Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Detailed Syllabus

For M.Sc. Physics

(2019-20 Course)

(with effect from 2019-20)

CIA: Continuous Internal Evaluation

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19ScPhyP101	Mathematical Methods of Physics – I	04	04	50	50	100
CCT-2	19ScPhyP102	Classical Mechanics	04	04	50	50	100
CCT-3	19ScPhyP103	Atomic and Molecular Physics	04	04	50	50	100
CCT-4	19ScPhyP104	Electronics	04	04	50	50	
CCP-1	19ScPhyP105	Lab Course I	04	04	50	50	
AECCT-1	19CpCysP101	Cyber Security-I	1	1	-	-	25
AECCT-2	19CpHrtP102	Human Rights-I	1	1	-	-	25
		Total Credits	**-**	**22**			

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-9	19ScPhyP201	Electrodynamics	04	04	50	50	100
CCT-10	19ScPhyP202	Statistical Mechanics	04	04	50	50	100
CCT-11	19ScPhyP203	Solid State Physics	04	04	50	50	100
CCT-12	19ScPhyP204	Quantum Mechanics - I	04	04	50	50	100
CCP-5	19ScPhyP205	Lab Course II	04	04	50	50	100
AECCT-	19CpCysP201	Cyber Security-II	1	1	-	-	25
AECCT-	19CpHrtP202	Human Rights-II	1	1	-	-	25
		Total Credits	**-**	**22**			

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP101
Course Name: Mathematical Methods in Physics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Vector Algebra
- Vector Calculus
- Basics of Complex numbers
- Differential equations
- Differentiation and Integration

Course Objectives:

- To Study various mathematical concepts used in the study of Physics
- To learn application of mathematical methods in solving various equations in Physics and interpretation of the equations from Physics view point.

Course Outcomes:

On completion of the course, student will be able to–

- Understand the concepts/ equations involved in various areas of Physics like Electrodynamics, Quantum Mechanics, Classical Mechanics, Solid State Physics etc.
- Apply the methods to various situations and determine solutions of the problems.

Course Contents

Module 1	**Linear vector spaces and matrices**	15 Lectures
	• Linear vector spaces, basis • Linear dependence and independence • linear operators, Inverses • Matrix representation, Eigen values and eigenvectors • Inner product, Orthonormality • Self adjoint and Unitary transformations, • Eigen values and eigenvectors of Hermitian & Unitary transformations • Experiential Learning	
Module 2	**Elements of complex analysis**	15 Lectures
	• Cauchy- Riemann conditions, • Analytic functions • Cauchy's theorems • Poles and singularities • Taylor and Laurent series, • Residues, Residue theorem • Contour Integra • Experiential Learning	
Module 3	**Fourier series and Transform**	15 Lectures
	• Fourier series: Definition • Dirichlet conditions • Fourier series for Even and Odd functions, • Fourier series of half range • Complex form of Fourier Series • Fourier Transform • Parseval's identity • Experiential Learning	

Module 4	**Special Functions**	15 Lectures
	• Legendre, Hermite, Laguerre function – Generating function • Recurrence relations and their differential equations • Orthogonality properties • Bessels's function of first kind • Spherical Bessel function • Associated Legendre function • Spherical harmonics • Experiential Learning	

References:

1. Complex Variables and Applications – J. W. Brown, R. V. Churchill – (7th Edition) - Mc-Graw Hill
2. Mathematics for Physical Sciences – Mary Boas, John Wiley & Sons
3. Linear Algebra – Seymour Lipschutz, Schaum Outlines Series- Mc-Graw Hill edition
4. Matrices and Tensors in Physics, A. W. Joshi, 3rd Edition, New Age International
5. Mathematical methods for Physicists – Arfken & Weber – 6th Edition-Academic Press- N.Y.
6. Fourier Series - Seymour Lipschutz, Schaum Outlines Series
7. Fourier Series and Boundary value problems - R. V. Churchill, McGraw Hill

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP102
Course Name: Classical Mechanics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**

Examination Scheme: CIA : 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Basic Mathematical Methods
- Newtonian Mechanics

Course Objectives:

- To Study Lagrangian and Hamiltonian Dynamics
- To study Non-inertial frames.
- To apply the theory into relevant numericals and solve them.

Course Outcomes:

On completion of the course, student will be able to–

- Apply the concepts of Inertial and Non-Inertial frames of reference and use in case studies
- Solve numerical examples using the concepts of Classical Mechanics.

Course Contents

Module 1	**Constrained Motion and Lagrangian formulation**	15 lectures
	• Revision of constraints and their types • Generalized coordinates • Langrange's equations of motion including velocity dependent potentials • Properties of kinetic energy function • Theorem on total energy • Generalized momenta, cyclic-coordinates • Integrals of motion, • Jacobi integrals and energy conservation • Concept of symmetry • Invariance under Galilean transformation • Experiential Learning	
Module 2	**Variational Principle and Hamilton's formulation Canonical Transformations**	15 lectures
	• Variational principle • Euler's equation • applications of variational principle, shortest distance problem, Brachistrochrone, Geodesics of a Sphere • Hamilton's function and Hamilton's equation of motion • configuration space, phase space and state space • Lagrangian and Hamiltonian of relativistic particles • Legendre transformations, Generating function • Conditions for canonical transformation and problems • Experiential Learning	
Module 3	**Poisson Brackets and Small Oscillations and Rigid Body Dynamics**	15 lectures
	• Poisson Brackets : Definition, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity, (statement only), invariance of PB under canonical transformation, • Small oscillations : Normal modes and coordinates. Coupled Oscillators • Rigid body Dynamics : Generalized Coordinates, Euler's Angles, Angular Momentum and Moment of Inertia, Euler's Equations • Experiential Learning	

Module 4	**Non-inertial frames of References, Central Forces**	15 lectures
	• Rotating frames of reference • Inertial forces in rotating frames • Terrestrial and astronomical applications of Coriolis force., • Foucault's pendulum. • Two body central force problem, stability of orbits • Condition for closure • Integrable power laws, Kepler's problems • Orbits of artificial satellites • Virial theorem • Experiential Learning	

Reference Books:

1. Classical Mechanics by N.C.Rana and P.S.Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
2. Classical Mechanics by J.C.Upadhyaya, Himalaya Publishing House.
3. Classical Mechanics by H.Goldstein, Narosa Publishing Home,, New Delhi.
4. Classical Dynamics of Particles and Systems by Marion and Thomtron, Third Edition, Horoloma Book Jovanovich College Publisher.
5. Introduction to Classical Mechanics by R.G.Takawale and P.S.Puranik, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
6. Analytical Dynamics E.T. Whittaker, Cambridge, University Press.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5
First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP103
Course Name: Atoms and Molecules

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Familiarity with UG level syllabus of Atoms and molecules physics

Course Objectives:

- To Study Historical Development of atomic models
- To study origin of spectrum in one electron and two electron systems
- To study behavior of energy levels in external electromagnetic field
- To study molecules, molecular energy levels and molecular spectra
- To Learn principles of various spectroscopic techniques and analysis methods
- To enrich knowledge of physics of atoms, molecules and spectroscopy through problem solving

Course Outcomes:

On completion of the course, student should be able to–

- Understand various molecular bonds
- Understand origin of spectrum in atoms and molecules
- Understand and apply various spectroscopic techniques and analysis methods in research

Course Contents

Module 1	**ATOMS**	15 Lectures
	• Revision: Atomic models, Hydrogen atom, quantum numbers, exclusion principle, electron configuration, Hund's rule • origin of spectral lines, selection rules • One electron spectra • Coupling schemes • two electron spectra • fine structure and hyperfine structure • The Hartree Theory, Results of Hartree theory • X-ray line spectra • Atoms in Electromagnetic field: Zeeman effect- Normal and Anomalous, Paschen- Back effect, Stark effect (weak field) • Problems and Experiential Learning	
Module 2	**MOLECULES**	15 Lectures
	• Bonding mechanism in molecules • Molecular orbital methods, Valence band method • Molecular Spectra – Rotational and vibrational spectra for diatomic molecules • Electronics spectra of diatomic molecules • Vibration course structure, vibrational analysis of band system • Frank – Condon principle • Dissociation energy and dissociation products • rotational fine structure of electronic vibration transitions • Electronic angular momentum in diatomic molecules. • Problems and Experiential Learning	
Module 3	**SPECTROSCOPIC TECHNIQUES**	15 Lectures

	• Microwave Spectroscopy: microwave spectrometer, information derived from rotational spectra and analysis of microwave absorption by H_2O • Infrared spectroscopy: IR spectrophotometer and instrumentation, sample handling techniques, FTIR spectroscopy and analysis of HCl spectrum, applications • Raman spectroscopy: Theory of Raman scattering, Rotational Raman spectra, Mutual exclusion, Raman spectrometer, sample handling techniques, Fourier transform Raman spectrometer, Structure determination using IR and Raman spectroscopy (diamond), Applications • Problems and Experiential Learning	
Module 4	**RESONANCE SPECTROSCOPY**	15 Lectures
	• ESR- Principles of ESR, ESR spectrometer, total Hamiltonian, hyperfine structure • NMR – Magnetic properties of nucleus, resonance condition, NMR instrumentation, relaxation process, chemical shift, applications of NMR • Problems and Experiential Learning	

References:

1) Fundamentals of Molecular spectroscopy. Collin N. Banwell and Elaine M. McCASH
2) Molecular structure and Spectroscopy G. Aruldhas.
3) Quantum Physics – Robert Eiesberg and Robert Resnik
4) Introduction to solid states Physics - Charles, Kittle 7th Edition
5) Solid States Physics – A.J. Dekkar

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5
First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP104
Course Name: Electronics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:
- Basic knowledge of Semiconductor devices
- Characteristics of operational amplifier
- Basic knowledge of sequential circuits

Course Objectives:
- To understand operation of semiconductor devices.
- To understand applications of operational amplifier.
- To learn operation of sequential circuits.

Course Outcomes:
- After successful completion of the course student will be able to understand principle of working and applications of different circuits.
- This course will be beneficial for further study of competitive exam.

Course Contents

Module 1	**Solid State Devices and applications**	20 Lectures
	• Basic circuits-Semiconductor diode, clipping circuit, clamping circuit, silicon controlled rectifier, LED and applications. • Transistors- n-p-n transistor, p-n-p transistor, Fabrication with working of UJT, BJT, FET, JFET, MOSFET. • Oscillators- Theory of sinusoidal Oscillations, Barkhausen criterion, Wien bridge oscillator, Colpitts oscillator, Hartley Oscillator, The 555 timer, Astable operation of the 555 timer. • Experiential Learning	
Module 2	**Power Supplies**	10 Lectures
	• Series regulator • Zener regulator • Foldback current limiting • Shunt regulators • CV power supplies, CC power supplies • SMPS • Experiential Learning	
Module 3	**Operational amplifier and its Applications**	15 Lectures
	• Operational amplifier block diagram, Operational amplifier characteristics • Inverting and non inverting amplifier • Operational amplifier as adder, subtractor, integrator and differentiator, comparator, Schmitt trigger and logarithmic amplifier • Active filters • Experiential Learning	
Module 4	**Sequential circuits**	15 Lectures
	• Flip- flops • Counters	

	• Shift registers • Digital to analog converters- Binary weighted type, R-2R ladder type • Analog to digital converter- Single slope, Dual slope, Flash, Counter type, Continuous type, Simultaneous type, Successive approximation type. • Experiential Learning	

References Books:
1) OPAMPS and Linear Integrated Circuits: Ramakant Gayakwad, Prentice Hall
2) Electronic Principles: A. P. Malvino
3) Digital Principles and Applications: Leach and Malvino
4) Data Converters: B. S. Sonde
5) Principles of electronics: V.K.Mehta
6) Integrated circuits: K.R.Botkar

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP105

Course Name: Physics Laboratory Course I

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Basic Mathematical Methods
- Modern Physics
- Electronics

Course Objectives:

- To apply the theory studied to practice.
- To learn the use of bread boards and design the circuit

Course Outcomes:

On completion of the course, student will be able to–

- Design a circuit for the requisite output.
- Have hands-on practice of the theory course and its applications.

Course Contents

Module 1	**General Physics (Any 6)**	
	1. Michelson Interferometer. 2. Resistivity of Ge at various temperature by Four Probe method and determination of band gap 3. Susceptibility, Gauy method.. 4. Skin depth in Al using electromagnetic radiation. 5. Counting statistics, G.M. tube. 6. End point energy and Absorption coefficient using G.M.tube. 7. Electron Spin Resonance. (ESR) 8. Fabry-Parot Etalon. 9. Franck – Hertz Experiment. 10. 'e' by Millikan oil drop method 11. Study of electromagnetic damping	
Module 2	**Electronics (Any 4)**	
	• DAC (R-2R for 4-bit). • Active filter- Low pass, High pass, Band pass using OP-AMP • Function generator using OP-AMP/IC –8038. • Study of multiplexer and Demultiplexer. • Study of voltage controlled oscillator using IC-566. • Crystal oscillator. • Diode pump using UJT. • Pulse train generator. • CVCC Power Supply	

Reference Books :

1. Solid State Laboratory Manual in Physics, Department of Physics, University of Pune, Pune-7. (1977)
2. Experimental Physics, Wersnop and Flint.
3. Practical Physics, D.R. Behekar, Dr.S. T. Seman, V.M.Gokhale,P.G.Kale (Kitab Mahal Publication)
4. Power supplies: B.S. Sonde.
5. Operational Amplifier: G.B.Clayton.
6. OP-AMPS and Linear integrated circuits: RamakantGaikwad.

7. Data Converters: B.S. Sonde, Tata Mc-Graw Hill Pub. Co. Ltd. (1974).
The C programming Language: B.W.Kernighan and D.M.Ritchie.Prentice Hall of India Pvt.Ltd., (1985).
8. Schuam’s series “programming in C”.
9. Computational Physics, R.C.Verma, P.K.Ahluwalia and K.C.Sharma, New Age International Publishers
10. Computational Physics,S.E.Koonin, Benjamin/Cumming Pub .Co.,(1986).
11. An Introduction to Computational Physics, T.Pang, Cambridge Uni. Press. (1997).

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP201
Course Name: Electrodynamics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:
- Vector Analysis
- Ordinary Differential Equations
- Basic Electricity and Magnetism

Course Objectives:
- To Study the laws of Electric and Magnetic Theory
- To study the behavior of fields in material media.
- Learn the concepts Relativity and Four-vector form of fields.
- To apply the theory into relevant numericals and solve them.

Course Outcomes:

On completion of the course, student will be able to–
- Apply the concepts of Electrodynamics and use in case studies
- Solve numerical examples using the concepts of Electrodynamics and Relativity.

Course Contents

Module 1	**Electromagnetics**	15 Lectures
	• Coloumb's law, Gauss's law, Poisson's equation and Laplace's equation, Electrostatic potential energy, • Simple applications, Simple boundary value problems illustrating various techniques such as method of images, separation of variables, • Green's functions, Multipole expansion. • linear quadrapole potential and field • Scalar and vector potentials, Maxwell's displacement current, differential and integral forms of Maxwell's equations • Experiential Learning	
Module 2	**Dielectrics and Electromagnetic Wave Equations**	15 Lectures
	• Dielectric materials, Polarization, • Electric field of a polarized material, Bound charges, Gauss's law in dielectric materials, • Linear dielectric materials, Boundary conditions at the interface of two dielectrics • Energy relations in quasi-stationary current systems, Magnetic interaction between two current loops, Energy stored in electric and magnetic fields, • Poynting's theorem, General expression for electromagnetic energy, • Electromagnetic wave equations, Electromagnetic plane waves in stationary medium, • Reflection and refraction of electromagnetic waves at plane boundaries (Oblique incidence), • Electromagnetic waves in conducting medium, Skin effect and skin depth • Experiential Learning	
Module 3	**Inhomogeneous wave equations**	15 Lectures
	• Inhomogeneous wave equations, Lorentz's and Coulomb's gauges, • Gauge transformations, • Wave equations in terms of electromagnetic potentials,	

	D'Alembertian operator • Radiation- retarded potentials • Lienard-Wiechert potentials of a point charge • Electric dipole radiation, Magnetic dipole radiation from moving charges and dipoles. • Experiential Learning	
Module 4	**Relativistic Mechanics and Covariance**	15 Lectures
	• Experimental basis for special theory of relativity (Michelson – Morley experiment) • Lorentz transformations • Relativistic velocity addition • Minkowski's spacetime diagram, Four vector potential, electromagnetic field tensor • Lorentz force on a charged particle • Experiential Learning	

Reference Books :

1. Classical Mechanics by N.C.Rana and P.S.Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
2. Classical Mechanics by J.C.Upadhyaya, Himalaya Publishing House.
3. Classical Mechanics by H.Goldstein, Narosa Publishing Home,, New Delhi.
4. Classical Dynamics of Particles and Systems by Marion and Thomtron, Third Edition, Horoloma Book Jovanovich College Publisher.
5. Introduction to Classical Mechanics by R.G.Takawale and P.S.Puranik, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
6. Analytical Dynamics E.T. Whittaker, Cambridge, University Press.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5
First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP202
Course Name: Statistical Mechanics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA : 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Thermodynamical laws
- Maxwell relations
- Concept of ensemble

Course Objectives:

- To study thermodynamics of particles from statistical point of view.
- To study applications of statistical mechanics in physics.
- To learn Ideal Bose and Fermi systems.

Course Outcomes:

- After successful completion of the course student will be able to understand different concepts and applications of statistical mechanics in physics.
- This course will be beneficial for further study of competitive exam.

Course Contents

Module 1	**Statistical Description and Thermodynamics of Particles**	15 Lectures
	• Specification of the state of the system, Macroscopic and Microscopic states, Phase space, Statistical ensemble • Postulate of equal a priori probability, Probability calculations • Behaviour of density of states, Liouville's theorem (Classical), Equilibrium conditions and constraints • Distribution of energy between systems in equilibrium, Approach to thermal equilibrium • Sharpness of the probability distribution, Dependence of the density of states on the external parameters • Equilibrium between interacting systems, Thermodynamical laws and basic statistical relations • Experiential Learning	
Module 2	**Classical Statistical Mechanics**	15 Lectures
	• Micro-canonical ensemble, System in contact with heat reservoir • Canonical ensemble, Applications of canonical ensembles (Paramagnetism, Molecule in an ideal gas, Law of atmosphere), System with specified mean energy, Calculation of mean values and fluctuations in a canonical ensemble, Connection with thermodynamics • Grand-canonical ensemble, Chemical potential in the equilibrium state, Mean values and fluctuations in grand canonical ensemble, Thermodynamic functions in terms of the Grand partition function • Experiential Learning	
Module 3	**Applications of Statistical Mechanics and Quantum Distribution Functions**	15 Lectures
	• Classical partition functions and their properties, Calculations of thermodynamic quantities, Ideal monoatomic gas, Gibbs paradox • Equipartition theorem and its Simple applications. i) Mean kinetic energy of a molecule in a gas ii) Brownian motion iii) Harmonic Oscillator iv) Specific heat of solid, Maxwell velocity distribution, Related distributions and mean values	

	• Symmetry of wave functions, Quantum distribution functions, Boltzmann limit of Boson and Fermion gases, Evaluation of the partition function • Partition function for diatomic molecules, Equation of state for an ideal gas, quantum mechanical paramagnetic susceptibility • Experiential Learning	
Module 4	**Ideal Bose and Fermi Systems**	15 Lectures
	• Photon gas – i) Radiation pressure ii) Radiation density iii) Emissivity iv)Equilibrium number of photons in the cavity • Einstein derivation of Planck's law, Bose-Einstein Condensation, Specific heat • Photon gas – Einstein and Debye's model of solids • Fermi energy, Mean energy of fermions at absolute zero, Fermi energy as a function of temperature, Electronic specific heat • Introduction to Ising model • Experiential Learning	

Reference books:

1. Fundamentals of Statistical and Thermal Physics, - F.Reif, McGrawHill International Edition
2. Fundamentals of Statistical Mechanics, B.B. Laud, New Age International Publication
3. Statistical Mechanics, R.K. Pathria, Bufferworgh Heinemann (2nd Edition)
4. Statistical Mechanics, K. Huang, John Willey and Sons (2nd Edition)
5. Statistical Mechanics, Satya Prakash and Kedar Nath Ram, Nath Publication
6. Statistical Mechanics by Loknathan and Gambhir

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5
First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP203
Course Name: Solid State Physics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:
- Crystal systems
- 2D and 3 D Lattices
- Crystal structures
- Reciprocal lattice concept

Course Objectives:
- To understand the importance of crystal structure in imparting different properties to the solid
- To study various properties of solids like thermal, electrical and magnetic properties

Course Outcomes:
On completion of the course, student will be able to–
- Understand the interactions of electrons and atoms within solids
- Understand how the bonding of atoms affects the various properties of solids

Course Contents

Module 1	**Specific heat of solids**	15 Lectures
	• Vibrations of monatomic lattice • Long wavelength or continuum limit • Lattice with two atoms per primitive cell • Quantisation of lattice vibrations • Phonon momentum • Experiential Learning	
Module 2	**Band Theory of Solids**	15 lectures
	• Nearly free electron model, DC and AC electrical conductivity of metals • Bloch theorem (with proof) • Kronig-Penney model • Motion of electron in 1 D, effective mass • Tight binding approximation • Zone schemes, distinction between metals, semiconductors and insulators • Impurity levels in doped semiconductors • Experiential Learning	
Module 3	**Diamagnetism and Paramagnetism**	15 Lectures
	• Theory of Diamagnetism • Classical and quantum theory of paramagnetism, • Pauli paramagnetism • Magnetic properties of rare earth and iron group ions • Field splitting and quenching of orbital angular momentum • Experiential Learning	
Module 4	**Ferromagnetism, Antiferromagnetism and Ferrimagnetism**	15 Lectures
	• Ferromagnetism: Weiss theory, Curie point, Exchange integral • Classical saturation magnetization and its temperature dependence, Pauli paramagnetism	

	• Magnetic , Saturation magnetization at absolute zero, Field splitting and quenching of orbital angular momentum • Ferromagnetic domains, Anisotropy energy, Bloch wall • Antiferromagnetism: Neel temperature • Ferrimagnetism: Curie temperature, susceptibility of ferrimagnets. • Experiential Learning	

References:

1. Introduction to solid states Physics - Charles, Kittle 7th Edition
2. Introductory Solid States Physics – H. P. Myers
3. Solid States Physics - S.O. Pillai (latest edition)
4. Elementary Solid States Physics- M. Ali Omar
5. Problem in Solid State Physics – S.O. Pillai
6. Solid States Physics – A.J. Dekkar
7. Solid states Physics – Wahab
8. Solid State Physics: Neil W. Ashcroft, N. David Mermin

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP204
Course Name: Quantum Mechanics

Teaching Scheme: TH: 5 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Basic Mathematical Methods
- Classical Mechanics
- Solution of Differential Equations
- Old Quantum Theory

Course Objectives:

- To Study the New Quantum Theory
- To learn the Schrodinger and Dirac Approach to Quantum Mechanics
- To apply the theory into relevant numerical examples and solve them.

Course Outcomes:

On completion of the course, student will be able to–

- Use the concepts of Quantum Mechanics and apply them.
- Solve numerical examples using the concepts of Quantum Mechanics.

Course Contents

Module 1	**Schrodinger Formalism**	15 lectures
	• Inadequacy of classical Physics, wave packets and uncertainty relations • Schrodinger wave equation and probability interpretation, • Simple one dimensional problems wells, barriers and harmonic oscillator (One dimension) • Postulates of quantum mechanics Representation of states and dynamical variables, observables, Self-adjoint Operators • Eigen functions and eigen values, degeneracy • Dirac delta function • Completeness and closure property • Physical interpretation of eigen values, eigen functions and expansion coefficients, eigen values and eigen functions of momentum operator • Experiential Learning	
Module 2	**Representation of States – Dirac notation**	15 lectures
	• Hilbert space, Dirac's bra and ket notation, • Dynamical variables and linear operators • Projection operators, unit operator • Unitary operator, matrix representation of an operator change of basis, unitary transformation • Eigen values and eigen functions of simple harmonic oscillator by operator method. • Experiential Learning	
Module 3	**Angular Momentum**	15 lectures

	• Eigen values and eigen functions of L^2 and L_z operators, • Ladder operators L_+ and L_-, • Pauli theory of spins(Pauli's matrices) , • Matrix representation of J in |jm> basis. • Addition of angular momenta, Computation of Clebsch-Gordon coefficients in simple cases ($j_1=½$, $j_2=½$) • Experiential Learning	
Module 4	**Approximation Methods**	15 lectures
	• Time-Independent Perturbation theory: Non degenerate, Zeeman effect, Stark Effect • Time dependent Perturbation theory: Transition amplitude 1st and 2nd order • Fermi's Golden rule, Harmonic perturbation • Introduction to WKB approximation • Variational method : Basic principles and applications to particle in box, Simple Harmonic Oscillator • Experiential Learning	

References:

1) A Text-book of Quantum Mechanics by P.M.Mathews and K.Venkatesan.
2) Quantum mechanics by A. Ghatak and S. Lokanathan
3) Quantum Mechanics by L.I. Schiff
4) Modern Quantum mechanics by J. J.Sakurai
5) Quantum Physics by R. Eisberg and R.Resnick
6) Introduction to Quantum Mechanics by by David J.Griffiths
7) Introductory Quantum mechanics by Granier, Springer Publication.
8) Introductory Quantum Mechanics, Li boff, 4th Edition, Pearson Education Ltd
9) Quantum Mechanics by Nouredine Zettili, , A John Wiley and Sons, Ltd., Publication
10)Shankar R. Principles of Quantum Mechanics, IInd Edition (Plenum, 1994)

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

First Year of B. Sc. (2019 Course)

Course Code: 19ScPhyP205
Course Name: Physics Laboratory Course II

Teaching Scheme: TH: 5 Hours/Week **Credit : 04**

Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Basic Mathematical Methods
- Modern Physics
- Electronics

Course Objectives:

- To apply the theory studied to practice.
- To learn the use of bread boards and design the circuit

Course Outcomes:

On completion of the course, student will be able to–

- Design a circuit for the requisite output.
- Have hands-on practice of the theory course and its applications.
- Develop algorithms and write basic programs in C – Language.

Course Contents

Module 1	**General Physics (Any 4)**	
	12. Michelson Interferometer. 13. Resistivity of Ge at various temperature by Four Probe method and determination of band gap 14. Susceptibility, Gauy method.. 15. Skin depth in Al using electromagnetic radiation. 16. Counting statistics, G.M. tube. 17. End point energy and Absorption coefficient using G.M.tube. 18. Electron Spin Resonance. (ESR) 19. Fabry-Parot Etalon. 20. Franck – Hertz Experiment. 21. 'e' by Millikan oil drop method 22. Study of electromagnetic damping	
Module 2	**Electronics (Any 4)**	
	• DAC (R-2R for 4-bit). • Active filter- Low pass, High pass, Band pass using OP-AMP • Function generator using OP-AMP/IC –8038. • Study of multiplexer and Demultiplexer. • Study of voltage controlled oscillator using IC-566. • Crystal oscillator. • Diode pump using UJT. • Pulse train generator. • CVCC Power Supply	
Module 3	**Programming in 'C' Language : Physics Lab Course II**	
	• Write a program to find the sum and product of first 100 numbers • Write a program to display first 10 Fibonacci numbers • Write a program to display prime numbers within a given range input by the user • Write a program to evaluate the sum and product of a 3 by 3 matrix • Write a program to find the roots of a quadratic equation • Write a program to sort a set of 10 numbers by bubble sort technique.	

Reference Books :

1. Solid State Laboratory Manual in Physics, Department of Physics, University of Pune, Pune-7. (1977)
2. Experimental Physics, Wersnop and Flint.
3. Practical Physics, D.R. Behekar, Dr.S. T. Seman, V.M.Gokhale,P.G.Kale (Kitab Mahal Publication)
4. Power supplies: B.S. Sonde.
5. Operational Amplifier: G.B.Clayton.
6. OP-AMPS and Linear integrated circuits: RamakantGaikwad.
7. Data Converters: B.S. Sonde, Tata Mc-Graw Hill Pub. Co. Ltd. (1974).
The C programming Language: B.W.Kernighan and D.M.Ritchie.Prentice Hall of India Pvt.Ltd., (1985).
8. Schuam’s series “programming in C”.
9. Computational Physics, R.C.Verma, P.K.Ahluwalia and K.C.Sharma, New Age International Publishers
10. Computational Physics,S.E.Koonin, Benjamin/Cumming Pub .Co.,(1986).
11. An Introduction to Computational Physics, T.Pang, Cambridge Uni. Press. (1997).