"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(Empowered Autonomous)

Department of Physics

Annual Teaching Plan (PG)

Academic Year: 2024-25
Subject: Physics
Name of the teacher: **Dr. S. S. Latthe**

<table>
<tr><td colspan="4">Month June</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Research Methodology</td><td rowspan="2">Meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus research and scientific methodology, importance of knowing how research is done, research progress, criteria of good research.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><td colspan="4">Month July</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Literature Searching and Report Writing:</td><td rowspan="2">i)Literature Searching: On-line searching, Database, SciFinder, Scopus, Science Direct, CA on CD, Searching research articles,Citation Index, Impact Factor, h-index etc, ii)Writing scientific report: Structure and components of research report, revision, and refining writing project proposal, Paper writing for International Journals, submitting to editors, conference presentation, preparation of effective slides, pictures, graphs, and citation styles. iii)Thesis writing: the preliminary pages and the introduction, the literature review, methodology, the data analysis chapters, conclusion.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><td colspan="4">Month August</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td>Vacuum</td><td></td></tr>
</table>

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

M.Sc. I	16	-	16		Production of low pressures: rotary, diffusion, and sputter ion pumps; measurement of low pressure: McLeod, Pirani, thermocouple & Penning gauges; leak detection: sim
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Low Temperature and Microscopy Techniques:	Production of low temperatures: Adiabatic cooling, the Joule-Kelvin expansion, adiabatic demagnetization, 3He cryostat, the dilution refrigerator, principle of Pomeranchuk cooling, principle of nuclear demagnetization; measurement of low temperatures. Optical microscopy, scanning electron microscopy, electron microprobe analysis, low energy electron diffraction. Research Methodology
M.Sc. I	16	-	16		
Month October					
Course	**Lectures**	**Practicals**	**Total**	**Module/Unit:**	**Sub-units planned**
M.Sc. I	16	-	16	**Unit I Vacuum Techniques**	**Unit I Vacuum Techniques** Production of low pressures: rotary, diffusion, and sputter ion pumps; measurement of low pressure: McLeod, Pirani, thermocouple & Penning gauges; leak detection : simple methods of LD, palladium barrier and halogen leak detectors
Month December					
Course	**Lectures**	**Practicals**	**Total**	**Module/Unit:**	**Sub-units planned**
M.Sc. II	16	-	16	**Unit I Vacuum Techniques**	Production of low pressures: rotary, diffusion, and sputter ion pumps; measurement of low pressure: McLeod, Pirani, thermocouple & Penning gauges; leak detection : simple methods of LD, palladium barrier and halogen leak detectors
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total		

M.Sc. II	16	-	16	Production of low temperatures:	Adiabatic cooling, the Joule-Kelvin expansion, adiabatic demagnetization, 3Hecryostat, principle Pomerunchukcooling,principle of nuclear demagnetization; measurement of low temperatures. Optical microscopy,scanning electron microscopy, electron microprobe analysis, low energy electron diffraction2)
Month February				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	**Unit III Atomic Absorption Spectrometry**	Fundamentals: principle, basic equipment modulation; apparatus: double beam instrument, radiation sources, aspiration and atomization; interferences, control of AAS parameters, reciprocal sensitivity and detection limit techniques of measurement: routine procedure, matrix matching method, and method of additions
M.Sc. I	16	-	16		
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	**Unit IV X-Ray Fluorescence Spectrometry and Mössbauer Spectroscopy**	The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikon approximation, Free particle states, Partial wave formalism, Low energy scattering and bound states, Resonances, Scattering of identical particles, Symmetries in scattering, Time-dependent formulation of scattering, Inelastic electron-atom scattering, Coulomb scattering
M.Sc. I	16	-	16		
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. S. S. Latthe

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Vivekanand College, Kolhapur

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Department of Physics

Annual Teaching Plan (PG)

Academic Year: 2024-25
Subject: Physics
Name of the teacher: **Dr. G. J. Navathe**

<table>
<tr><th colspan="4">Month June</th><th>Module/Unit:</th><th>Sub-units planned</th></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Contact between Statistics and Thermodynamics:</td><td rowspan="2">Fundamental postulate of equilibrium statistical mechanics, Basic concepts – Phase space, ensemble, a priori probability, Liouville's theorem (Revision). Fluctuations of physical quantities, Statistical Equilibrium, Thermodynamic Laws and their consequences (in brief), Thermodynamic Functions – Entropy, Free energy, Internal Energy, Enthalpy (definitions), Maxwell's Equations (only equations), Contact between statistics and thermodynamics – Entropy in terms of microstates, Gibb's paradox, Sackur–Tetrode equation.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><th colspan="4">Month July</th><th>Module/Unit:</th><th>Sub-units planned</th></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Classical Statistical Mechanics:</td><td rowspan="2">Micro canonical Ensemble– Micro canonical distribution, Entropy and specific heat of a perfect gas, Entropy and probability distribution, Canonical Ensemble– Canonical Distribution, Partition function, Calculation of free energy of an ideal gas, Thermodynamic Functions, Energy fluctuations, Grand Canonical Ensemble– Grand Canonical distribution, Thermodynamic Functions, Number and Energy fluctuations.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><th colspan="4">Month August</th><th>Module/Unit:</th><th>Sub-units planned</th></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td></td><td>Distinction between MB, BE and FD distributions, Quantum distribution</td></tr>
</table>

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

M.Sc. I	16	-	16	Quantum Statistical Mechanics: Quantum Statistics:	functions – Bosons and Fermions and their distribution functions, Boltzmann limit of quantum gases, Partition function, Ideal Bose gas, Bose -Einstein Condensation, Specific heat of solids (Einstein and Debye models), Phonon gas, Liquid He4 : Second Sound, Ideal Fermi gas: Weakly and strongly degenerate, Fermi temperature, Fermi velocity of a particle of a degenerate gas , Electron gas: Free electron theory of metals, Pauli paramagnetism, white dwarfs, Brownian motion: Einstein Smoluchowski theory, Langevin theory, Approach to equilibrium: Fokker-Planck equation, the fluctuation-dissipation theorem
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lect ures	Practicals	Total	Phase Transitions and Critical Phenomenon:	Phase Transitions, Conditions for phase equilibrium, First order Phase 1Transition: Clausius - Clayperon equation, Second order phase transition, The critical indices, Weakly Interacting Gases, Weiss Molecular theory of paramagnetism, The Ising Model of a Ferromagnetism.
M.Sc. I	16	-	16		
Month October				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total	Maxwell's Equations and E.M. Waves:	Maxwell's Equations: microscopic and macroscopic forms (revision), Maxwell's equations in free space, dielectrics and conductors, conservation of the bound charge and current densities (Equation of Continuity and Displacement Current), E.M. wave equations in waveguide of the arbitrary cross section: TE and TM modes; Transmission lines and wave guides, rectangular and circular waveguides , dielectric waveguide, resonant cavity. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction.

M.Sc. I	16	-	16		
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Time –Dependent Potentials and Fields:	Scalar and vector potentials: coupled differential equations, Gauge transformations: Lorentz and Coulomb Gauges, Retarded Potentials, Lienard – Wiechert Potentials, Fields due to a charge in the arbitrary motion.
M.Sc. I	16	-	16		
Month February				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Radiation from Accelerated Charges and Radiation Reaction:	Fields of charge in uniform motion, applications to linear and circular motions: cyclotron and Synchrotron radiations, Power radiated by point charge – Larmor's formula, Angular distribution of radiated power, Cerenkov radiation and Bremsstrahlung (qualitative treatments). Radiation Reaction: criteria for validity, Abraham –Lorentz formula, Physical basis of radiation reaction –self force.
M.Sc. I	16	-	16		
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Electrodynamics and Relativity:	Geometry of Relativity, the Lorentz Transformations, The Structure of Space time, Relativistic Mechanics, Proper Time and Proper Velocity, Relativistic Energy and Momentum, Relativistic Kinematics, Relativistic Dynamics, Relativistic Electrodynamics Field Tensor, Relativistic Potential. Four vectors and Tensors:
M.Sc. I	16	-	16		
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. S. S. Latthe

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Department of Physics

Annual Teaching Plan (PG)

Academic Year: **2024-25**
Subject: Physics
Name of the teacher: Dr. S. S. Kumbhar

Month June				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Energy Bands and Charge Carriers in Semiconductors:	Direct and Indirect semiconductors, variation of energy bands with alloy composition, Charge carriers in semiconductors: electrons and holes, effective mass, intrinsic and extrinsic semiconductors, electrons and holes in quantum wells, The Fermi level, carrier concentration at equilibrium, temperature dependence, space charge neutrality, conductivity and mobility, Drift and resistance, effects of temperature and doping on mobility, Hall effect.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals	1. Hall effect (Hall coefficient & carrier concentration of semiconductor). 2. Linear Variable Differential Transducer. 3. Crystal structure identification by Neutron diffraction pattern.
Month July				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Excess Carriers in Semiconductors:	Optical absorption, Luminescence: photoluminescence and electroluminescence, Direct recombination of electrons and holes, Indirect recombination and trapping, steady state carrier generation and Quasi Fermi levels, Diffusion processes, Diffusion and Drift of carriers, built-in fields, The continuity equation, steady state carrier injection, diffusion length.
M.Sc. I	16	-	16		

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

M.Sc. II	-	32	32	Practicals :	1. Wavelength of given source by using Fabry-Parrot etalon. 2. Crystal structure identification by X-ray diffraction pattern. 3. Structure identification of given samples (F.C.C.& B.C.C.)
Month August				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Junctions-I	Fabrication of p-n junctions; Thermal oxidation, diffusion, Chemical vapor deposition (CVD), Photolithography, etching, metallization, The contact potential, Space charge at a junction, qualitative description of current flow at a junction, reverse-bias breakdown, Capacitance of p-n junctions, Zener and Avalanche breakdown, rectifiers
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals	1. Monatomic/ diatomic lattice vibrations using lattice dynamics kit. 2. Characteristic of Temperature Transducers (Thermocouple, Thermistor and IC sensor) 3. Specific heat capacity of given metals
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Junctions-II:	The tunnel diode, the Varactor diode, recombination and generation in the transition region, ohmic losses, graded junctions, Schottky barriers, rectifying contacts, ohmic contacts, hetero-junctions, AlGaAs-GaAs hetero-junction.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	1. Staircase Ramp Generator using UJT 2. Negative feedback amplifier (with and without feedback) 3. Astable multivibrator
Month October				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Hilbert space and wave function	Hilbert space and wave function, Dirac notations, Operators (General

M.Sc. I	16	-	16		definitions, Hermitian adjoint operator, projection operators, uncertainty relation between two operators, functions of operators, inverse and unitary operators, eigenvalues and eigenvectors of an operator, parity Representation in continuous bases (Position representation, Momentum representation and connection between them), Matrix representation of orbital and spin angular momentum.
M.Sc. II	-	32	32	Practicals :	Practicals : 1) Fourier analysis. 2) Transmission characteristics of passive filters. 3) I-V characteristics of solar cell.
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Variational Method and WKB Approximation:	The variational principle, Rayleigh-Ritz method, variational method for excited states, the Hellmann Feynman theorem, ground state of harmonic oscillator, infinite square well, hydrogen atom, the WKB method, the connection formulas, validity of WKB method, barrier penetration, Alpha emission
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : 1) A. C. bridges 2) Thermal diffusivity of brass. 3) Mutual inductance of given coil
Month February				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Perturbation Theory:	Time independent perturbation: basic concept, non-degenerate energy levels,

M.Sc. I	16	-	16		Eigen value of energy and Eigen function in the first order approximation, Anharmonic oscillator: first order correction, first order correction to ground state of helium. The pictures of quantum mechanics (Schrodinger picture, Heisenberg picture and Interaction picture), Time dependent perturbation: Basic concept, Dyson series, First-order perturbation, transition probability, constant perturbation, harmonic perturbation, transition to continuum states (Fermi-Golden rule), semiclassical theory of radiation: absorption and emission of radiation, electric dipole approximation, Einstein's A and B coefficients.
M.Sc. II	-	32	32	Practicals :	1) Series & parallel resonant LCR circuits. 2) Young's modulus of a beam by flexural vibration created by frequency generator. 3) 2-D and 3-D plots using Mathematica.
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Scattering Theory:	Scattering cross-section, scattering amplitude, partial wave, scattering by central potential: partial wave analysis, optical theorem, scattering by hard sphere, scattering by square well, Breit-Wigner formula, scattering length, expression for phase shifts, integral equation, the Born approximation, scattering by screened Coulomb potential, scattering by Yukawa potential, validity of Born approximation.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : 1) Band gap energy of semiconductor. 2) Resistivity of given semiconductor sample using four probe method. 3) Thermoelectric Power
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. S. S. Latthe

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Department of Physics

Annual Teaching Plan (PG)

Academic Year: 2024-25
Subject: Physics
Name of the teacher: Dr. S. I. Inamdar

<table>
<tr><th colspan="4">Month June</th><th>Module/Unit:</th><th>Sub-units planned</th></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Physical methods of thin film deposition:</td><td rowspan="2">Vacuum deposition apparatus: Vacuum systems, substrate deposition technology, substrate materials, Thermal Evaporation methods: Resistive heating, Flash evaporation, Arc evaporation, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, Magnetic field assisted (Triode) sputtering, RF Sputtering, Ion beam sputtering, sputtering of multi- component materials.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><td>M.Sc. II</td><td>-</td><td>32</td><td>32</td><td>Practicals</td><td>Practicals
1. Hall effect (Hall coefficient & carrier concentration of semiconductor).
2. Linear Variable Differential Transducer.
3. Crystal structure identification by Neutron diffraction pattern.</td></tr>
<tr><th colspan="4">Month July</th><th>Module/Unit:</th><th>Sub-units planned</th></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Chemical methods:</td><td rowspan="2">Common CVD reactions, Methods of film preparation, laser CVD, Photochemical CVD, Plasma enhanced CVD, Chemical bath deposition, Electro deposition, Spray pyrolysis, successive ionic layer adsorption reaction method (SILAR) method, Sol-gel method, Hydrothermal method.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
</table>

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

M.Sc. II	-	32	32	Practicals : [1] Thin film deposition by dip-coating method [2] Thin film deposition by CBD method [3] Microwave assisted synthesis of thin film [4] Thin film deposition by spray pyrolysis method	1. Wavelength of given source by using Fabry-Parrot etalon. 2. Crystal structure identification by X-ray diffraction pattern. 3. Structure identification of given samples (F.C.C.& B.C.C.)
Month August				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Nucleation growth processes and thickness measurement:	Condensation process, Langmuir-Frenkel theory of condensation, Theory of nucleation and growth process, Thickness measurements: Electrical methods, Microbalance monitors, mechanical method, radiation absorption and radiation emission methods, optical interference methods: photometric method, spectrometric method, interference fringes, X-ray interference fringes.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals	1. Monatomic/ diatomic lattice vibrations using lattice dynamics kit. 2. Characteristic of Temperature Transducers (Thermocouple, Thermistor and IC sensor) 3. Specific heat capacity of given metals
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Properties and characterization of thin films:	Mechanical properties of thin films: Introduction to elasticity, plasticity, and mechanical behavior, Electrical and magnetic properties of thin films, Optical 15 Vivekanand College, Kolhapur (Empowered Autonomous) properties of thin films, Structural characterization: X-ray diffraction, Scanning electron microscopy, Transmission electron spectroscopy, chemical characterization: X-ray Energy Dispersive Analysis (EDX), X-ray photoelectron spectroscopy (XPS).
M.Sc. I	16	-	16		

M.Sc. II	-	32	32	Practicals :	1. Staircase Ramp Generator using UJT 2. Negative feedback amplifier (with and without feedback) 3. Astable multivibrator
Month October				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total	Defects in crystals	Thermodynamics of point defects, Schottky and Frenkel defects, annealing, electrical conductivity of ionic crystals, color centers, Polarons and exciton, dislocations, strength of crystals, crystal growth, stacking faults and grain boundaries.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	1) Fourier analysis. 2) Transmission characteristics of passive filters. 3) I-V characteristics of solar cell.
Month January				Module/Unit:	Sub-units planned
Course	Lect ures	Practicals	Total	Electronic Structure of Crystals:	Basic assumptions of Model, Collision or relaxation times, DC electrical conductivity, Failures of the free electron model, The tightbinding method, Linear combinations of atomic orbitals, Application to bands from s-Levels, General features of Tight-binding levels, Wannier functions, Other methods for calculating band structure, Independent electron approximation, general features of valence band wave functions, Cellular method, Muffin Tin potentials, Augmented plane wave (APW) method, Green's function (KKR) method, Orthogonalized Plane Wave (OPW) method Pseudo potentials.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : 1) A. C. bridges 2) Thermal diffusivity of brass. 3) Mutual inductance of given coil
Month February				Module/Unit:	Sub-units planned
Course	Lect ures	Practicals	Total		Drift velocity and relaxation time, The Boltzmann transport relation, The

M.Sc. I	16	-	16	Transport Properties of Metals :	Sommerfeld theory of metals of electrical conductivity, The mean free path in metals, Thermal scattering, The electrical conductivity at low temperature, The thermal conductivity of metals, Dielectric Properties of insulators, Macroscopic electrostatic Maxwell equations, Theory of Local Field, Theory of polarizability, Clausius- Mossotti relation, Long-wavelength optical modes in Ionic crystals.
M.Sc. II	-	32	32	Practicals :	1) Series & parallel resonant LCR circuits. 2) Young's modulus of a beam by flexural vibration created by frequency generator. 3) 2-D and 3-D plots using Mathematica.
Month March				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	Phonons, Plasmons, Polaritons, and Polarons:	Vibrations of monatomic lattices: first Brillion zone, group velocity, Long wavelength limit, Lattice with two atoms per primitive cell. Quantization of lattice vibrations, Phonon momentum Dielectric function of the electron gas, Plasma optics, Dispersion relation for Electromagnetic waves, Transverse optical modes in a plasma, Longitudinal Plasma oscillations, Plasmons, Polaritons, LST relations, Electron- electron interaction, Electron phonon interaction: Polarons.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : 1) Band gap energy of semiconductor. 2) Resistivity of given semiconductor sample using four probe method. 3) Thermoelectric Power
Month April				Module/Unit:	Sub-units planned
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

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Department of Physics

Annual Teaching Plan (PG)

Academic Year: 2024-25
Subject: Physics
Name of the teacher: **Mr. A. V. Shinde**

<table>
<tr><td colspan="4">Month June</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Matrices</td><td rowspan="2">Matrix multiplication – Inner product, direct product, Diagonal matrices, trace, matrix Inversion, Gauss-Jordon Inversion, Eigenvalues and Eigenvectors, Properties of Eigenvalues and Eigenvectors, Cayley-Hamilton Theorem and applications, similar matrices and diagonalizable Matrices, functions of matrices, Quadratics forms.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><td colspan="4">Month July</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">Complex Variables</td><td rowspan="2">Limits and continuity of complex functions, Derivatives and analytic functions, Cauchy-Riemann conditions, Line integrals in the complex plane, Cauchy Integral theorem and Cauchy integral formulas, Singularities-Poles, Branch Points, Calculus of Residues-Residues Theorem, Cauchy Principle value, Pole Expansion of Meromorphic Functions, Product expansion of entire functions.</td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td></tr>
<tr><td colspan="4">Month August</td><td>Module/Unit:</td><td>Sub-units planned</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td>Fourier series and integrals</td><td>Fourier series and Fourier transform, Dirichlet condition, (Statement only)</td></tr>
</table>

M.Sc. I	16	-	16		Properties of Fourier series: 1) convergence, 2) Integration 3) Differentiation. Physical applications of Fourier series 4) square wave (high frequencies) 5) full wave rectifier, Differentiation and integration of Fourier series, Fourier transform, Inverse functions.
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Special Functions	Frobenius power series method, Legendre differential equation (Rodrigues' formula for Legendre polynomials, generating function, Orthogonality of Legendre polynomials), Hermite differential equation (Rodrigues' formula for Hermite polynomials, generating function, Orthogonality of Hermite polynomials), Laguerre differential equation ((Rodrigues' formula for Laguerre polynomials, generating function, Orthogonality of Laguerre polynomials)
M.Sc. I	16	-	16		
Month October				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Crystallography	Bonding in Solids-Ionic, Covalent and Metallic. Crystalline state of solids, Bravai's

M.Sc. I	16	-	16		lattices and crystal structure , Symmetry elements(cubic),coordination number and packing fraction. Crystal structuresCsCl, ZnS, and diamond, Brag's law in reciprocal lattice, Brillouin zones, Comparison between X-Ray, Electron and Neutron diffraction, Field ion microscopy-Principal, working and applications
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Crystal defects:	Point defects-Vacancies, Interstitials, impurities, electronic, Expression for Schottky and Frenkel defects Line defects-Edge and screw dislocation, Interpretation of SGP (Plastic deformation) Burgur's vector and circuit, Frank-Read mechanism. Planer defects, Surface defects- Grain boundaries, Tilt boundaries, Twin boundaries, Effect of Imperfections
M.Sc. I	16	-	16		
Month February				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Dielectric, Magnetism & Supercondivity:	Dielectric-Polarisation mechanism, Dielectric constant, Clausis-Mossoti relation, MagnetismComparison between dia, Para, and ferromagnetism ,Exchange interaction. Magnetic order (Fero, Antifero and ferri), Weiss theory of magnetism Superconductivity- High Tc superconductors, BCS theory of superconductors, SQUID
M.Sc. I	16	-	16		
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total		Energy band gap, Determination of Band gap energy, intrinsic and extrinsic

M.Sc. I	16	-	16	Semiconductor theory and devices:	semiconductors, carrier concentration, fermi level and conductivity for intrinsic and extrinsic semiconductor. Review of UJT, switching characteristics of UJT, SCR- construction and working, switching characteristics.
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. S. S. Latthe
HEAD
DEPARTMENT OF PHYSICS
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(Empowered Autonomous)

Department of Physics

Annual Teaching Plan (PG)

Academic Year: 2024-25
Subject: Physics
Name of the teacher: **Mr. A. R. Gaikwad**

Month June				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Atomic Spectra	Quantum states of an electron in an atom, electron spin, spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, llcoupling, ss-coupling, LS or Russell - Saunder's coupling; the Pauli exclusion principle, Coupling schemesfor two electrons, Γ- factorsfor LS coupling, Lande interval rule, jj coupling, branching rules, selection rules, Intensity relations.
M.Sc. II	16	-	16		
Month July				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Effect of magnetic and electric field on atomic spectra	The magnetic moment of the atom, Zeeman effect for two-electrons, Intensity rules for Zeeman effect, Paschen-Back effect for two electrons, Stark effect of hydrogen, weak field Stark effect in hydrogen, strong field Stark effect in hydrogen, origin of hyperfine structure, Inner shell vacancy, X- ray and Auger transitions, Compton effect.
M.Sc. II	16	-	16		
Month August				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Molecular spectra:	Molecular spectra: Molecular physics – covalent, ionic and Vander Waal's

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M.Sc. II	16	-	16		interaction, Classification of molecules: linear, symmetric tops, spherical tops, asymmetric tops; rotational spectra: the rigid diatomic molecule, the non- rigid rotator, spectrum of a non-rigid rotator, techniques and instrumentation of microwave spectroscopy, chemical analysis by microwave spectroscopy, the vibrating diatomic molecule: the energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating-rotator, vibrational rotational spectra, techniques and instrumentation of infra-red spectroscopy, chemical analysis by infra-red spectroscopy.
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lect ures	Practicals	Total	Electronic, Nuclear and Raman spectra	Revision on electronic spectra of diatomic molecules, electron spins resonance, nuclear magnetic resonance, chemical shift, Frank-Condon principle, dissociation energy and dissociation products, rotational fine structure of electronic-vibration, transitions, Born-Oppenheimer approximation, separation of electronic and nuclear motions in molecules, band structures of molecular 15 Vivekanand College, Kolhapur (Empowered Autonomous) spectra, Raman spectra: Pure rotational Raman spectra, vibrational Raman spectra, polarization of light and Raman effect, techniques and instrumentation of Raman spectroscopy.
M.Sc. II	16	-	16		
Month October				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lect ures	Practicals	Total		Bipolar junction transistor (BJT), Frequency response and switching of BJT, Base

M.Sc. II	16	-	16	Transistors and Microwave Devices:	Narrowing, Ebers-Moll Model, Gummel–Poon Model, Kirk Effect, Field effect transistor (FET), JFET, MOSFET, MESFET, Tunnel diode, Transferred electron devices and Gunn diode, Avalanche transit time diode and, IMPATT diode
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Photonic Devices:	Optical absorption, Radiative and non-radiative transitions, Light emitting diodes, Organic LED, Infrared LED, Photo detector, Photoconductor, Photodiode, Solar cells, Semiconductor Lasers.
M.Sc. II	16	-	16		
Month February				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Memory Devices:	Number system and its conversion to binary number, Semiconducting memories, Memory organization, Read and Write operation, expanding memory size, Classification and characteristics of memories, Static and dynamic RAM, Charge couple memory (CCD) devices, Magnetic, optical, ferroelectric, Spintronic and other memory based devices.
M.Sc. II	16	-	16		
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Other electronic Devices	Magneto-optic and acousto-optic effects, Material's properties related to get these effects, Piezoelectric, Electrostrictive and Magnetostrictive effects, Sensors, and actuator devices.
M.Sc. II	16	-	16		
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

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Department of Physics

Annual Teaching Plan (PG)

Academic Year: **2024-25**
Subject: Physics
Name of the teacher: **Dr. N. A. Narewadikar**

Month June				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Central Force Problem and Small oscillations:	Two body problem, The equation of motion and first integrals, Equation of orbit, Kepler's laws, Kepler's problem, General analysis of orbits, Stability of orbits, Rutherford Scattering: Differential scattering cross section, Rutherford Formulae for scattering, Virial theorem. Small oscillations: Potential energy and equilibrium-one dimensional oscillator, general theory of small oscillations
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals	Practicals [1] Thin film deposition by SILAR method [2] Thin film deposition by electro-deposition method [3] Thin film deposition by hydrothermal method [4] Thin film deposition by reflux method
Month July				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Variational principle and Hamiltonian Dynamics:	Variational principle, Deduction of canonical equations from Variational principle, Principle of least action with proof, Hamilton's principle, Hamiltonian, Generalized momentum & Conservation Theorems using cyclic coordinates, Hamilton's canonical equations of motion, Applications of Hamilton's equations of motion-i) Simple Pendulum ii) Compound Pendulum iii) Linear Harmonic Oscillator, Problems.
M.Sc. I	16	-	16		

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M.Sc. II	-	32	32	Practicals :	Practicals : [1] Thin film deposition by dip-coating method [2] Thin film deposition by CBD method [3] Microwave assisted synthesis of thin film [4] Thin film deposition by spray pyrolysis method
Month August				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Canonical Transformations and Poisson's Brackets	Legendre transformations, Generating Functions, Illustrations of Canonical transformations, Condition for Canonical Transformation, Examples. Poisson's Brackets, Poisson's theorem, Properties of Poisson's Brackets, Lagrange Bracket, Relation between Lagrange and Poisson's Brackets, Hamilton's Canonical equations in terms of Poisson's Brackets, Hamilton–Jacobi Theory, Solution of harmonic oscillator problem by HJ Method, Problems
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals	Practicals [1] Thin film deposition by SILAR method [2] Thin film deposition by electro-deposition method [3] Thin film deposition by hydrothermal method [4] Thin film deposition by reflux method
Month September				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Special Theory of Relativity and Relativistic Mechanics:	Special theory of relativity and its postulates, Galilean transformations, Lorentz transformations, Relativistic kinematics (Relativity of Mass, Length, Time), Minkowski Space, 4-Vectors, 4- Momentum, Lorentz Tensor, Addition of velocities, Mass-Energy relation, Force in relativistic mechanics, Lagrangian formulation of relativistic mechanics, Particle accelerating under constant force, Hamiltonian formulation of relativistic mechanics, Relativistic Doppler's Effect.
M.Sc. I	16	-	16		

M.Sc. II	-	32	32	Practicals :	Practicals : [1] Thin film deposition by dip-coating method [2] Thin film deposition by CBD method [3] Microwave assisted synthesis of thin film [4] Thin film deposition by spray pyrolysis method
Month October				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Examination	Examination
Month December				**Module/Unit:**	**Sub-units planned**
	Lectures	Practicals	Total	Semiconductor theory and devices:	Energy band gap, Determination of Band gap energy, intrinsic and extrinsic semiconductors, carrier concentration, fermi level and conductivity for intrinsic and extrinsic semiconductor. Review of UJT, switching characteristics of UJT, SCR-construction and working, switching characteristics.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : [1] Thermoelectric power of thin film [2] Contact angle measurement of thin film [3] Determination of band gap energy of thin film [4] Measurement of dielectric constant
Month January				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Crystal defects:	Point defects-Vacancies, Interstitials, impurities, electronic, Expression for Schottky and Frenkel defects Line defects-Edge and screw dislocation, Interpretation of SGP (Plastic deformation) Burgur's vector and circuit, Frank-Read mechanism. Planer defects, Surface defects- Grain boundaries, Tilt boundaries, Twin boundaries, Effect of Imperfections
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals :	Practicals : [1] Rietveld method of structure refinement [2] Calculation of XRD peak positions and intensities [3] Thickness measurement of thin film [4] Electrical resistivity of thin film by 2 probe method
Month February				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total		Energy band gap, Determination of Band gap energy, intrinsic and extrinsic

M.Sc. I	16	-	16	Semiconductor theory and devices:	semiconductors, carrier concentration, fermi level and conductivity for intrinsic and extrinsic semiconductor. Review of UJT, switching characteristics of UJT, SCR-construction and working, switching characteristics.
M.Sc. II	-	32	32	Practicals :	Practicals : [1] Thermoelectric power of thin film [2] Contact angle measurement of thin film [3] Determination of band gap energy of thin film [4] Measurement of dielectric constant
Month March				**Module/Unit:**	**Sub-units planned**
Course	Lectures	Practicals	Total	Semiconductor theory and devices:	Energy band gap, Determination of Band gap energy, intrinsic and extrinsic semiconductors, carrier concentration, fermi level and conductivity for intrinsic and extrinsic semiconductor. Review of UJT, switching characteristics of UJT, SCR-construction and working, switching characteristics.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	Practicals:	Practicals: [1] Rietveld method of structure refinement [2] Calculation of XRD peak positions and intensities [3] Thickness measurement of thin film [4] Electrical resistivity of thin film by 2 probe method
Month April				**Module/Unit:**	**Sub-units planned**
Lectures		Practicals	Total	Examination	Examination

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