Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: B K KAJALE **Department: PHYSICS**

Program: MSc FY **Subject**: PHYSICS **Course Code**: **PHY 101**

Paper Title: Mathematical Methods in Physics (Core-1)

Unit Number	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.	Will be able to solve problems in physics using techniques of 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.	will be able to solve problems in physics, Engineering, Biophysics using techniques of special functions
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.	Will acquire skill to apply technique of integral transforms to solve problems in physics and similar subjects
IV	**Complex function and Calculus of**	Definition of complex function, exponential function and properties, circular function and properties, hyperbolic function and properties, Inverse hyperbolic function,	Will acquire skill to apply technique of calculus of complex function

	Complex function	logarithmic function, limit of a complex function, continuity, derivative (theorm), analytic 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.	to solve problems in physics and similar subjects

Specify Course Outcome: After learning this course students will be able to

1. solve problems in physics using techniques of matrices
2. solve problems in physics, Engineering, Biophysics using techniques of special functions
3. apply technique of integral transforms to solve problems in physics and similar subjects
4. apply technique of calculus of complex function to solve problems in physics and similar subjects

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc FY **Subject**: PHYSICS **Course Code**: **PHY 102**

Paper Title: Classical Mechanics (Core-2)

Unit Number	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.	Will acquire the techniques of elementary principles of physics
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	will be able to solve problems in physics, Engineering using techniques

		energy in terms of 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.	of Lagrangian formulae
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. **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	Will acquire skill to solve problems in Hamiltonian classical mechanics& central force problems

		in a central force field; Rutherford scattering cross section.	
IV	**Rigid body dynamics and small oscillations**	**Rigid body dynamics** Coordinate systems; Euler's angles; Angular momentum and inertia tensor; Principle axes; Components of angular velocity; Rotational kinetic energy of a body; Euler's equation of motion for a rigid body; Torque free motion of a rigid body. **Small oscillations** Potential energy and equilibrium; Stable and unstable equilibriums; Small oscillations in a system with one degree of freedom; small oscillations in a system with more than one degree of freedom; Normal coordinates; Normal modes and normal frequencies of vibration.	Will acquire skill to solve problems in rigid body dynamics and small oscillations

Specify Course Outcome: After learning this course students will be able to

1. acquire the techniques of elementary principles of physics
2. solve problems in physics, Engineering using techniques of Lagrangian formulae
3. acquire skill to solve problems in Hamiltonian classical mechanics& central force problems
4. acquire skill to solve problems in rigid body dynamics and small oscillations

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc FY **Subject**: PHYSICS **Course Code**: **PHY 103**

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

Unit Number	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	Will be able to understand and explain spectra of monovalent and divalent atoms and can understand LS and JJ coupling in case of two valance electron atoms and the origin of spin-orbit interaction
		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	

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	will be able to study and analyze microwave spectra of molecules
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	Will be able to study and analyze vibrational spectra of diatomic and polyatomic

		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, CO2 and H2O molecules, techniques and 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,	molecules and electronic spectra of diatomic molecules
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	Will be able to study and analyze pure and vibrational Raman spectra of various molecules

		infra-red spectroscopy, Experimental setup for Raman spectroscopy	

Specify Course Outcome: After learning this course students will be able to

1. Will be able to understand and explain spectra of monovalent and divalent atoms and can understand LS and JJ coupling in case of two valance electron atoms and the origin of spin-orbit interaction
2. study and analyze microwave spectra of molecules
3. study and analyze vibrational spectra of diatomic and polyatomic molecules and electronic spectra of diatomic
4. study and analyze pure and vibrational Raman spectra of various molecules

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc FY **Subject**: PHYSICS **Course Code**: **PHY 104**

Paper Title: Electronic Devices and Applications (Core-4)

Unit Number	**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	Will be able to explain working principle and applications of semiconductor devices

		semiconductor devices as amplifiers and oscillators	
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)	will be able to explain working principle and applications of photonic devices
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	Will be able to working principle and applications of operational amplifiers
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	Will be able to explain construction, working principle and applications

		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	of various digital circuits

Specify Course Outcome: After learning this course students will be able to

1. explain working principle and applications of semiconductor devices
2. explain working principle and applications of photonic devices
3. working principle and applications of operational amplifiers
4. explain construction, working principle and applications of various digital circuits

Signature of Teacher

Name of Teacher: P. S. KACHAVE **Department: PHYSICS**

Program: M. Sc FY **Subject**: PHYSICS **Course Code**: **PHY 201**

Paper Title: Quantum Mechanics (Core-7)

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
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, Completeness of eigen functions, Matrix representation of an operator, Unitary Transformation	Will be able to understand fundamentals of quantum mechanics
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	Will be able to understand and apply principle of angular momentum to solve microscopic problems

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 bound State	Will be able to understand how to apply various approximation methods to microscopic physics
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,	Will be able to workout various problems of collision in 3d and scattering

		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)	

Specify Course Outcome: After completion of this course the students will be able to

1. understand fundamentals of quantum mechanics
2. understand and apply principle of angular momentum to solve microscopic problems
3. understand how to apply various approximation methods to microscopic physics
4. workout various problems of collision in 3d and scattering

Signature of Teacher

Name of Teacher: B K KAJALE **Department: PHYSICS**

Program: M. Sc FY **Subject**: PHYSICS **Course Code**: **PHY 202**

Paper Title: Statistical Mechanics (Core-8)

Unit Number	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;	Will be able to understand fundamentals of classical statistics

II	**Quantum Statistics**	Density matrix, statistics of ensembles, statistics of indistinguishable particles 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	Will be able to understand and apply FD quantum statistics

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.	Will be able to understand and apply BE quantum statistics
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 understand various concepts of classical gas and phase transitions

Specify Course Outcome: After completion of this course the students will be able to

1. understand fundamentals of classical statistics
2. Will be able to understand and apply FD quantum statistics and BE quantum statistics
3. understand various concepts of classical gas and phase transitions

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: M. Sc FY **Subject**: PHYSICS **Course Code**: **PHY 203**

Paper Title: Numerical Techniques in Physics (Core-9)

Unit Number	Unit Name	Topics	Unit-wise Outcome
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.	Will acquire the skill of curve fitting & interpolation and can find roots of equations employing various method
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	Will be able to solve problems of numerical integration and can solve differential equations

III		**Solution of simultaneous equation**: Gaussian elimination method, pivotal condensation method, Gauss-Jordan elimination method, Gauss-Seidel 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	Will be able to find solutions of simultaneous and partial differential equations and can find eigenvalues and eigenvectors of a matrix
IV		**C- Programming** Elementary information about digital computer 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.	Will be able to write simple C programs and can understand random numbers

Specify Course Outcome: After completion of this course the students will be able to

1. acquire the skill of curve fitting & interpolation and can find roots of equations employing various method
2. solve problems of numerical integration and can solve differential equations
3. find solutions of simultaneous and partial differential equations and can find eigenvalues and eigenvectors of a matrix
4. write simple C programs and can understand random numbers

Signature of Teacher

Name of Teacher: B K KAJALE **Department: PHYSICS**

Program: M. Sc FY **Subject**: PHYSICS **Course Code**: **PHY 204**

Paper Title: Condensed Matter Physics (Core-10)

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	**Crystal structure, X-ray diffraction and**	**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	Will be able to understand crystal structures and x-ray diffraction

	Crystal imperfections	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	
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	Will be able to understand band theory of solids
III	**Semiconducting, Dielectric and optical properties of material**	**Semiconductor:** Basics of semiconductors: Carrier concentration in semiconductors and impurity states, Fermi level position as a function of charge carrier concentration semiconductor, optical methods to determine the forbidden gap, Direct and indirect band gap, Transport properties in semiconductor (resistivity, carrier	Will be able to understand semiconducting, dielectric and optical properties of solids

		concentration, mobility temperature dependence, Hall Effect) **Dielectric and optical property of material** The dielectric constant and polarizability, Sources of polarizability, Dipolar polarizability and Dipolar dispersion in solids, Ionic polarizability, Electronic polarizability, Piezoelectricity and Ferro electricity	
IV	**Superconductivity and Magnetic properties of materials**	**Superconductivity:** Introduction to superconductivity, Meissner effect, Critical temperature and persistent 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.	Will be able to understand superconductivity and magnetic properties of materials

Specify Course Outcome: After completion of this course the students will be able to

1. understand crystal structures and x-ray diffraction
2. understand band theory of solids
3. understand semiconducting, dielectric and optical properties of solids
4. understand superconductivity and magnetic properties of materials

Signature of Teacher

Name of Teacher: P S KACHAVE **Department: PHYSICS**

Program: M. Sc SY **Subject**: PHYSICS **Course Code**: **PH-15**

Paper Title: Electrodynamics

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	**Maxwell's equation**	Maxwell's equations and their physical significance. Equation of continuity and relaxation time, Vector and scalar potentials, Lorentz and Coulomb gauge,	Will be able to understand and

	s and Electromagnetic waves	electromagnetic energy and Poynting's theorem, electromagnetic wave equations in free space, their plane wave solutions, waves in conducting medium: skin depth, waves in ionized medium (ionospheric propagation) polarization of EM waves. Concept of radiation pressure	apply Maxwell's equations
II	**Electromagnetic waves in bounded media**	Reflection and refraction of plane electromagnetic waves at a plane interface: normal incidence, oblique incidence, Fressnel's equations, and 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.	Will acquire knowledge of behaviour of EM waves in bounded media
III	**Radiations from moving charges**	Concept of retarded potential, The Lienard-Wiechert potentials, Fields produced by moving charges, radiations from an accelerated charged particle at low velocities, radiations from a charged particles with co-linear velocity and acceleration, Radiations from an accelerated charged particle at low velocities in circular orbits-Larmor formula, Radiations from an accelerated charged particle at relativistic velocities in circular orbitsrelativistic generalization of Larmor Formula.	Will be able to understand how radiations emit from moving charges
IV	**Radiating Systems**	Multipole expansion of EM fields, Electric dipole radiations, field due to oscillating electric dipole, magnetic dipole radiations, electric quadrupole	Will be able to understand the process of radiation from

		radiation, fields due to linear, centre-fed antenna, simple array of antennas.	various radiating systems
V	**Relativistic Electrodynamics**	Galilean transformations, Lorentz transformations and basic kinematical results of special relativity (length contraction, time dilation, addition of velocities, charge invariance, field transformation, etc), relativistic momentum and energy of a particle, mathematical properties of space-time in special relativity	Will be able to understand application of relativity to electrodynamics

Specify Course Outcome: After completion of this course the students will be able to

1. understand and apply Maxwell's equations
2. acquire knowledge of behaviour of EM waves in bounded media
3. understand how radiations emit from moving charges
4. understand the process of radiation from various radiating systems
5. understand application of relativity to electrodynamics

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: M. Sc SY **Subject**: PHYSICS **Course Code**: **PH-16**

Paper Title: Nuclear and Particle Physics

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	Basic Nuclear properties	Nuclear size & its determination, nuclear radii by Rutherford scattering, electron scattering & mirror nuclei method, nuclear quantum numbers, angular Momentum, nuclear dipole moment, electric quadruple moment.	Will be able to understand basic nuclear properties
II	Interaction of nuclear radiation with matter	Interaction of charged particles & em rays with matter, range, straggling, stopping power, ionization chamber, proportional counter, GM counter, scintillation detector, semiconductor detector.	Will be able to understand interaction of nuclear radiation with matter
III	**Nuclear forces and Nuclear Models**	Elements of two body problem, charge independence & charge symmetry of nuclear forces, Meson theory of nuclear forces. Nuclear Models: B.E., Semi empirical mass formula & applications, nuclear shell model, liquid drop model collective model, collective model, Fermi gas model.	Will be able to understand various nuclear models and nuclear forces

IV	**Nuclear decay & Reactions**	Radioactive decay, laws of successive transformation, dosemetry nuclear reactions, fission & fusion. β – decay, three forms of β - decay, Fermi theory of β - decay, kurie plot, selection rule, non conservation of parity in β decay	Will be able to understand nuclear reactions and nuclear decay
V	**Elementary particles**	Weak, strong & electromagnetic interaction, classification of elementary particles, conservation laws, quark theory.	Will be able to acquire knowledge of elementary particles

Specify Course Outcome: After completion of this course the students will be able to

1. understand basic nuclear properties
2. understand interaction of nuclear radiation with matter
3. understand various nuclear models and nuclear forces
4. understand nuclear reactions and nuclear decay
5. acquire knowledge of elementary particles

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc SY **Subject**: PHYSICS **Course Code**: **PH-17**

Paper Title: Basics of Laser and Devices

Unit Number	Unit Name	Topics	Unit-wise Outcome
I		Properties of Lasers, Intensity, Monochromaticity, Directionality and coherence, Einstein's coefficients, Momentum transfer, Life time and possibility of amplification.	Will be able to understand properties of laser
II		Concepts of waves and interference, Temporal and spatial coherence, Coherence of the field and size of the source, Coherence and monochromaticity, Shape and width of spectral lines, Line broadening mechanism, Intrinsic broadening, collision broadening, Doppler broadening.	will be able to understand various characteristics of laser
		Basic principles of lasers, population inversion, Laser pumping, Two level and three level pumping, Vibrational modes and mode density of resonator, Open and confocal resonator.	Will be able to understand the process of production of laser

IV		**Ruby laser**, Three level system and its pumping power, Nd : YAG and Nd: Glass laser ,its energy level diagram and salient features. **He-Ne lasers:** Energy level diagram, construction and salient features of the He-Ne laser device, **He-Cd and He-Sc laser:** Energy level description and salient features, Molecular gas laser-CO_2 gas laser, Energy level scheme and general features.	Will be able to understand the lasers such as RUBY, He-Ne, He-Cd and He-Sc etc

V		Nonlinear optics, Harmonic generation, Phase matching, Optical mixing parametric generation of light and self focusing. **Applications of Lasers:** Applications of lasers in (i) Communication (ii) Industry (iii) Medicine (iv) Biology (v) Astronomy.	Will be able to understand applications of lasers

Specify Course Outcome: After learning this course students will be able to

1. understand properties of laser
2. understand various characteristics of laser
3. understand the process of production of laser
4. understand the lasers such as RUBY, He-Ne, He-Cd and He-Sc etc
5. understand applications of lasers

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc SY **Subject**: PHYSICS **Course Code**: **PH-18B**

Paper Title: Materials Science

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Types of Materials and Glass**	**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.	Will be able to understand various types of materials including glass
II	**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.	will be able to understand thoroughly the magnetic materials

	Dielectric materials and	Dielectric as an electric field medium, Leakage currents, Dielectric losses, Breakdown voltage and Dielectric strength,	Will be able to understand Dielectric and
	Ferroelectric Materials:	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	ferroelectric materials
IV	**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.	Will be able to understand the biomaterials
V	**Materials Synthesis**	Solid State Reactions: general principles, processes 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	Will be able to learn synthesis of various materials

		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,	

Specify Course Outcome: After learning this course students will be able to

1. understand various types of materials including glass
2. understand thoroughly the magnetic materials
3. understand Dielectric and ferroelectric materials
4. understand the biomaterials
5. learn synthesis of various materials

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: MSc SY **Subject**: PHYSICS **Course Code**: **PH-22**

Paper Title: Fiber Optics and Optical fiber Communication

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Ray theory of transmission and preparation of optical fibers**		Will be able to understand various types of materials including glass
II	**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.	will be able to understand thoroughly the magnetic materials
	Dielectric materials 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	Will be able to understand Dielectric and ferroelectric 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	
IV	**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.	Will be able to understand the biomaterials
V	**Materials Synthesis**	Solid State Reactions: general principles, processes 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,	Will be able to learn synthesis of various materials

		Interfacial growth materials between the two immiscible phases,	

Specify Course Outcome: After learning this course students will be able to

1. understand various types of materials including glass
2. understand thoroughly the magnetic materials
3. understand Dielectric and ferroelectric materials
4. understand the biomaterials
5. learn synthesis of various materials

Signature of Teacher

Name of Teacher: B K KAJALE **Department: PHYSICS**

Program: M. Sc SY **Subject**: PHYSICS **Course Code**: **PH-23**

Paper Title: Microwaves and Measurements

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	**Microwave Fundamentals**	Microwave frequency spectrum, Types and characteristics of transmission line, Transmission line equation solution, Reflection coefficient and transmission coefficient, Standing wave and standing wave ratio, Line impedance and admittance, Smith chart.	Will be able to understand microwave fundamentals
II	**Microwave**	**Microwave Passive Devices** Rectangular wave guide, Circular wave guide, Microwave cavities, Microwave hybrid circuit, Directional coupler,	Will be able to understand working of

	Passive Devices	Circulators and ferrit devices, Attenuators, Scattering matrix, Isolators	microwave bench components
III	**Microwave Active Devices**	Klystron, Reflex Klystron, Velocity modulation, Basic principle of magnetron, Principles and operations of magnetrons and traveling wave tube, Transfer electron devices, Gunn diode, Pin diode	Will be able to understand working principle of microwave active components
IV	**Microwave Measurements**	Attenuation measurement, Frequency measurement, Power measurement, Reflection coefficient and VSWR measurement, Scattering measurement. Microwave detection, Point contact diode, Schottly barrier diode, Impedance measurement using smith chart.	Will be able to understand how to do various microwave measurements
V	**Microwave Applications**	Antenna fundamental, Microwave antennas, Antenna basic, Power received from an antenna, Radiation pattern, Radiation resistance, Efficiency, Directivity and gain, Antenna types, Rectangular horn antennas, H and E plane Horn antennas, Pyramidal Horn antenna, Parabolic reflector antenna. Radar system, Basic radar system, Radar range, Moving target indicator, Time domain reflectometry, Network analyzer, Microwave dielectric measurement techniques.	Will be able to understand and explain microwave applications

Specify Course Outcome: After completion of this course the students will be able to

1. understand microwave fundamentals
2. understand working of microwave bench components
3. understand working principle of microwave active components
4. understand how to do various microwave measurements

5. understand and explain microwave applications

Signature of Teacher

Name of Teacher: B K KAJALE **Department: PHYSICS**

Program: M. Sc SY **Subject**: PHYSICS **Course Code**: **PH-24**

Paper Title: Microprocessors and Microcontrollers

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	**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	Will be able to understand architecture of microprocessor 8085
II	**Programming of Microprocessor 8085 and Data Transfer Techniques**	Introduction, 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.	Will be able to construct simple (ALP) programmes for microprocessor 8085

III	**Advanced Microprocessors**	Architecture of 8086, Pin diagram and pin function, Register organization, Minimum and Maximum mode of 8086, Microprocessor 80286, 80386	Will be able to understand outline of architecture of advanced microprocessors
IV	**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).	Will be able to understand the architecture of microcontroller 8051 and can write simple programmes
V	**16 bit Micro-controller and Embedded Controller:**	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).	Will be able to understand architecture of 16 bit microcontroller

Specify Course Outcome: After completion of this course the students will be able to

1. understand architecture of microprocessor 8085
2. construct simple (ALP) programmes for microprocessor 8085
3. understand outline of architecture of advanced microprocessors
4. understand the architecture of microcontroller 8051 and can write simple programmes
5. understand architecture of 16 bit microcontroller

Signature of Teacher

Name of Teacher: S R MAGAR **Department: PHYSICS**

Program: M. Sc SY **Subject**: PHYSICS **Course Code**: **PH-25 (A)**

Paper Title: Energy Physics

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	**Conventional and Non-conventional Energy Sources**	Man and energy, 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- scope and potential, Concept of Solar constant, Solar intensity on earth's surface, Direct and diffused radiation ,Measurements of Solar Radiations – Moll-Gorezynsky pyronometer, Sunshine Recorder	Will be able to understand conventional and non-conventional energy sources
II	Photovoltaic Conversion Technologies	Crystalline Solar Cell Technology- purification of Silicon conversion of metallurgical grade silicon to semiconductor grade- Czocharlski crystalline silicon formation process, Processes	Will be able to understand how photovoltaic technology used for conversion of energy
		involved in the conversion of silicon wafer to solar cell ,Modular design of solar cell, Power generation through satellite solar power station, Advantages and Disadvantages of solar cell	

III	**Photo thermal conversion technologies**	Basic principles of flat plate collector (FPC), elements of flat plate collector, selective coatings and ideal characteristics of absorber plate of flat plate collector, Solar cooker, Hot water system, Solar dryer, Solar pond, Design of central tower receiving system for power generation, Essential elements of Solar Concentrators, parameters and efficiency of solar concentrators, Cylindrical parabolid concentrators (PTC), Compound parabolid concentrators (CPC), Applications of solar concentrators	Will be able to understand the technique of conversion of solar energy to thermal energy
IV	**Biogas**	Principles of biogas production, The anaerobic digestion process, types of systems (standard and high rate system) proportion of gases in biogas, Design of the plant, process control consideration (temperature, pH), gas production, gas collection, gas utilization, Advantages and Disadvantages of biogas plant.	Will be able to understand biogas in detail
V	**Fuel Cells**	Hydrogen as source of energy, photo electrochemical cell, source of hydrogen, solar hydrogen through electrolysis and photo catalytic process, hydrogen storage, brief discussion of various processes, concept of fuel cell, thermodynamics of fuel cell, merits and demerits of fuel cell.	Will be able to understand fuel cells functioning of clean energy generation

Specify Course Outcome: After completion of this course the students will be able to

1. Will be able to understand conventional and non-conventional energy sources
2. Will be able to understand how photovoltaic technology used for conversion of energy
3. Will be able to understand the technique of conversion of solar energy to thermal energy
4. understand biogas in detail
5. understand fuel cells functioning of clean energy generation

Signature of Teacher

OUTCOME OF THE PROGRAMME: Students after completing their post graduation in Physics will

1. be eligible to get employment as an asst. professor in private, semi-government, government institutions after fulfilling the requirements.

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

3. be able to handle standard and advanced laboratory equipments, modern instrumentation and various techniques to carry out experiments.

4. work as entrepreneurs.

6. be eligible to get employment in various industries

7. will be eligible to prepare for civil services examinations conducted by state government agencies and central government agencies.

8. will be eligible to prepare for SET/NET/PET/GATE etc conducted by various agencies .