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

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

Syllabus completion Report

PG

Academic Year: 2020-21
Subject: Physics
Name of the teacher: **Mr. P. Y. Hawaldar**

Month June				Module/Unit:	Syllabus Covered / Not Covered	Remark
Course	Lectures	Practicals	Total	**Crystallography**	Covered	
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		
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, Surface defects- Grain boundaries, Tilt boundaries, Twin boundaries, Effect of Imperfections	Covered	
Month July				Module/Unit:		
Course	Lectures	Practicals	Total		Covered	

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M.Sc. I	16	-	16	**Dielectric, Magnetism & Supercondivity** 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, switching characteristics.	Covered	
Month August				Module/Unit:		
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	Covered	
M.Sc. I	16	-	16			

				condition of nucleus, NMR instrument, Relaxation process, Chemical shift, NMR applications		
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 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.	Covered	
Month September				Module/Unit:		
Course	Lectures	Practicals	Total	**Atomic Absorption Spectrometry**	Covered	

M.Sc. I	16	-	16	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. 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.	Covered	
Month October						
Course	Lectures	Practicals	Total	Module/Unit:	Covered	
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	Covered	

				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.	Covered	
Month December						
Course	Lectures	Practicals	Total	Module/Unit:		
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	Covered	
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	Covered	

				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:		
Course	Lectures	Practicals	Total	**Junctions-I**	Covered	
M.Sc. I	16	-	16	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. 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.	Covered	
Month February				Module/Unit:		
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	Covered	

				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.		
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.	Covered	
Month March				Module/Unit:		
Course	Lectures	Practicals	Total	**Quantum Statistics-I**	Covered	

M.Sc. I	16	-	16	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.		
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.	Covered	
Month April				Module/Unit:		
Lectures		Practicals	Total	Examination		

Teacher Incharge

HOD

Head of the
Department of Physics
Vivekanand College, Kolhapur

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Department of Physics

Syllabus completion Report

PG

Academic Year: **2020-21**
Subject: **Physics**
Name of the teacher: **Miss M. J. Medhekar**

<table>
<tr><td colspan="4">Month June</td><td>Module/Unit:</td><td>Syllabus Covered / Not Covered</td><td>Remark</td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td rowspan="2">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.</td><td rowspan="2">Covered</td><td></td></tr>
<tr><td>M.Sc. I</td><td>16</td><td>-</td><td>16</td><td></td></tr>
<tr><td>M.Sc. II</td><td>-</td><td>32</td><td>32</td><td>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</td><td>Covered</td><td></td></tr>
<tr><td colspan="4">Month July</td><td>Module/Unit:</td><td></td><td></td></tr>
<tr><td>Course</td><td>Lectures</td><td>Practicals</td><td>Total</td><td>Matrices</td><td>Covered</td><td></td></tr>
</table>

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M.Sc. I	16	-	16	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		
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	Covered	
Month August				Module/Unit:		
Course	Lectures	Practicals	Total	**Fourier series and integrals** 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.	Covered	
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	Covered	
Month September				Module/Unit:		
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)	Covered	
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	Covered	
Month October				Module/Unit:		
	Lectures	Practicals	Total	Examination		
Month December				Module/Unit:		
	Lectures	Practicals	Total	**Crystallography**	Covered	

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 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. 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	Covered	
Month January				Module/Unit:		
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	Covered	
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	Covered	
Month February				Module/Unit:		
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	Covered	
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	Covered	
Month March				Module/Unit:		
Course	Lectures	Practicals	Total	**Dielectric, Magnetism & Supercondivity:**	Covered	

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		
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	Covered	
Month April				Module/Unit:		
Lectures		Practicals	Total	Examination		

Teacher Incharge

HOD

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Department of Physics

Syllabus completion Report

PG

Academic Year: 2020-21
Subject: Physics
Name of the teacher: **Mr. A. N. Gore**

Month June				Module/Unit:	Syllabus Covered / Not Covered	Remark
Course	Lectures	Practicals	Total	**Mechanics**	Covered	
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		
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 instrumentation, different type of spray techniques; spray pyrolysis technique, electrospray deposition technique, advantages and disadvantages of spry	Covered	

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				deposition techniques, Electrodeposition, Spin coating, SILAR technique, Chemical bath deposition.		
Month July				Module/Unit:		
Course	Lectures	Practicals	Total	**Lagrange's and Hamilton's theory:** 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.	Covered	
M.Sc. I	16	-	16			
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 furnace, Air convection furnace, salt bath furnace-advantages and limitations, Furnace atmosphere and temperature control.	Covered	
Month August				Module/Unit:		
Course	Lectures	Practicals	Total	**Research Methodology**	Covered	

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.		
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 effects on mechanical properties	Covered	
Month September				Module/Unit:		
Course	Lectures	Practicals	Total	**Vacuum deposition** apparatus: Vacuum systems ,substrate materials, Thermal Evaporation methods: Resistive heating, laser	Covered	

M.Sc. I	16	-	16	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. 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	Covered	
Month October						
Course	Lectures	Practicals	Total	Module/Unit:	Covered	
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	Covered	

				,photoelectron spectroscopy (XPS		
M.Sc. II	16	-	16	**Raman and ESR Techniques** Raman Scattering-introduction theory , Rotational and Vibrational spectra, 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	Covered	
Month December						
Course	Lectures	Practicals	Total	Module/Unit:		
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.	Covered	
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	Covered	
Month January				Module/Unit:		
Course	Lectures	Practicals	Total		Covered	

M.Sc. I	16	-	16	**Unit-2: Angular Momentum** 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	Covered	
Month February				Module/Unit:		
Course M.Sc. I	Lectures 16	Practicals -	Total 16	**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.	Covered	