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

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)
Department of Physics
Annual Teaching Plan
PG

Academic Year: 2019-20
Subject: Physics
Name of the teacher: **Mr. S. M. Kumbhar**

Month June				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Crystallography**	**Crystallography**
M.Sc. I	16	-	16	Bonding in Solids-Ionic, Covalent and Metallic. Crystalline state of solids, Bravai's lattices and crystal structure , Symmetry elements(cubic),coordination number and packing fraction. Crystal structures-CsCl, 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	Bonding in Solids-Ionic, Covalent and Metallic. Crystalline state of solids, Bravai's lattices and crystal structure , Symmetry elements(cubic),coordination number and packing fraction. Crystal structures-CsCl, 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
M.Sc. II	16	-	16	**Crystal defects** Point defects-Vacancies, Interstitisials, 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,	**Crystal defects** Point defects-Vacancies, Interstitisials, impurities, electronic, Expression for Schottky and Frenkel defects Line defects-Edge and screw dislocation, Interpretation of SGP

				Surface defects- Grain boundaries, Tilt boundaries, Twin boundaries, Effect of Imperfections	(Plastic deformation) Burgur's vector and circuit, Frank-Read mechanism. Planer defects, Surface defects- Grain boundaries, Tilt boundaries, Twin boundaries, Effect of Imperfections
Month July				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Dielectric, Magnetism & Supercondivity**	**Dielectric, Magnetism & Supercondivity**
M.Sc. I	16	-	16	Dielectric-Polarisation mechanism, Dielectric constant, Clausis-Mossoti relation, Magnetism-Comparison between dia, para,and feromgnetism ,Exchange interaction. Magnetic order(Fero,Antifero and ferri), Weiss theory of magnetism Superconductivity- High Tc superconductors, BCS theory of superconductors ,SQUID	Dielectric-Polarisation mechanism, Dielectric constant, Clausis-Mossoti relation, Magnetism-Comparison between dia, para,and feromgnetism ,Exchange interaction. Magnetic order(Fero,Antifero and ferri), Weiss theory of magnetism Superconductivity-High Tc superconductors, BCS theory of superconductors ,SQUID
M.Sc. II	16	-	16	**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,	**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.	switching characteristics of UJT , SCR- construction and working, switching characteristics.
Month August				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Zeeman Effect, Paschen-Back Effect** The magnetic moment of the atom, Zeeman Effect for two electrons, intercity rules for Zeeman Effect, Paschen-Back effect for two electrons, Principle of resonance Spectroscopy *ESR-Principle, ESR Spectrometer, Hyperfine structure, Total Hamiltonian *NMR-Nuclear magnetic properties, Resonance condition of nucleus, NMR instrument, Relaxation process, Chemical shift, NMR applications	**Zeeman Effect, Paschen-Back Effect** The magnetic moment of the atom, Zeeman Effect for two electrons, intercity rules for Zeeman Effect, Paschen-Back effect for two electrons, Principle of resonance Spectroscopy *ESR-Principle, ESR Spectrometer, Hyperfine structure, Total Hamiltonian *NMR-Nuclear magnetic properties, Resonance condition of nucleus, NMR instrument, Relaxation process, Chemical shift, NMR applications
M.Sc. I	16	-	16		
M.Sc. II	16	-	16	**X-Ray Fluorescence Spectrometry and Mössbauer Spectroscopy** Introduction to wavelength-dispersive X-ray fluorescence spectrometry (WDXRF) and energy- dispersive X-ray fluorescence spectrometry (EDXRF), dispersive systems, detectors ,instruments, matrix effects, XRF with synchrotron	**X-Ray Fluorescence Spectrometry and Mössbauer Spectroscopy** Introduction to wavelength-dispersive X-ray fluorescence spectrometry (WDXRF) and energy- dispersive X-ray fluorescence spectrometry (EDXRF), dispersive systems,

				radiation. Elementary theory of recoil free emission and resonant absorption of gamma rays, Mössbauer experiment, hyperfine, interactions: chemical isomer shift, magnetic dipole hf splitting, and electric quadrupole hf splitting; line broadening.	detectors ,instruments, matrix effects, XRF with synchrotron radiation. Elementary theory of recoil free emission and resonant absorption of gamma rays, Mössbauer experiment, hyperfine, interactions: chemical isomer shift, magnetic dipole hf splitting, and electric quadrupole hf splitting; line broadening.
Month September				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Atomic Absorption Spectrometry** Fundamentals : principle, basic equipment, operation, monochromator action, 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.	**Atomic Absorption Spectrometry** Fundamentals : principle, basic equipment, operation, monochromator action, 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		

M.Sc. II	-	32	32	**Atomic Absorption Spectrometry** Fundamentals : principle, basic equipment, operation, monochromator action, 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.	**Atomic Absorption Spectrometry** Fundamentals : principle, basic equipment, operation, monochromator action, 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.
Month October					
Course	Lectures	Practicals	Total	Module/Unit:	Sub-units planned
M.Sc. I	16	-	16	**Low Temperature and Microscopy Techniques** Production of low temperatures: Adiabatic cooling, the Joule-Kelvin expansion, adiabatic demagnetization, 3He cryostat, the dilution refrigerator, principle of Pomerunchuk cooling,principle of nuclear demagnetization; measurement of low temperatures. Optical microscopy,scanning electron microscopy, electron microprobe analysis, low energy electron diffraction.	**Low Temperature and Microscopy Techniques** Production of low temperatures: Adiabatic cooling, the Joule-Kelvin expansion, adiabatic demagnetization, 3He cryostat, the dilution refrigerator, principle of Pomerunchuk cooling,principle of nuclear demagnetization; measurement of low temperatures. Optical microscopy,scanning electron microscopy, electron microprobe analysis, low energy

					electron diffraction.
M.Sc. II	16	-	16	**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.	**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. I	16	-	16	**Energy Bands and Charge Carriers in Semiconductors:** Bonding forces and energy bands in solids, Direct and Indirect semiconductors, variation of energy bands with alloy composition, Charge carriers in semiconductors: electrons and holes,effective mass, intrinsic and extrinsic materials, 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	**Energy Bands and Charge Carriers in Semiconductors:** Bonding forces and energy bands in solids, Direct and Indirect semiconductors, variation of energy bands with alloy composition, Charge carriers in semiconductors: electrons and holes,effective mass, intrinsic and extrinsic materials, 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

M.Sc. II	16	-	16	**Excess Carriers in Semiconductors:** Optical absorption, Luminescence, 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, The Haynes-Shockley experiment.	**Excess Carriers in Semiconductors:** Optical absorption, Luminescence, 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, The Haynes-Shockley experiment.
Month January				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Junctions-I** Fabrication of p-n junctions; Thermal oxidation, diffusion, Rapid thermal processing, Ion implantation, CVD, Photolithography, etching, metallization, The contact potential, Space charge at a junction, qualitative description of current flow at a junction, reverse-bias breakdown, Zener and Avalanche breakdown.	**Junctions-I** Fabrication of p-n junctions; Thermal oxidation, diffusion, Rapid thermal processing, Ion implantation, CVD, Photolithography, etching, metallization, The contact potential, Space charge at a junction, qualitative description of current flow at a junction, reverse-bias breakdown, Zener and Avalanche breakdown.
M.Sc. I	16	-	16		

M.Sc. II	16	-	16	**Junctions-II** Capacitance of p-n junctions, the Varactor diode, recombination and generation in the transition region, ohmic losses, graded junctions, schottky barriers, rectifying contacts, ohmic contacts, heterojunctions, AlGaAs-GaAs heterojunction.	**Junctions-II** Capacitance of p-n junctions, the Varactor diode, recombination and generation in the transition region, ohmic losses, graded junctions, schottky barriers, rectifying contacts, ohmic contacts, heterojunctions, AlGaAs-GaAs heterojunction.
Month February				Module/Unit:	Sub-units planned
Course M.Sc. I	Lectures 16	Practicals -	Total 16	**Classical statistics-I** Statistical description of system of particles, Phase space, Phase space diagram of an oscillator, Volume in phase space, Phase space cells in harmonic oscillator and three dimensional free particle. Concept of ensembles, Ensemble average and its uses Liouville's theorem-principal of conservation of density in phase space and extension in space. Condition for stastical and thermal equilibrium. Statistical interpretation of thermodynamic variables-Energy, work pressure, and entropy.	**Unit 4 : Scattering Theory** The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal 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.

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M.Sc. II	16	-	16	**Classical statistics-II** Microcanonical ensemble and its implication in practical use, Perfect gas in Microcanonical ensemble – internal energy, entropy, Canonical ensemble, derivation of canonical distribution (alternative method) probability density, partition and thermodynamic function for canonical ensembles. Perfect monoatomic gas in canonical ensemble Grand Canonical ensemble-Partition function and thermodynamics, Perfect gas in Grand canonical ensemble. Comparison between Microcanonical, canonical and Grand canonical.	**Classical statistics-II** Microcanonical ensemble and its implication in practical use, Perfect gas in Microcanonical ensemble – internal energy, entropy, Canonical ensemble, derivation of canonical distribution (alternative method) probability density, partition and thermodynamic function for canonical ensembles. Perfect monoatomic gas in canonical ensemble Grand Canonical ensemble-Partition function and thermodynamics, Perfect gas in Grand canonical ensemble. Comparison between Microcanonical, canonical and Grand canonical.
Month March				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Quantum Statistics-I** Density Matrix, Liouville's theorem in quantum statistical mechanics, condition for statistical equilibrium. The Boltzman limit of Boson and Fermion gases, Evaluation of partition function . Ideal Bose system-Photon gas, Bose Einstein condensation, Liquid Helium-Landau's theory.	**Quantum Statistics-I** Density Matrix, Liouville's theorem in quantum statistical mechanics, condition for statistical equilibrium. The Boltzman limit of Boson and Fermion gases, Evaluation of partition function . Ideal Bose system-Photon gas, Bose Einstein condensation, Liquid Helium-Landau's
M.Sc. I	16	-	16		

					theory.
M.Sc. II	16	-	16	**Quantum Statistics-II** Ideal Fermi gas systems-energy and pressure of the gas, slight and strong degeneracy, free electron model, white dwarfs. Phase transition and phase diagram. Clausis-Clapeyron equation, Second order phase transition-Ferromagnetic materials .Transport phenomenon-Electrical and thermal conductivity. Thermionic emission. Photoelectric effect, Effusion, Diffusion, Einstein's relation for mobility.	**Quantum Statistics-II** Ideal Fermi gas systems-energy and pressure of the gas, slight and strong degeneracy, free electron model, white dwarfs. Phase transition and phase diagram. Clausis-Clapeyron equation, Second order phase transition-Ferromagnetic materials .Transport phenomenon-Electrical and thermal conductivity. Thermionic emission. Photoelectric effect, Effusion, Diffusion, Einstein's relation for mobility.
Month April				Module/Unit:	Sub-units planned
Lectures		Practicals	Total	Examination	Examination

Kumbhar

Teacher Incharge

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HOD

Head of the Department of Physics Vivekanand College, Kolhapur

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PG

Academic Year: **2019-20**
Subject: **Physics**
Name of the teacher: **Dr. P. D. Patke**

Month June				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Complex Variables** 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.	**Complex Variables** 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.
M.Sc. I	16	-	16		
M.Sc. II	-	32	32	**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	**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	Matrices Matrix multiplication – Inner	Matrices Matrix multiplication – Inner

M.Sc. I	16	-	16	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	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
M.Sc. II	-	32	32	**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	**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 August				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Fourier series and integrals**	**Fourier series and integrals**
M.Sc. I	16	-	16	Fourier series and Fourier transform, Dirichlet condition, (Statement only) 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.	Fourier series and Fourier transform, Dirichlet condition, (Statement only) 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.

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	**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 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)	**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		
M.Sc. II	-	32	32	**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	**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 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 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	**Crystallography** Bonding in Solids-Ionic, Covalent and Metallic. Crystalline state of solids, Bravai's 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
M.Sc. I	16	-	16		
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	**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 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	**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 :** [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	**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	**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	**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 :** [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	**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	Lect	Practicals	Total	**Dielectric, Magnetism &**	**Dielectric, Magnetism &**

	ures			**Supercondivity:**	**Supercondivity:**
M.Sc. I	16	-	16	Dielectric-Polarisation mechanism, Dielectric constant, Clausis-Mossoti relation, Magnetism Comparison 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	Dielectric-Polarisation mechanism, Dielectric constant, Clausis-Mossoti relation, Magnetism Comparison 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. II	-	32	32	**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	**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 April				Module/Unit:	Sub-units planned
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

HOD

Head of the Department of Physics Vivekanand College, Kolhapur

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Academic Year: 2019-20
Subject: Physics
Name of the teacher: **Miss T. U. Urunkar**

Month June				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Mechanics**	**Mechanics**
M.Sc. I	16	-	16	Mechanics of a system of particles in vector form. Conservation of linear momentum, energy and angular momentum. Degrees of freedom, generalised coordinates and velocities. Lagrangian, action principle, external action, Euler-Lagrange equations. Constraints. Applications of the Lagrangian formalism. Generalised momenta, . Legendre transform, relation to Lagrangian formalism. Phase space, Phase trajectories. Applications to systems with one and two degrees of freedom	Mechanics of a system of particles in vector form. Conservation of linear momentum, energy and angular momentum. Degrees of freedom, generalised coordinates and velocities. Lagrangian, action principle, external action, Euler-Lagrange equations. Constraints. Applications of the Lagrangian formalism. Generalised momenta, . Legendre transform, relation to Lagrangian formalism. Phase space, Phase trajectories. Applications to systems with one and two degrees of freedom
M.Sc. II	16	-	16	**Thin Film Deposition and Other Techniques** Introduction, reaction types, thermodynamics of CVD, gas transport and growth kinetics, CVD process and basic systems; Spray deposition Introduction, basic	**Thin Film Deposition and Other Techniques** Introduction, reaction types, thermodynamics of CVD, gas transport and growth kinetics, CVD process and basic systems; Spray

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				instrumentation, different type of spray techniques; spray pyrolysis technique, electrospray deposition technique, advantages and disadvantages of spry deposition techniques, Electrodeposition, Spin coating, SILAR technique, Chemical bath deposition.	deposition Introduction, basic instrumentation, different type of spray techniques; spray pyrolysis technique, electrospray deposition technique, advantages and disadvantages of spry deposition techniques, Electrodeposition, Spin coating, SILAR technique, Chemical bath deposition
Month July				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Lagrange's and Hamilton's theory:**	**Lagrange's and Hamilton's theory:**
M.Sc. I	16	-	16	Configuration space, techniques of calculus of variation, Applications of the variational principle. Hamiltonian principle, Equivalence of Lagrange's and Newton's Equations, Lagrange's Equation for non-Holonomic systems, Hamilton's equations of motion, Hamilton's applications-Simple pendulum, Charged particle in an electromagnetic field.	Configuration space, techniques of calculus of variation, Applications of the variational principle. Hamiltonian principle, Equivalence of Lagrange's and Newton's Equations, Lagrange's Equation for non-Holonomic systems, Hamilton's equations of motion, Hamilton's applications-Simple pendulum, Charged particle in an electromagnetic field.of good research.
M.Sc. II	16	-	16	**Heat treatment furnaces** Definition and concept of furnace, types of heat treatment furnaces : Oil and Gas fired furnaces, Electric furnaces, Batch furnace and their types, Semi continuous and continuous	**Heat treatment furnaces** Definition and concept of furnace, types of heat treatment furnaces : Oil and Gas fired furnaces, Electric furnaces, Batch

				furnace, Air convection furnace, salt bath furnace-advantages and limitations, Furnace atmosphere and temperature control.	furnace and their types, Semi continuous and continuous furnace, Air convection furnace, salt bath furnace-advantages and limitations, Furnace atmosphere and temperature control.
Month August				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Research Methodology**	**Research Methodology**
M.Sc. I	16	-	16	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.	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.
M.Sc. II	16	-	16	**Thin Film Deposition and Other Techniques** Types of solid solutions, substitutional, disordered, ordered, interstitial solid solution, intermediate phases ,Hume Rothery's rules, concept of solidification of metals-nucleation, homogeneous and heterogeneous nucleation, growth its new phase and phase change kinetics, solid solution hardening, Age hardening, dispersion hardening, phase transformation hardening principles of hot and cold working of metals and their	**Thin Film Deposition and Other Techniques** Types of solid solutions, substitutional, disordered, ordered, interstitial solid solution, intermediate phases ,Hume Rothery's rules, concept of solidification of metals-nucleation, homogeneous and heterogeneous nucleation, growth its new phase and phase change kinetics, solid solution hardening,

				effects on mechanical properties	Age hardening, dispersion hardening, phase transformation hardening principles of hot and cold working of metals and their effects on mechanical properties
Month September				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Vacuum deposition** apparatus: Vacuum systems ,substrate materials, Thermal Evaporation methods: Resistive heating, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, RF Sputtering, Ion beam sputtereing Research Methodology Vacuum deposition apparatus: Vacuum systems ,substrate materials, Thermal Evaporation methods: Resistive heating, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, RF Sputtering, Ion beam sputtereing	**Vacuum deposition** apparatus: Vacuum systems ,substrate materials, Thermal Evaporation methods: Resistive heating, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, RF Sputtering, Ion beam sputtereing Research Methodology Vacuum deposition apparatus: Vacuum systems ,substrate materials, Thermal Evaporation methods: Resistive heating, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, RF Sputtering, Ion beam sputtereing
M.Sc. I	16	-	16		

M.Sc. II	-	32	32	**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	**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 October					
Course	Lectures	Practicals	Total	Module/Unit:	Sub-units planned
M.Sc. I	16	-	16	**Unit 4: 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 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	**Unit 4: 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 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. II	16	-	16	**Raman and ESR Techniques** Raman Scattering- introduction theory , Rotational and Vibrational spectra, Raman spectrometer Fourier	**Raman and ESR Techniques** Raman Scattering- introduction theory , Rotational and Vibrational spectra,

				transform Raman spectrometer, Structure determination using IR and Raman - Electron Spin Resonance(ESR)-Principle, construction and working ,Total Hamiltonian, Hyperfine structure, ESR of Transition metals	Raman spectrometer Fourier transform Raman spectrometer, Structure determination using IR and Raman - Electron Spin Resonance(ESR)-Principle, construction and working ,Total Hamiltonian, Hyperfine structure, ESR of Transition metals
Month December					
Course	Lectures	Practicals	Total	Module/Unit:	Sub-units planned
M.Sc. I	16	-	16	**Unit 1 : Origin and general formalism** Sequential Stern-Gerlach experiment, analogy with polarization of light, linear vector space, linear operator, eigenfunction and eigen values, Hermitian operator, Postulates of quantum mechanics , Diracs bra and ket notation, equation of motion, schrodinger representation, Heisenberg representation, momentum representation.	**Unit 1 : Origin and general formalism** Sequential Stern-Gerlach experiment, analogy with polarization of light, linear vector space, linear operator, eigen function and eigen values, Hermitian operator, Postulates of quantum mechanics , Diracs bra and ket notation, equation of motion, schrodinger representation, Heisenberg representation, momentum representation
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	**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	**Unit-2: Angular Momentum**	**Unit-2: Angular Momentum**
M.Sc. I	16	-	16	Angular momentum operator, angular momentum commutation relations, Eigen values of J^2 & JZ, angular momentum matrices spin angular momentum , addition of angular momenta, computation of clebsch-Gorden coefficients in simple cases(J1=1/2, J2=1/2)	Angular momentum operator, angular momentum commutation relations, Eigen values of J^2 & JZ, angular momentum matrices spin angular momentum , addition of angular momenta, computation of clebsch- Gorden coefficients in simple cases(J1=1/2, J2=1/2)
M.Sc. II	16	-	16	**Unit II Low Temperature and Microscopy Techniques** 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 diffraction	**Unit II Low Temperature and Microscopy Techniques** 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 diffraction
Month February				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Unit 4 : Scattering Theory**	**Unit 4 : Scattering Theory**
M.Sc. I	16	-	16	The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal approximation, Free particle states, Partial wave	The Lippmann-Schwinger equation, The Born approximation, Optical Theorem,

				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.	Eikonal 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. II	16	-	16	**Unit III Atomic Absorption Spectrometry** Fundamentals :principle,basic equipmentmodulation;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	**Unit III Atomic Absorption Spectrometry** Fundamentals :principle,basic equipmentmodulation;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
Month March				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Unit 3 : Time Dependent**	**Unit 3 : Time**

M.Sc. I	16	-	16	**Perturbation Theory** Time dependent potentials, Time dependent Perturbation theory, Applications to interactions with the classical radiation field, energy shift and decay width, Adiabatic Approximation.	**Dependent Perturbation Theory** Time dependent potentials, Time dependent Perturbation theory, Applications to interactions with the classical radiation field, energy shift and decay width, Adiabatic Approximation.
M.Sc. II	16	-	16	**Unit IV X-Ray Fluorescence Spectrometry and Mössbauer Spectroscopy** The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal 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	**Unit IV X-Ray Fluorescence Spectrometry and Mössbauer Spectroscopy** The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal 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
Month April				Module/Unit:	Sub-units planned
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

HOD
Head of the Department of Physics
Vivekanand College, Kolhapur

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

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

Annual Teaching Plan

PG

Academic Year: 2019-20
Subject: Physics
Name of the teacher: **Mr. A V. Shinde**

Month June				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Origin and general formalism of QM** Inadequacy of classical physics (origin of quantum mechanics), sequential Stern-Gerlach experiment, analogy with polarization of light, linear vector space, linear operator, eigenfunction and eigen values, Hermitian operator	**Origin and general formalism of QM** Inadequacy of classical physics (origin of quantum mechanics), sequential Stern-Gerlach experiment, analogy with polarization of light, linear vector space, linear operator, eigenfunction and eigen values, Hermitian operator
M.Sc. I	16	-	16		
M.Sc. II	16	-	16	**Representation of states and quantum dynamics** Postulates of quantum mechanics , Diracs bra and ket notation, equation of motion, schrodinger representation, Heisenberg representation, momentum representation.	**Representation of states and quantum dynamics** Postulates of quantum mechanics , Diracs bra and ket notation, equation of motion, schrodinger representation, Heisenberg representation, momentum representation
Month July				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Angular Momentum**	**Angular Momentum**

M.Sc. I	16	-	16	Angular momentum operator, angular momentum commutation relations, Eigen values of J2 JZ , angular momentum matrices, spin angular momentum , addition of angular momenta, computation of clebsch-Gorden coefficients in simple cases(J1=1/2, J2=1/2)	Angular momentum operator, angular momentum commutation relations, Eigen values of J2 JZ , angular momentum matrices, spin angular momentum , addition of angular momenta, computation of clebsch- Gorden coefficients in simple cases(J1=1/2, J2=1/2)
M.Sc. II	16	-	16	**Approximation methods I** Time independent perturbation theory, non degenerate and degenerate case, first and second perturbations, applications-anharmonic oscillator ,stark effect, hydrogen like atoms: fine structure and Zeeman effect	**Approximation methods I** Time independent perturbation theory, non degenerate and degenerate case, first and second perturbations, applications-anharmonic oscillator ,stark effect, hydrogen like atoms: fine structure and Zeeman effect
Month August				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Nucleon-Nucleon Interaction:** Nature of the nuclear forces, form of nucleon-nucleon potential, Deuteron problem: The theory of ground state of deuteron, excited states of deuteron, n-p scattering at low energies (cross-section, phase shift analysis, scattering length, n-p scattering for square well potential, effective	**Nucleon-Nucleon Interaction:** Nature of the nuclear forces, form of nucleon-nucleon potential, Deuteron problem: The theory of ground state of deuteron, excited states of deuteron, n-p scattering at low energies (cross-section, phase shift analysis, scattering length, n-p scattering for square
M.Sc. I	16	-	16		

				range theory); p-p scattering at low energies (cross-section, experiment , and results) ; exchange forces, tensor forces; high energy N-N scattering (qualitative discussion only of n-p and p-p scatterings), charge-independence and charge-symmetry of nuclear forces.	well potential, effective range theory); p-p scattering at low energies (cross-section, experiment , and results) ; exchange forces, tensor forces; high energy N-N scattering (qualitative discussion only of n-p and p-p scatterings), charge-independence and charge-symmetry of nuclear forces.
M.Sc. II	16	-	16	**Cosmic rays and elementary particles** Concept of cosmic rays and their properties, secondary radiations Cosmic ray stars, Electronic showers-geomagnetic, latitude, longitude and azimuth effects, Elementary particles and their properties.	**Cosmic rays and elementary particles** Concept of cosmic rays and their properties, secondary radiations Cosmic ray stars, Electronic showers-geomagnetic, latitude, longitude and azimuth effects, Elementary particles and their properties.
Month September				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Particle Physics:** Classification of fundamental forces. Classification of Elementary particles and their quantum	**Particle Physics:** Classification of fundamental forces. Classification of Elementary particles

M.Sc. I	16	-	16	numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, CPT invariance. Application of symmetry arguments to particle ,reactions, Parity non-conservation in weak interaction, Relativistic kinematics.	and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, CPT invariance. Application of symmetry arguments to particle ,reactions, Parity non-conservation in weak interaction, Relativistic kinematics.
M.Sc. II	-	32	32	**Nuclear Reactions:** Elementary ideas of alpha, beta and gamma decays and their classifications, characteristics, selection rules and basic theoretical understanding. Nuclear reactions, reaction mechanism, Compound nucleus reaction (origin of the compound nucleus hypothesis, discrete resonances, continuum states), optical model of particle-induced nuclear reaction and direct reactions (experimental characteristics, direct inelastic scattering and transfer reactions). Fission and fusion, Fission and heavy ion reactions.	**Nuclear Reactions:** Elementary ideas of alpha, beta and gamma decays and their classifications, characteristics, selection rules and basic theoretical understanding. Nuclear reactions, reaction mechanism, Compound nucleus reaction (origin of the compound nucleus hypothesis, discrete resonances, continuum states), optical model of particle-induced nuclear reaction and direct reactions (experimental characteristics, direct inelastic scattering and transfer reactions). Fission and fusion, Fission and heavy ion reactions.
Month October					
Course	Lectures	Practicals	Total	Module/Unit:	Sub-units planned

M.Sc. I	16	-	16	**Physical methods of thin film deposition** Vacuum deposition apparatus: Vacuum systems, substrate deposition technology, substrate materials, substrate cleaning, masks and connections, multiple film deposition, Thermal Evaporation methods: Resistive heating, Flash evaporation, Arc evaporation, laser evaporation, electron bombardment heating, Sputtering: Introduction to sputtering process andsputtering variants, glow discharge sputtering, Magnetic field assisted (Triode) sputtering, RFSputtering, Ion beam sputtering, sputtering of multicomponent materials	**Physical methods of thin film deposition** Vacuum deposition apparatus: Vacuum systems, substrate deposition technology, substrate materials, substrate cleaning, masks and connections, multiple film deposition, Thermal Evaporation methods: Resistive heating, Flash evaporation, Arc evaporation, laser evaporation, electron bombardment heating, Sputtering: Introduction to sputtering process andsputtering variants, glow discharge sputtering, Magnetic field assisted (Triode) sputtering, RFSputtering, Ion beam sputtering, sputtering of multicomponent materials
M.Sc. II	16	-	16	**Chemical methods** Chemical vapor deposition: Common CVD reactions, Methods of film preparation, laser CVD, Photochemical CVD, Plasma enhanced CVD, Chemical bath deposition: ionic and solubility products, preparation of binary semiconductors, Electrodeposition: Deposition mechanism and preparation of compound thin film Spray pyrolysis : Deposition mechanism and	**Chemical methods** Chemical vapor deposition: Common CVD reactions, Methods of film preparation, laser CVD, Photochemical CVD, Plasma enhanced CVD, Chemical bath deposition: ionic and solubility products, preparation of binary semiconductors, Electrodeposition: Deposition mechanism

				preparation of compound thin films, Chemical bath deposition, successive ionic layer adsorption reaction method (SILAR) method, Sol-gel method, Hydrothermal method	and preparation of compound thin film Spray pyrolysis : Deposition mechanism and preparation of compound thin films, Chemical bath deposition, successive ionic layer adsorption reaction method (SILAR) method, Sol-gel method, Hydrothermal method
Month December					
Course	Lectures	Practicals	Total	Module/Unit:	Sub-units planned
M.Sc. I	16	-	16	**Magnetism in solids** Types of magnetism: Langevin's classical and quantum theory in diamagnetism, paramagnetism, ferromagnetism-Magnetostriction, Weiss theory and molecular field concept of domains, Antiferomagnetism, Ferimagnetism	**Magnetism in solids** Types of magnetism: Langevin's classical and quantum theory in diamagnetism, paramagnetism, ferromagnetism-Magnetostriction, Weiss theory and molecular field concept of domains, Antiferomagnetism, Ferimagnetism
M.Sc. II	16	-	16	**Electrical Properties in solids** Classical theory of electric conduction and its temperature dependence , Wiedermann-Franz law, Electron scattering and sources of resistance in metals, variation of resistivity with temperature, resistivity of alloys, mechanical effects on electrical resistance, conductivity at high frequencies, effect of the magnetic fields-hall effect and	**Electrical Properties in solids** Classical theory of electric conduction and its temperature dependence , Wiedermann-Franz law, Electron scattering and sources of resistance in metals, variation of resistivity with temperature, resistivity of alloys, mechanical effects on electrical resistance, conductivity at high

				magnetorésistance, thermionic emission	frequencies, effect of the magnetic fields- hall effect and magnetorésistance, thermionic emission
Month January				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**The atom Model for Two Valance Electron**	**The atom Model for Two Valance Electron**
M.Sc. I	16	-	16	**The atom Model for Two Valance Electron** Revision of atomic structure and atomic spectra, Origin of spectral lines, General selection rules, Fine structure, Hyperfine Structure, Quantum numbers, Pauli's exclusion principle, Coupling Schemes for two electrons, Γ-factors for LS coupling, Lande interval rule, jj-coupling, branching rules, Selection rules, Intensity relations.	**The atom Model for Two Valance Electron** Revision of atomic structure and atomic spectra, Origin of spectral lines, General selection rules, Fine structure, Hyperfine Structure, Quantum numbers, Pauli's exclusion principle, Coupling Schemes for two electrons, Γ-factors for LS coupling, Lande interval rule, jj-coupling, branching rules, Selection rules, Intensity relations.
M.Sc. II	16	-	16	**Microwave Spectroscopy** Classification of molecules: linear, symmetric tops, spherical tops, asymmetric tops; rotational spectra: the rigid diatomic molecule, The non- rigid rotator, spectrum of non-rigid rotator, Techniques and instrumentations of microwave spectroscopy, chemical analysis by Microwave spectroscopy	**Microwave Spectroscopy** Classification of molecules: linear, symmetric tops, spherical tops, asymmetric tops; rotational spectra: the rigid diatomic molecule, The non- rigid rotator, spectrum of non-rigid rotator, Techniques and instrumentations of microwave spectroscopy, chemical analysis by Microwave spectroscopy
Month February				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Unit 4 : Scattering Theory**	**Unit 4 : Scattering**

M.Sc. I	16	-	16	The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal 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.	**Theory** The Lippmann-Schwinger equation, The Born approximation, Optical Theorem, Eikonal 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. II	16	-	16	**Unit III Atomic Absorption Spectrometry** Fundamentals :principle,basic equipmentmodulation;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	**Unit III Atomic Absorption Spectrometry** Fundamentals :principle,basic equipmentmodulation;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
Month March				Module/Unit:	Sub-units planned
Course	Lectures	Practicals	Total	**Infra-Red Spectroscopy**	**Infra-Red**

M.Sc. I	16	-	16	Spectroscopic characterization, Principle, Instrumentation, Working, Applications, The vibrating diatomic molecule: the energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating-rotator, techniques and instrumentation of infra-red spectroscopy.	**Spectroscopy** Spectroscopic characterization, Principle, Instrumentation, Working, Applications, The vibrating diatomic molecule: the energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating-rotator, techniques and instrumentation of infra-red spectroscopy.
M.Sc. II	16	-	16	**Quantum Statistics-I** Density Matrix, Liouville's theorem in quantum statistical mechanics, condition for statistical equilibrium. The Boltzman limit of Boson and Fermion gases, Evaluation of partition function . Ideal Bose system-Photon gas, Bose Einstein condensation, Liquid Helium-Landau's theory.	**Quantum Statistics-I** Density Matrix, Liouville's theorem in quantum statistical mechanics, condition for statistical equilibrium. The Boltzman limit of Boson and Fermion gases, Evaluation of partition function . Ideal Bose system-Photon gas, Bose Einstein condensation, Liquid Helium-Landau's theory.
Month April				Module/Unit:	Sub-units planned
Lectures		Practicals	Total	Examination	Examination

Teacher Incharge

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

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