied in clocks as an oscillator

		instrumentations, IR spectrometer **Electronic spectra of diatomic molecules** Born-Oppenheimer approximation, vibrational coarse structure of electronic bands, progressions and sequences, P, Q and R branches. The band head formation and shading of bands, Franck Condon principle, dissociation energy and dissociation products,	
IV	**Raman spectroscopy of molecules**	Introduction, quantum theory of Raman Effect, classical theory of Raman effect, molecular polarizability, **Pure rotational Raman spectra** linear diatomic molecules, intensity alteration in Raman spectra of diatomic molecules, Raman spectra of symmetric top molecule, R and S branches in Raman spectra **Vibrational Raman spectra** Raman activity of vibrations (H2O and CO2 molecules), rule of mutual exclusion, nature of polarized light, structure determination from Raman and infra-red spectroscopy, Experimental setup for Raman spectroscopy	Raman spectroscopy has wide variety of applications in biology and medicine

Specify Course outcome: Upon successful completion of these modules, students will be able to understand and explain the following;
1. The atomic spectra of one valance electron atoms.
2. what is meant by LS and JJ coupling in case of two valance electron atoms and the origin of spin orbit interaction.
3. Use appropriate quantum numbers for labeling of energy levels/terms symbols.
4. The change in behavior of atoms in external applied electric and magnetic field.

Specify Program outcome Atomic and molecular physics is of great importance and very basic field in physics. The basic of all matter, which exist in nature, is based on atomic and molecular structure. It is one of the most important subjects for the testing grounds of the quantum theory. It helps in understanding, many fields of science and technology, namely spectroscopy, Laser Physics & Technology, Plasma Physics, Nuclear physics, Particle Physics, Astrophysics, Condensed Matter Physics and Material Sciences, Metrology, Biosciences, Atmospheric Sciences, Chemical sciences, biological physics, energy research and fusion studies. Specific objectives are:

1. To introduce the world of atoms and molecules to the students.

2. To focus on development of various atomic models and to explain the importance and application of Bohr atomic model for atomic spectra of hydrogen like atoms.

3. To shed light on various basic concepts like vector atomic model, introduction of spin, coupling schemes for many electron atoms, term symbols to designate quantum states.

4. To bring into notice the basic concepts of molecular spectroscopy and their types, origin of

rotational, vibrational , electronic and Raman spectra of various molecules and to explain the importance of polymeric materials to humanity and molecules

5. To introduce the working principle of various spectroscopic techniques and instrumentation used for analyzing spectra of various types of molecules.

Signature of Teacher

Name Of the Teacher: Mr. V S Pabboj

Department :- Physics

Program : M.Sc I sem I **Subject** : Physics **Course Code** :PHY 104

Paper Title : Electronic device and applications

Unit No	Unit Name	Topics	Unit wise outcome
I	Semiconductor Devices	Fundamentals of semiconductor: Classification based on band gap (insulator, conductor and semiconductor), n-type and p-type semiconductors, understanding p-n junction Devices: Structure and characteristics of diodes, bipolar transistors, field effect transistor, metal oxide field effect transistor, uni-junction transistors and silicon control rectifier Applications of semiconductor devices as amplifiers and oscillators	Majority students passed
II	Photonic Devices	Basics of photonic devices: Direct and Indirect band gap of semiconductor, radiative transitions, photoconductors Photodiodes, Phototransistor and Photo-detectors (construction, working and application) Light emitting diodes (Visible and Infrared) Solar cells (Solar radiations and ideal conversion efficiency P-N junction solar cell, spectral response, I-V characteristics)	Majority students passed
III	Operational Amplifier & Its Applications	OP-AMP parameters, ideal OP-AMP, differential amplifier OP-AMP as an 1) Inverting amplifier 2) Non –Inverting amplifier 3) Adder 4) Subtractor 5) Differentiator 6) Integrator 6) Schmitt trigger 7) Comparator Applications of OP-AMP as active filters: First order High pass, Low Pass & Band Pass Filters	Majority students passed
IV	Digital Electronics	Number system: Binary, Decimal & Hexadecimal no. system and its algebra, Logic devices: AND, OR, NOR, NAND, XOR (Symbols, working and truth tables) Registers: Flip–flop-R-S, J-K, T, D (logic symbols, working and truth tables) Shift registers: 4-bit left to right and right to left Digital counters: Synchronous and asynchronous Encoder and decoder: 1:4 and 4:19 (logical diagram and truth table) Multiplexer and demultiplexer: Logical diagram and truth table DAC: R-2R ladder network ADC using comparators Monostable and astable multivibrators using IC555 Application of Digital devices: Microprocessor	Majority students passed

Specify Course outcome : After completion of this course, students will be able to explain the working principles and application of various electronic devices used in various electronic gadgets of domestic uses. They will also understand the construction, working and operational characteristics of semiconductor devices and their applications in advanced electronics industries. The students will also understand the utility and functioning of the microprocessors, the heart of the advanced computing machines.

Specify Program outcome : This paper is aimed to enhance comprehension and application capabilities of the electronic devices that are being used in day to day life in the form of various gadgets like, mobile phone, television, microwave, calculators, computer, etc. This paper is designed with an objective to expose students to the basics and advancements in the electronic device technology and to inculcate them towards future device technology/research

Signature of Teacher

Name Of the Teacher:- Ms. G T Jinklor

Department :- Physics

Program : M.Sc I sem II **Subject** : Physics **Course Code**- PHY 201

Paper Title : Quantum Mechanics

Unit No	Unit Name	Topics	Unit wise outcome
I	**Module-I:**	Derivation of time dependent and time independent Schrodinger equation, Physical significance of wave function, Quantum numbers, Postulates of Quantum Mechanics, Commutation relations for position and momentum operator, Dirac Delta function and its properties, Ket and Bra notations, ssCompleteness of eigen functions, Matrix representation of an operator, Unitary Transformation.	Students will understand the basic concepts of QM
II	Angular Momentum	Angular momentum and rotations, Orbital angular momentum, Spin angular momentum, Rotational symmetry and conservation of angular momentum, Commutation relations for Spin, orbital and total angular momentum, Ladder operators, eigen values of the angular momentum operators; L2, Lz, J2, Jz, J+ and J-, Reflection invariance and Parity, Addition of two angular momenta– Clebsch – Gorden Coefficient , calculation of C.G.coefficient	Students can apply the QM to many quantum mechanical systems
III	Approximation methods	a) **Time independent Perturbation Theory** Stationary perturbation theory, Non-degenerate case; First order correction to energy, First order correction to wave function, Second order perturbation, and corrections, Stark effect in the ground state of hydrogen atom, Time independent perturbation theory: degenerate case, application for the He atom, degenerate case – Stark effect. (b) **Time dependent perturbation Theory** Zero order perturbation, First order perturbation, second order perturbation, Fermi Golden rule, adiabatic and sudden approximation. (c) **Variational Method** The basic Principle, expectation value of energy in ground state, application to excited state, application to two electrons atom, (d) **WKB approximation** The classical limit, One dimensional case, turning point, connection formulae, the application to	Will be able to solve many problems in QM

		bound	
IV	**Collision in 3-d and Scattering**	Laboratory and Centre of Mass reference frames, scattering amplitude, differential scattering cross section, total scattering cross section, Asymptotic form of scattering states, Relation between angles and cross sections in the laboratory and center of mass systems, Scattering by spherically symmetric potentials, Integral equation of scattering, The Born approximation, Partial Waves and Phase shifts, Scattering by a perfectly rigid sphere and by square well potential, Complex potential and absorption. Identical particles, symmetric and asymmetric wave functions and their construction for N particle system, Slater's determinant, Collision of identical particles (Mathematical derivations are not expected)	Some of the advanced concepts can be understood by the students

Specify Course outcome : Upon successful completion of these modules, students will be able to understand, that quantum mechanics is basic of many branches of Physics and will be able to apply quantum, theory to other applied areas like nuclear physics, atomic and molecular physics, solid state physics, laser physics etc. The students will be able to relate the ideas and concepts from physics to chemistry, materials science and engineering. Students will be able to use quantum theory to model natural and physical phenomena in materials science, chemistry and nanotechnology. Students will be able to understand and explain the differences between classical and quantum mechanics. They will be able to understand the idea of wave function and to solve Schrodinger equation for simple potentials

Specify Program outcome: Quantum mechanics helps to understand of number of aspects of physics, chemistry, and modern technology.

1. To introduce the physical principles and the mathematical background important to quantum, **mechanical descriptions**.
2. To introduce the mathematical properties of the waves that describe free particles
3. To give basic understanding of the basic postulates of quantum mechanics which are helpful to formalize the rules of quantum mechanics.
4. To explain the importance and applications of quantum mechanics to various industries.

Signature of Teacher

Name Of the Teacher:- Mr. V S Pabboj

Department :- Physics

Program : M.Sc I sem II **Subject** : Physics **Course Code** : PHY202

Paper Title : Statistical Mechanics

Unit No	Unit Name	Topics	Unit wise outcome
I	**Classical Statistics**	**Fundamentals** Foundation of statistical mechanics, specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox **Ensembles** Micro canonical ensemble; phase space; trajectories and density of states; Liouville's theorem; Canonical ensemble and Grand Canonical ensemble; partition function, Calculation of statistical quantities, Energy and density fluctuations. Maxwell-Boltzmann System: Maxwell-Boltzmann distribution formula; evaluation of constants and, Maxwell-Boltzmann velocity distribution formula;	Students are able to apply the statistical mechanics at micro and macro level
II	**Quantum Statistics**	Density matrix, statistics of ensembles,statistics of indistinguishable particals Fermi-Dirac Gas:- Fermi Dirac distribution formula, ideal F.D. gas, Weakly degenerate Fermi gas; Strongly degenerate Fermi gas; thermodynamic functions of degenerate F.D. gas, Thermionic emission; electron gas, Free electron model, Photo electric emission, Pauli's theory of Para magnetism, Statistical equilibrium in a white dwarf star	Students are able to apply the statistical mechanics at quantum level
III		Bose-Einstein Gas :-Bose-Einstein distribution formula, Ideal B.E. gas, Black body radiation, Photon statistics, Phonon statistics, B.E. condensation, liquid helium, London Theory, Tisza's two fluid model, Landau's theory.	Students are able to understand the statistical problems and solve them
IV		Cluster expansion for a classical gas, Virial equation of state, Ising model, mean field theories, Ising model in one, two, three dimensions, exact solution of one dimension.**Phase Transitions:** Landau's theory of phase transition, Critical indices, Fluctuations and transport phenomena, Brownian motion, Langevin's theory, fluctuation dissipation theorem, The Fokker-Plank equation	Will be able to apply statistical mechanics at advanced level

Specify Course outcome : **T**he main outcome after learning the course is that students can apply and extend concepts learned in this course to theoretical physics. Students will be well acquainted with the particle nature on the basis of distribution laws and their uses in order to illustrate propertis of most exotic systems like white dwarf stars, superfluid materials, etc.

Specify Program outcome The main objective of this course is that students will be well aware of studying physical properties of matter “in bulk” on the basis of dynamical behaviour of its microscopic constituents. Fundamentals of heat and laws of thermodynamics with the help of statistics will be covered in order to obtain physical properties on the basis of distribution laws including their applications in view of classical and quantum statistics. The course also includes basics of phase transition with their applications.

Signature of Teacher

Name Of the Teacher: Mr. D S Waghmare

Department :- Physics

Program : M.Sc I sem II **Subject** : Physics **Course Code** : PHY 203

Paper Title : Numerical Techniques in Physics

Unit No	Unit Name	Topics	Unit wise outcome
I	Module-I:	**Curve fitting and interpolation** The Principle of Least squares, fitting a straight line, fitting a parabola, fitting an exponential curve, fitting curve of the form y=axb, fitting through a polynomial, Cubic spline fitting, Linear interpolation, difference schemes, Newton's forward and backward interpolation formula. **Roots of equation** Polynomial and transcendental equations, limits for the roots of polynomial equation. Bisectional method, false position method, Newton Raphson method, direct substitution method, synthetic division, complex roots.	numerical techniques to solve problems in physics related to the applications like data handling
II	Module-II	**Numerical integration** Newton cotes formula, trapezoidal rule, Simpson's one third rule, Simpson's three eight rule, Gauss quadratics method, Monte Carlo method. **Solution of differential equation** Taylor series method, Euler method, Runge Kutta method, predictor-corrector method	numerical techniques to solve problems in physics related to the applications like data handeling and
III	Module-III	**Solution of simultaneous equation**: Gaussian elimination method, pivotal condensation method, Gauss-Jordan elimination method, Gauss- Seidal iteration method, Gauss-Jordan matrix inversion method, Gaussian-elimination matrix inversion method **Eigen values and eigenvectors of a matrix** Computation of real eigen values and corresponding eigenvectors of a symmetric matrix, power method and inverse power method. **Partial differential equations** Difference equation method over a rectangular domain for solving elliptic, parabolic and hyperbolic partial differential equation	solving the differential and integral equations, simultaneous equations and partial differential equations
IV	Module-IV:	**C- Programming** Elementary information about digital computer	solving the differential

		principles, compliers, interpreters, and operating systems, C programming, flow charts, integer and floating point arithmetic, expression, build in functions, executable and non-executable statements, assignment, control and input-output elements, user defined functions, operation with files: pointers **Random numbers**: Random numbers, Random walk, method of importance sampling.	and integral equations, simultaneous equations and partial differential equations

Specify Course outcome : After completion of the course students shall be able to employ the studied numerical techniques to solve problems in physics related to the applications like data handling and fitting, finding solutions and root of equations, solving the differential and integral equations, simultaneous equations and partial differential equations. They shall also be well versed with writing their programmes using C-language of computer programming. Students can apply these learned techniques not only to physics related problems but can extend the use and their applications to Engeering science and technology, Biotechnology, Biophysics etc.

Specify Program outcome The main objective of the course is to introduce students to the useful numerical methods and tools that are being adopted for handling data in Physics. The course also aimed to introduce the students to C-Programing language, which is an essential tool for handling and solving numerical problems in physics.

Signature of Teacher

Name Of the Teacher: Dr. A G Chawhan

Department :- Physics

Program : M.Sc I sem II **Subject** : Physics **Course Code**:- PHY 204

Paper Title : Condensed Matter Physics

Unit No	Unit Name	Topics	Unit wise outcome
I	Crystal structure, X-ray diffraction and Crystal imperfections	**Crystal structure** Basic of crystal structure, Bravais lattices in two and three dimension Some important crystal structure: Simple cubic (SC), Body centered cubic (BCC), Face centered cubic (FCC), Hexagonal close packed (HCP), NaCl and diamond structure Miller indices and spacing between set of a crystal planes**X-ray diffraction and Reciprocal lattice** Generation and interaction of X-ray, Braggs law and experimental methods: Laue method, Rotating crystal method, powered method Reciprocal lattice and diffraction condition Atomic scattering factor and Geometrical structure factor **Crystal Imperfections** Point defects, line defects and Surface defects Energies of dislocations	After completing the course students will have knowledge of different types of solids and an understanding of how their microscopic structure
II	Band theory and Fermi Surface	**Band theory** Electron motion in crystal (one dimensional) Bloch theorem and implementation in Kroning-penny model Concept of effective mass, Concept of holes Metals, insulators and semiconductor Other model and methods **Fermi Surface** Fermi surface and Brillouin zones, Experimental determination of Fermi surface	Students will able understand the Band theory
III	Semiconducting, Dielectric and optical properties of materials	**Semiconductor:** Basics of semiconductors: Carrier concentration in semiconductors and impurity states, Fermi level position as a function of charge carrier concentration	in semiconductor their resistivity is higher than conductor
IV	Superconductivity and Magnetic properties of	**Superconductivity** Introduction to superconductivity Meissner effect, Critical temperature and persistent	Students will able understand the Superconductivity

	materials	current Type-1 & Type-II superconductors The London theory, BCS theory, Cooper pair Flux quantization **Magnetic properties:** Origin of Magnetic properties of materials, Magnetic susceptibility, Curie Weiss law for susceptibility, Classification of magnetic materials, Weiss molecular field theory of ferromagnetism, Heisenberg model, Ferromagnetic domain and Hysteresis, Closure domains, Exchange interactions in Ferromagnets, The Bloch wall and Bloch wall energy, Antiferromagetism: two sublattice model, Neel temperature, Susceptibility below Neel temperature, Ferrimagnetism: Structure of ferrites, Spin arrangement in FerriteSpin waves and magnons.	

Specify Course outcome : After completing the course students will have knowledge of different types of solids and an understanding of how their microscopic structure affects their mechanical, thermal and electrical properties

Specify Program outcome The main objective is to provide an overview of different types of materials and illustrate how their properties depend on the microscopic structure. The course will deliver basic knowledge, but it should also serve as an orientation on the current issues in the different branches of condensed matter physics, providing additional arguments for the choice of master thesis topic.

Signature of Teacher

Dharmabad Shikshan Sanstha's

Lal Bahadur Shastri Mahavidyalaya, Dharmabad. 431809

Pro-forma for program and course outcomes (2.6.1) for academic year 2020-21

Name of Teacher: Mr. H N Lakhamawad

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem III **Subject:** Physics **Course Code:** PHY 301

Paper Title: Electrodynamics

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Maxwell equations and Electromagnetic waves	Maxwell's equations and their physical significance, Equation of continuity & relaxation time, Vector and scalar potentials, Lorentz and Coulomb gauge, gauge transformation, electromagnetic energy and Poynting's theorem, electromagnetic wave equations in free space, their plane wave solutions, waves in conducting medium: skin effect and skin depth, waves in ionized medium (ionospheric propagation), polarization of EM waves, Concept of radiation pressure	Students will be able to understand the Maxwell's equations
2	Electromagnetic waves in bounded media	Reflection and refraction of plane electromagnetic waves at a plane interface: normal incidence, oblique incidence, Fressnel's equations, Brewster's angle. Total internal reflection, Reflection and refraction from metallic surfaces, Electromagnetic wave propagation between two parallel conducting plates, waves in hollow conductors, Rectangular wave guides - TE and TM modes.	Students will be able to apply Maxwell's equations to various concepts
3	Radiations from moving charges	Concept of retarded potential, The Lienard-Wiechert potentials, Field produced by moving charges, radiation from a linearly accelerated charged particle at low velocity, radiation from accelerated charged particles at low velocities in circular orbits-Larmor formula, radiation from accelerated charged particles at relativistic velocities in circular orbits-relativistic generalization of Larmor formula Multipole expansion of EM field, Electric dipole radiation, field due to oscillating electric dipole, magnetic	Students will be able to understand the electric potentials and radiations

		dipole radiations, electric quadrupole radiation, fields due to linear centre-fed half wave and full wave antenna, array of antennae	
4	Covariance and Relativistic Electrodynamics	Basic kinematical results of special relativity (length contraction, time dilation, addition of velocities, charge invariance, field transformation), relativistic momentum and energy of a particle, 4-vectors in electrodynamics, 4-potential and 4-current, electromagnetic field tensor, Lorentz force and equation of motion of a charged particle in an electromagnetic field, Covariance of Maxwell's equations, transformation of EM fields and field tensor. Electromagnetic wave equation and plane wave solution in 4-vector form.	Students will be able to understand and apply the relativistic concepts in electrodynamics

Course Outcome: Upon successful completion of this course students will be able to apply the knowledge of Maxwell’s equations to a variety of problems including various types of charge distributions including time-dependent processes, tackle the problems related to the propagation and scattering of EM waves in a variety of media, understand how to design EM sources of different powers, and will also be ablle to have a good understanding of the relativistic electrodynamics.

Program Outcome: Student after completing their post graduation in Physics (M Sc Physics) will

1. be eligible to get employment as an assistant professor, teacher, in private, semi government, government colleges and schools after fulfilling the requirements and can rise up to the top positions

2. pursue their higher studies in related fields including M Phil, Ph D in the national and international universities depending upon the eligibility conditions of the concerned universities.

3. work as research fellow, scientist in research institutes and carry out research after qualifying the NET/SET/PET examinations.

4. handle standard and advanced laboratory equipment, modern instrumentation and classical techniques to carry out experiments.

Signature of Teacher:

Name of Teacher: Mr. V S Pabboj

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem III **Subject:** Physics **Course Code:** PHY 302

Paper Title: Nuclear and Particle Physics

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Basic Nuclear Properties and Interaction of Radiation with Matter	Basic Nuclear Properties: Nuclear mass, Nuclear size , Nuclear Radius & its determination by Rutherford scattering, electron scattering & mirror nuclei method, Nuclear quantum numbers, Angular momentum, nuclear dipole moment, electric quadruple moment, Nuclear Binding , average binding energy and its variation with mass number, Semi empirical mass formula & its applications.	Students will get introduced to structure of nucleus
2	Interaction of nuclear radiation with matter and elementary particles	Interaction of charged particles & electromagnetic rays with matter, range, straggling, stopping power, interaction of alpha, beta, gamma rays with matter, absorption law of gamma rays, photoelectric effect, Compton effect, pair production, annihilation of electron- positron pair, Nuclear Detectors: Classification, Ionization chamber: Principle, construction and working, Proportional counter: Principle, construction and working, Geiger Muller counter: Principle, construction and working (pulse formation, dead time, recovery time etc), quenching of discharge, Regions of multiplicative operations, Scintillation Detector: photo multiplier tube, organic and inorganic scintillators, scintillation process, theory, characteristic and detection efficiency Semiconductor Detector: properties, types (diffuse junction and surface barrier), Li- drifted junction detector Elementary particles: classification, their interaction, types: weak, strong and electromagnetic interactions, their quantum numbers (charge, lepton number, baryon number, iso-spin, strangeness etc), conservation laws: elementary ideas of CP and CPT invariance, Quark theory: assumptions, properties, classification, Gell- Mann mass formula colour of quark & its importance.	Establishes an understanding of radiation, matter interactions and it introduces various elementary particles
3	Nuclear Forces and Nuclear Models	Nuclear Forces: Introduction , properties, characteristics, spin dependence of nuclear forces, charge independence & charge symmetry of nuclear forces, Elements of two body problem (Deuteron),	Introduces properties and structure of nucleus

		its properties, Meson theory of nuclear forces, exchange force and tensor forces, its properties, neutronproton scattering at low energy, partial wave analysis, phase shift. Nuclear Models: Nuclear shell model: spin orbit coupling, nuclear magic numbers, experimental evidences of magic numbers, Angular momenta and parities of nuclear ground states, significance, achievements and limitations, magnetic moment and Schmidt lines. Liquid drop model: assumptions, achievements, Bohr Wheeler theory of fission, Failure and limitations of liquid drop model, Collective model: vibration and rotation states, achievements of Bohr and Mottelson collective model Fermi gas model: assumptions, achievements, limitations of Fermi gas model	
4	Nuclear decay & Nuclear decay Reactions	Radioactive decay, laws of successive transformation, dosemetry, nuclear reactions: types, kinematics, transmutation, fission & fusion concept, energy production in stars, P-P and C-N cycles. β – decay, three forms of β- decay, Fermi and Gamow Teller transitions, Fermi theory of β- decay, Kurie plot, Angular momentum and parity, selection rules, allowed and forbidden transitions, non conservation of parity in β- decay, neutrino hypothesis: detection and properties.	Students will understand concept of nuclear radiation

Course Outcome: After the completion of the subject the students are able to know its Scientific and technological applications in addition with social, economic and environmental implications.

Program Outcome: Student after completing their post graduation in Physics (M Sc Physics) will

1. be eligible to get employment as an assistant professor, teacher, in private, semigovernment, government colleges and schools after fulfilling the requirements and can rise up to the top positions

2. pursue their higher studies in related fields including M Phil, Ph D in the national and international universities depending upon the eligibility conditions of the concerned universities.

3. work as research fellow, scientist in research institutes and carry out research after qualifying the NET/SET/PET examinations.

4. handle standard and advanced laboratory equipment, modern instrumentation and classical techniques to carry out experiments.

Signature of Teacher:

Name of Teacher: Prof. A G Chawhan

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem III **Subject:** Physics **Course Code:** PHY 303

Paper Title: Basics of Lasers and Devices

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Basics of Laser	Introduction, Interaction of Light and Matter, Quantum Behavior of Light, Energy Levels, Population, Thermal Equilibrium, Absorption and Emission of Light, Einstein's prediction and three processes, Light Amplification, High Intensity, Einstein's Relations, Conditions for Large Stimulated Emission, Conditions for Light Amplification, Population Inversion, Pumping, Pumping Methods: Optical; Electrical; Direct Pumping, Active Medium, Metastable States, Pumping schemes, Properties of Laser-Directionality, Intensity, Coherence, Monochromaticity, Polarization	Students will get introduced to basics of lasers
2	Optical Resonator and Laser Cavity Modes	Optical Resonator: Introduction, Action of Optical Resonator, Threshold Condition, Critical Population Inversion, Condition for Steady State Oscillation, Cavity Resonance Frequencies, Line Broadening Mechanism, Natural or Intrinsic Broadening, Collision Broadening, Doppler Broadening, Laser Cavity Modes: Introduction, Cavity Configuration, Modes: Longitudinal and Transverse Modes, Single Mode Operation, Laser Rate Equation: Two Level System, Three Level System and Four Level System, Comparison of Three Level System and Four Level Lasers, Optimum Output Power, Properties of Laser Modes,	Introduces the properties of Laser
3	Types of Laser	Introduction, Solid State Laser:- General Description, Structure and Working: Ruby Laser, Nd: YAG Laser, Nd: Glass LaserGas Laser:- General Description, Structure and Working of : He-Ne Laser, Argon Laser, CO2 Laser Semiconductor lasers-Population inversion, pn junction, Lasing condition, Gain in a semiconductor, Optical cavity, Threshold condition for lasing, Threshold population inversion, and current density, Power output, Efficiency, Basic Laser structure, Diode laser operation	Introduces many types of Lasers
4	Application of lasers	Application of lasers : Introduction, optical fiber lasers (Low and High Power) for Industrial,	Students will be able to understand

		Medical and Communication applications, High Power Gas Lasers Material Processing with Lasers – Surface treatments, Drilling with Lasers, Cutting Process with Lasers, Laser Welding Process Lasers in Nuclear Energy: Nuclear Fusion, Nuclear Fission, Laser in Isotopes Separation Lasers in Medicine and surgery: Biological Effect of Electromagnetic Radiation , Laser Diagnostics, Lasers in Electronics industry Lasers in Consumer Electronics industry	applications of Lasers

Course Outcome: After the completion of the subject the students are able to know its Scientific and technological applications in addition with social, economic and environmental implications.

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2. pursue their higher studies in related fields including M Phil, Ph D in the national and international universities depending upon the eligibility conditions of the concerned universities.

3. work as research fellow, scientist in research institutes and carry out research after qualifying the NET/SET/PET examinations.

4. handle standard and advanced laboratory equipment, modern instrumentation and classical techniques to carry out experiments.

Signature of Teacher:

Name of Teacher: Dr. D N Rander

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem III **Subject:** Physics **Course Code:** PHY 304-B

Paper Title: Materials Science

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Types of Materials and Glasses	Materials Science: Introduction, Importance of materials, Types of materials, Typical materials behaviour, significant properties, Applications. Glass: Types of glasses, Glass Manufacturing process, Ceramics: Types of ceramics, Processing ceramics, Concrete: properties of concretes, Constituents of concretes (Cement, Aggregate, Water, Admixtures), Characteristic of good concrete, Classification of concrete, properties of cement concrete, water proof concrete, R.C.C (properties, advantages and disadvantages, uses), Adhesives, abrasives, Application of concretes	Students will get introduced to types of magnetic materials
2	Magnetic and Bio Materials	Magnetic Materials: Terms related to Magnetic Materials, origin of magnetism, Classification of magnetic materials, Magnetic Domains, Magnetization, Magnetic anisotropy, Losses in magnetic materials, Factors effecting permeability and Hysteresis loss, soft and hard magnetic materials, Ferro fluids. Bio Materials :General aspects of good timber, Advantages and disadvantages of Timber, Uses of timber, Defects in timber, seasoning of timber, Decay of timber, Testing timber. Play-wood, Lamin board, Black board, Fiber board, Hard Board.	Introduces basic properties of magnetic and bio-materials
3	Dielectric and Ferroelectric Materials	Dielectric as an electric field medium, Leakage currents, Dielectric losses, Breakdown voltage and Dielectric strength, break down in solid dielectrics, liquid dielectrics, Gases as dielectrics, polarization, Electrical conductivity in solid liquid and gaseous dielectrics. Applications of dielectric materials. Common ferroelectric materials, Properties of ferroelectric materials in static field, spontaneous polarization, causes for existence of curie temperature, application of ferroelectric materials. Antiferroelectric materials, piezoelectric materials, pyroelectric materials.	Introduces the dielectric materials and their applications
4	Materials	Solid State Reactions:general principles, processes	Students will be

	Synthesis	of the reactions between solids, precursor, solution and gel methods, sealed tubes and special atmospheres, solution and hydrothermal methods, phase diagram and synthesis. Low temperature reactions, intercalation in layer structures, insertion compounds of metal oxides, ion exchange methods. Synthesis by different wet chemical techniques viz., sol-gel, combustion, emulsion and polyol methods, Self-propagation combustion reaction, precursor dependent process, Microwave assisted process, Hydrothermal bomb calorimeter-hydrothermal and solvo-thermal process, Interfacial growth materials between the two immiscible phases,	able to understand synthesis of many materials and able to apply these methods at industry level

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Signature of Teacher:

Name of Teacher: Mr. H N Lakhamawad

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem IV **Subject:** Physics **Course Code:** PHY 401

Paper Title: Fiber Optics and Optical Fiber Communication

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Elementary Theory of Optical Fibers	Ray Theory of transmission and preparation of optical fibers: Propagation of light in different media : propagation of light in an optical fiber, Basic structure and optical path of an optical fiber, Acceptance angle and acceptance cone, Numerical aperture(NA) (General), Modes of propagation, Meridional and skew rays, Number of modes and cut-off parameters of fibers. Fiber Fabrication Techniques : Chemical vapour deposition technique, Double cruciblemethod.	Introduces many concepts of transmission media for optical fiber communication
2	Losses, Dispersion in Fibers, Sources and Detectors for Optical Fiber	Fiber Losses : Attenuation in optic fibers, Materials or impurity losses, Rayleigh scatteringlosses, Absorption loss, Leaky modes, Bending losses, Radiation losses. Dispersion in optical fiber : Electrical Vs. optical bandwidth. Bandwidth-length product, Intermodaldispersion, Mixing modes, Material chromatic dispersion. Light Sources and Detectors for Optical Fiber Light Sources : Introduction, LED (Light Emitting Diode), Processes involved, structurematerial and output characteristics of LED, Fiber LED coupling, Bandwidth, Spectral emission of LEDs, LASERS : Operation types, Spatial emission pattern, Current Vs. output characteristics. Detectors : Introduction, Characteristics of photodetectors (General), hotoemissive type, Photoconductive and photo voltaic devices, PN junction type, PIN photo diode, Avalanche photo diode (APD).	Introduces many concepts related to transmission of light through optical fiber and detectors
3	Fiber Optic Sensors, Communication Systems and Modulation	Fiber optic sensors : Introduction, Fiber optic sensors, Intensity modulated sensors, Micro bend strain intensity modulated sensor, Liquid level type hybrid sensor, internal effect intensity modulated sensor, Diffraction grating sensors and Interferometric sensors. Communication systems :Transmitter for fiber optic	Students will be able to understand the communication systems in details

		communication, High performance transmitter circuit LED – Analog transmitter, LASER transmitter, Digital laser transmitter, Analog laser transmitter with A/D conversion and digital multiplexing, Fiber optic receiver, Fiber based modems : Transreceiver. Modulation: LED analog modulation, Digital modulation, Laser modulation, Pulse code modulation (PCM), Intensity modulation (IM).	
4	Optical Fiber Communication and Measurements of Optical Fibers	Optical fiber communication systems : Introduction, Important applications of integratedoptic fiber communication technology, Long haul communication, Coherent optical fiber communication, Principle of coherent detection. Measurements on Optical Fibers : Introduction, Measurements of numerical aperture (NA), Measurements of Fiber- attenuation, Optical time Domain Reflectometry (OTDR), Measurements of dispersion losses, Measurements of refractive index, Cut-off wavelength measurement, Measurements of Mode Field Diameter (MFD), Near field scanning technique.	Introduces many concepts of communication, various measurements

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Signature of Teacher:

Name of Teacher: Mr. V S Pabboj

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem IV **Subject:** Physics **Course Code:** PHY 402

Paper Title: Microwaves and Measurements

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Microwave Fundamentals	Microwave frequencies and band description, Fundamentals of transmission lines and different types of transmission lines, characteristics of transmission line, propagation constant and losses in transmission line, transmission line equation solution, Reflection coefficient and transmission coefficient, Standing wave and standing wave ratio, Line impedance and admittance, Smith chart and its application.	Students will get introduced to Microwaves
2	Microwave Passive Devices	Rectangular wave guide, Circular wave guide, Microwave cavities, Microwave hybrid circuit, Directional coupler, Circulators and ferrit devices, Attenuators, Scattering matrix, Isolators	Introduces many passive devises to generate MW
3	Microwave Active Devices	Klystron, Velocity modulation, bunching process, Reflex Klystron, efficiency, Basic principle of magnetron, Principles and operations of magnetrons and traveling wave tube, Helix TWT's amplification process, wave modes and gain. Transfer electron devices: Gunn diode, Gunn effect, principle of operation, modes of operation, Pin diode.	Introduces many active devises to generate MW
4	Microwave Measurements and Applications	Measurement: Attenuation measurement, Frequency measurement, Power measurement, Reflection coefficient and VSWR measurement, Impedance measurement. Applications: Antenna fundamental, Microwave antennas, Power received from an antenna, Radiation pattern, Radiation resistance, Efficiency, Directivity and gain, Antenna types, Rectangular horn antennae, H and E plane Horn antennae, Radar system, Basic radar system, Radar range, Moving target indicator, Time domain reflectometry.	Students will be able to measure various properties of MWs and are able to apply these microwave systems at industrial level

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Signature of Teacher:

Name of Teacher: Mr. V S Pabboj

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem IV **Subject:** Physics **Course Code:** PHY 403

Paper Title: Microprocessors and Microcontrollers

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Architecture of Microprocessor 8085	Intel 8085- Block diagram, ALU, Timing and control unit, Registers, Data and address bus, Pin configuration, Instruction word size, Instruction cycle, Fetch operation, Execute cycle, Machine cycle and state, Instructions and data flow, Timing diagram, Memory read, I/O read, Memory write, I/O write	Introduces many basic concepts of microprocessors
2	Programming of Microprocessor 8085 and Data Transfer Techniques	ntroduction, Instruction set for 8085, Programming of 8085, Assembly language programming (Data Transfer, Arithmetic, Branching, and Logical group). Programmed data transfer, Synchronous, Asynchronous and interrupt drivers modes, DMA, Serial data transfer.	Students will be able to program the microprocessor
3	Microprocessor 8086 and Micro-controller 8051	Architecture of 8086, Pin diagram and pin function, Register organization, Minimum and Maximum mode of 8086, Microprocessor 80286, 80386 (Block Diagram only) Micro-controller 8051 Introduction to 8 - bit micro-controller, Architecture of 8051 signal description of 8051, Register set of 8051, Important operational features of 8051, Memory and I/O addressing by 8051, Interrupts of 8051, Instructions set of 8051, programming of 8051 (Simple Arithmetic and Logical programs).	Students get introduced to advanced microprocessor and microcontroller and its programming
4	16 Bit Micro-controller and Embedded Controllers	Introduction, Architecture of 16 bit micro-controller (MCS-96 or 80196), General features of 80196, Register set of 80196, I/O processor, UPI 452 (Universal Peripheral Interface), Intel 80960 (block Diagram and its description only).	Introduces many advanced microcontrollers

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Signature of Teacher:

Name of Teacher: Prof. A G Chawhan

Department: Department of Physics, L B S College, Dharmabad

Program: M.Sc. S.Y. sem IV **Subject:** Physics **Course Code:** PHY 404 - A

Paper Title: Energy Physics

Unit Number	Unit Name	Topic	Unit-wise Outcome
1	Conventional and Non-conventional Energy Sources	World production and reserves of commercial energy sources - fossil fuel, hydroelectric power, Nuclear energy. Indian energy scenario- fossil fuel, hydroelectric power, Nuclear energy power plants. Non conventional energy sources: Solar energy, Bio mass and Bio gas energy, Tidal energy, Geothermal energy, Hydrogen energy, Fuel cells (brief description) Solar constant, Solar radiation at earth's surface, Solar radiation measurement-The Moll- Gorezynskipyranometer, The Epplypyranometer, Sun shine recorder Photo voltaic conversion technologies Purification of Silicon, The Czocharalski (CZ) method of crystal growing, Silicon wafer to Solar cell fabrication , Module design, Photovoltaic applications	Students will be introduced to various sources of energy
2	Solar energy collectorsand Solar Energy Applications	Solar energy collectors: Physical principle of the conversion of solar radiation into heat Flat plate collectors: A typical liquid collector, basic elements, materials for Flat plate collectors Selective absorber coatings Solar Concentrating Collectors: Parameters characterizing solar concentrators, Parabolic trough collector, Mirror strip collector, Fresnel Lens collector, Compound parabolic concentrator, Central Tower Receiver system Solar Energy Applications: Solar Water Heaters: Natural circulation solar water heater (pressurized and non pressurized) Solar Cooker: Design principle and constructional details of Box Type Solar Cooker, Box Type Solar Oven (Multi reflector type), merits and limitations Solar Desalination: Introduction, Simple Solar Still Solar Drying of Food: Introduction, types of Solar Dryers- Natural Convection Solar Dryer, Mixed mode type Solar Dryer Solar Pond: Introduction, Principle of operation and description of non-convective solar pond.	Students will understand the conversion of solar energy onto many other kinds of energy
3	Energy from Biomass and Biogas generation	Energy from Biomass: Introduction, Biomass conversion technologies- Biomass conversion, thermo chemical conversion, Wet processes, Dry processes Biogas generation: Introduction,	Students are able to use the Biogas for many purposes at

		Anaerobic digestion and its advantages, Basic processes and energetic. Factors affecting generation of Biogas (brief description), Classification of Biogas plants Advantages and Disadvantages of floating drum and fixed dome type plant, KVIC digester	domestic and industry level
4	Fuel Cells and Hydrogen Energy	Fuel Cells: Introduction, Design and principles of operation of a fuel cell, Types of fuel cells-Ion exchange membrane cell, Molten carbonate cell, photo chemically regenerative fuel cell, Advantages and Disadvantages of fuel cell, Hydrogen Energy: Introduction, Hydrogen production, Electrolytic production of Hydrogen-Tank type and filter press electrolyzer, Hydrogen production and storage (brief description)	Students will be able to apply the fuel cells at industry level

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