Core Courses for M.Sc. Physics

3. Core Courses (Theory)

S. No.	Course Code	Course Title	Course Coordinator
1.	21PHT501	Classical Mechanics	Dr. Akhilesh Nautiyal
2.	21PHT504	Mathematical Methods in Physics	Dr. Anees Ahmed
3.	21PHT502	Electronics	Dr. Anirban Dutta
4.	21PHT505	Quantum Mechanics	Prof. Kanupriya Sachdev
5.	21PHT507	Electrodynamics	Dr. Anirban Dutta
6.	21PHT506	Atomic & Molecular Spectroscopy	Dr. Rajnish Dhiman
7.	21PHT510	Statistical Mechanics	Dr. Subhayan Mandal
8.	21PHT508	Nuclear and Particle Physics	Dr. Kavita Lalwani
9.	21PHT602	Solid State Physics	Dr. Manoj Kumar
10.	21PHD601	Dissertation 1	Dr. Srinivasa Rao Nelamarri
11.	21PHD604	Dissertation 2	Dr. Srinivasa Rao Nelamarri

4. Lab Courses

S. No.	Course Code	Course Title	Course Coordinator
1.	21PHP503	Electronics Lab	Dr. Kamakshi Pandey
2.	21PHP509	Nuclear Physics and Spectroscopy Lab	Prof. Kanupriya Sachdev
3.	21PHP603	Solid State Physics Lab	Dr. Debasish Sarkar

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT501	**Classical Mechanics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE - None

COURSE OBJECTIVE(s)

This course aims to introduce the Lagrangian and Hamiltonian formalism of Newtonian Mechanics, action principle, symmetries and conservation laws. The course will also cover Hamilton-Jacobi theory and four-vector formalism of special theory of relativity.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Introduction and motivation, Mechanics of a system of particles, constraints and their classifications, virtual work and D'Alembert's principle, generalized coordinates, Lagrange's equation and its application, velocity dependent potentials and the dissipation function, calculus of variations, Hamilton's principle, Lagrange's equations from Hamilton's principle. Method of Lagrange's multipliers for nonholonomic systems, cyclic coordinates, conservation theorems and symmetry principles, Noether's theorem, Jacobi's integral.

(No. of lectures: 12)

Applications of Lagrangian formalism: central forces, Kepler's problem, Laplace-Runge-Lenz vector, virial theorem, scattering from a central force field in center of mass and laboratory coordinate systems, rigid body kinematics, orthogonal transformations, Eulerian angles, Euler theorem, Finite and infinite rotations, uniformly rotating frames, Coriolis force, force free motion of a rigid body small oscillations and normal modes. Free vibrations of a triatomic molecule.

(No. of lectures: 14)

Legendre Transformations and the Hamilton equations of motion, Routh's Procedure, derivation of Hamilton's equations from a variational principle, canonical transformations, examples of canonical transformations, phase space diagram, stability analysis, Poisson brackets, Liouville's Theorem Hamilton Jacobi theory.

(No. of lectures: 8)

Lorentz transformations, Minkowski spacetime, intervals, light cone, four-vector formalism, metric tensor, contravariant and covariant tensor, covariant Lagrangian and Hamiltonian formulation**,** four vector formalism of electrodynamics.

(No. of lectures: 5)

Recommended Readings

Text books –

1. Classical Mechanics –Goldstein, Poole and Safko (Pearson Education).
2. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw Hill).
3. Introduction to Electrodynamics, David J. Griffiths

Reference books –

1. Mechanics – L. D. Landau and E. M. Lifshitz (Pergamon Press, Oxford).
2. Classical theory of fields L. D. Landau and E. M. Lifshitz (Pergamon Press, Oxford).
3. Classical Mechanics: Kibble and Berkshir (World Scientific)
4. Introduction to Classical Mechanics with Problems and Solutions: David Morin (Cambridge University Press).

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT505	**Quantum Mechanics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE - None

COURSE OBJECTIVE(s)

This course aims to provide the students basic concepts and formalism of quantum mechanics. Additional topics discussed will be angular momentum, symmetries and standard approximation techniques for static quantum systems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Abstract formulation: Hilbert space, inner product space, eigen values and eigen functions, Dirac notation, operators, commutator and operator algebra, orthonormality, completeness, closure, position and momentum representation, generalized uncertainty principle, change of basis and unitary transformation, expectation values, Ehrenfest's theorem; Schrodinger equation (time-dependent and time independent), eigen value problems

(No. of lectures: 16)

Schrodinger picture, Heisenberg picture, Harmonic oscillator: operator method, two body problem, hydrogen atom; Symmetries, conservation laws, invariance under space and time translations and space rotation; angular momentum algebra, spin, addition of angular momenta, Clebsch-Gordan Coefficients

(No. of lectures: 13)

Time independent perturbation theory, normal Zeeman and Stark effects, WKB approximation and variational method

(No. of lectures: 10)

Recommended Readings

Text books –

1. Quantum Mechanics, Theory and Applications: A.K. Ghatak and S. Loknathan, (McMillan India)
2. Introduction to Quantum Mechanics: David J. Griffiths (Pearson Education)
3. Quantum Mechanics – A Modern Approach: Ashok Das and A.C. Milissiones, (Gordon and Breach Science Publishers)

Reference books –

1. Quantum Mechanics: R. Shankar.
2. Quantum Mechanics, B.H. Bransden, C.J. Joachain
3. Quantum Mechanics: E. Merzbacher, (Wiley).
4. Quantum Mechanics: L.I. Schiff, (McGraw Hill).
5. Quantum Mechanics: L. D. Landau and E. M. Liefshitz (Pergamon Press).
6. Quantum Mechanics- An Introduction: Walter Greiner (Springer).
7. Modern Quantum Mechanics: J.J. Sakurai, (Addision Wesley Publishing Co.).
8. Feynmann Lecturers: Vol I, II & III.
9. Quantum Mechanics, Stephen Gasiorowicz.

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DETAILS OF THE COURSE

Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT504	**Mathematical Methods in Physics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE COURSES
None

COURSE OBJECTIVES

1. To impart mathematical concepts and techniques required for undergraduate studies in Physics.
2. To encourage the development of the ability to apply these ideas in heretofore unseen problems and situations, including other mathematical disciplines.

COURSE ASSESSMENT

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Vector spaces, matrices, eigenvalues and eigenvectors, Cayley-Hamilton theorem, Gram-Schmidt orthogonalization process, groups, finite groups, non-Abelian groups, permutation groups, subgroups, SU(3) and O(3) groups.

(No. of lectures: 12)

Motivation for tensors, coordinate transformations, metric, algebra of tensors, Cartesian tensors, improper rotations and pseudo tensors, quotient law, isotropic tensors, dual tensors, physical applications of tensors, non-Cartesian coordinates

(No. of lectures: 8)

Laplace and Fourier transforms, their properties, inverse Laplace and Fourier transforms, application of Laplace and Fourier transforms in solving linear differential equations, Sturm-Liouville equation, Green's function and its applications.

(No. of lectures: 12)

Elements of complex analysis, analytic functions, Taylor and Laurent series, poles, residues and evaluation of integrals, applications towards Green's functions

(No. of lectures: 7)

Text Books:

1. Mathematics for Physics, Michael Stone and Paul Goldbart (Cambridge University Press)
2. A Guided Tour of Mathematical Physics (Third Edition), Roel Snieder and Kasper van Wijk (Cambridge University Press)
3. A Course in Mathematics for Students of Physics Vol. 1, Paul Bamberg and Shlomo Sternberg (Cambridge University Press)
4. Elements of Group Theory for Physicists, A. W. Joshi (Wiley Eastern Ltd.)

Reference Books:

1. Mathematical Methods for Physicists, G. Arfken, H. Weber and F. Harris (Academic Press)
2. Elements of Group Theory for Physicists, A. W. Joshi (Wiley Eastern Ltd.)
3. Mathematical Methods of Physics, Mathews and Walker (Pearson Educations)
4. Mathematical Physics, I. C. Goyal (Laxmi Publications Private Limited)

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT502	**Electronics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE – None

COURSE OBJECTIVE(s)

This course gives an overview of fundamentals of operational amplifier and digital circuits. After competition of this course, students should be able to design analog and digital circuits for required applications. They will learn how to analyse a circuit diagram and the limitations of those circuits.

COURSE ASSESSMENT

S. No.	Component	Weightage
a)	Internal assessment (based on assignments, quizzes, and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Review of Diodes and Transistors, Basic of op-amps, Op-amps circuit analysis, applications of op-amps- summer, subtractor, integrator, and differentiator, amplifier designing, Comparators, The Schmitt Trigger, summer, subtractor, integrator, and differentiator, Transfer function and Bode plots, Frequency and time response of filters, Active filters. Passive filters, Sallen-key topology, Higher order filters, Op-amp oscillators-Wien bridge and phase-shift oscillators, 555 timers: monostable and astable multivibrator, Regulated power supply, Analog Computers using op-amps.

(No. of lectures: 20)

Digital electronics- Boolean algebra, De Morgan's theorems, Simplification of Logic Circuit using Boolean Algebra. Number systems and codes, Error detection, Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) POS, Karnaugh Map.

(No. of lectures: 09)

Flip-flops, Registers, Counters, D/A conversion and A/D conversion. Concepts of Microprocessor, Microprocessor based system design

(No. of lectures: 10)

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Recommended Readings

Text books

1. Electronic Principles: Malvino and Bates (McGraw Hill Education).
2. The Art of Electronics: Horowitz and Hill (Cambridge University Press)
3. Digital Principles and Applications: A. P. Malvino and Donald P. Leach (TMH)
4. Fundamental of Digital Circuits: P Anand Kumar (PHI)
5. Electronic Devices and Circuit Theory: Robert Boylestad and Louis Nashdsky (PHI)
6. Microprocessor Architecture, Programming, and Applications with the 8085: R Gaonkar (Penram International Publishing)

Reference books-

1. Op-Amps and Linear Integrated Circuits: Ramakanth A. Gayakwad (PHI)
2. Digital Fundamentals: Floyd & Jain (Pearson Education)
3. Digital Electronics: Morris Nano (Pearson)

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DETAILS OF THE COURSE

Course	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT507	**Electrodynamics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE: None

COURSE OBJECTIVE(s)

This course provides an overview of the fundamental principles of electrodynamics. Upon successful completion of the course, students will be able to apply commonly used techniques in electrodynamics to determine the electric and magnetic fields and potentials of various charge and current distributions. Students will understand Maxwell's equations, the fundamental principles and basic properties of electromagnetic wave propagation, and electromagnetic radiation.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1- Gauss's Divergence Theorem, Stokes' Theorem, Basics of Electrostatics, Poisson's and Laplace's equations, Uniqueness theorems, Electrostatic boundary value problems with Green's function, Method of images, Techniques for calculating potentials, Multipole expansion, Polarization.

(No. of lectures- 12)

Module 2- Basics of Magnetostatics, Magnetic vector potentials, Equation of continuity, Maxwell's displacement current, Maxwell's equations, Maxwell's equations inside the matter for time varying fields, Poynting vector, Maxwell's stress tensor.

(No. of lectures- 07)

Module 3- Electromagnetic wave equation, Electromagnetic waves in vacuum, Electromagnetic waves in matter, Reflection and Transmission at normal and oblique incidence, Electromagnetic waves in conductors, Frequency dependence of permittivity, Wave guides.

(No. of lectures- 07)

Module 4- Scalar and vector potentials, Potential formulation of Maxwell's equations, Gauge transformations, Coulomb and Lorentz gauges, Retarded potentials, Lienard-Wiechert potentials, Field of a uniformly moving point charge, Dipole radiation, Electric dipole radiation, Magnetic dipole radiation, Power radiated by a point charge.

(No. of lectures- 13)

Text Books:

1. Introduction to Electrodynamics: David J. Griffiths, (Prentice Hall of India).
2. Classical Electrodynamics: J.D. Jackson, (John Wiley and Sons).

Reference Books:

1. Foundations of Electromagnetic Theory: J. Reitz and F.J. Milford (Addison-Wesley).
2. Elements of Electrodynamics: Matthew N. O. Sadiku.
3. Fields and Waves Electromagnetics: David K. Cheng (Addison – Wesley).
4. Electromagnetic Waves and Radiating Systems: E.C. Jordan (Prentice Hall of India).
5. The Classical Theory of Fields: L.D. Landau, E.M. Lifshitz (Pergamon Press, Oxford).

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT506	**Atomic & Molecular Spectroscopy**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE - None

COURSE OBJECTIVE(s)

This course aims to provide the students with basic concepts of atomic physics and molecular spectroscopy. Students would come to know about the hydrogen and helium spectra, spin-orbit interaction, coupling schemes, and spectra under electric and magnetic fields. factors influencing spectral line width. The other topics contain valence band theory, Born-Oppenheimer approximation, rotational, vibrational and electronic spectra of diatomic molecules, Frank-Condon principle, Raman effect, etc.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Atomic Physics (one electron)

Hydrogen atom spectrum, spin-orbit interaction and relativistic shift, fine structure, Lamb shift (only qualitative treatment), Nuclear magnetic dipole interaction and hyperfine structure, Electron spin and Orbital magnetic dipole moment of electron, Larmor precession

(No. of lectures - 10)

Atomic Physics (many electron atoms)

Helium spectrum, Vector atom model, Equivalent and non-equivalent electrons, Angular momentum coupling schemes: LS & JJ Coupling, Interaction with external fields: Stark effect, Zeeman and Paschen-Back effect, General factors influencing spectral line width and intensities

(No. of lectures - 11)

Molecular Physics

System with identical particles: exchange symmetry, Pauli exclusion principle, hydrogen Molecular Ion (Variation method), valence band theory, hydrogen molecule.

(No. of lectures - 6)

Molecular Spectroscopy

Born-Oppenheimer approximation; rotational, vibrational and electronic spectra of diatomic molecules, Frank-Condon principle, Raman effect & Raman spectroscopy (rotational & vibrational), advanced topics in atomic and molecular physics

(No. of lectures - 12)

TEXT BOOKS:-

1. Atomic Physics: Christopher J. Foot (Oxford University Press)
2. Physics of atoms and molecules, B. H. Bransden and C. J. Joachain, Pearson
3. Fundamentals of Molecular Spectroscopy: C. N. Banwell and E. M. McCash (McGraw)

REFERENCE BOOKS: -

1. Introduction to Atomic Spectra: H. E. White (McGraw Hill).
2. Molecular Spectroscopy: K. V. Raman, R. Gopalan and P.S. Raghavan (Thomson).
3. Spectra of Atoms and Molecules: Peter F. Bernath (Oxford University Press)
4. Atomic and Molecular Spectra: Lasers by Raj Kumar (KNRN)

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT510	**Statistical Mechanics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE – Quantum Mechanics, Thermodynamics

COURSE OBJECTIVE(s)

After successfully completing this course student should be able to understand basic physics principles underlying thermodynamic principles. They will also be able to use this knowledge in other branches of physics, such as condensed matter, astrophysics, magnetism etc.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Review of thermodynamics. Introduction to statistical methods: micro and macro states, phase space, Liouville's theorem, postulates of statistical mechanics, system in thermodynamic equilibrium, law of equipartition of energy and its applications

(No. of lectures: 8)

Statistical ensembles: micro canonical ensembles, statistical interpretation of entropy, Gibbs paradox, Canonical and ensembles, partition functions and its properties (factorizability), calculation of thermodynamic quantities, Fluctuations in energy and other thermodynamic quantities in canonical ensemble

(No. of lectures: 14)

Grand Canonical ensemble, Calculation of thermodynamic quantities using grand canonical ensemble approach, fluctuations in energy & other thermodynamic quantities.

(No. of lectures: 6)

Quantum distribution functions: Bose-Einstein (BE) and Fermi-Dirac (FD) statistics, vis–a–vis classical M-B statistics, Applications of FD and BE statistics: such as paramagnetism, liquid Helium problem etc.; Boltzmann Transport Equation and its applications, Phase transitions and its classifications: order parameter critical exponents and some important phase transitions.

(No. of lectures: 11)

TEXT BOOKS:

1. Statistical Mechanics: R. K. Patharia & Paul D. Beale (Elsevier, Academic Press)
2. Statistical Mechanics, An Introduction: Evelyn Guha (Narosa Publishing House)

REFERENCE BOOKS:

3. Statistical Mechanics: K. Huang (John Wiley and Sons).
4. Fundamentals of Statistical and Thermal Physics: Reif (McGraw Hill).
5. An Introductory course on Statistical Mechanics: P.B. Pal (Narosa)

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT508	**Nuclear and Particle Physics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE - None

COURSE OBJECTIVE(s)

This course aims to provide the students with basic concepts and formalism of Nuclear and Particle Physics. This course will also introduce for modern detectors, accelerators and their applications.

COURSE ASSESSMENT

The Course Assessment (culminating in the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Introduction to Nuclear Radiations

Nuclear radiations and their classification, Production of nuclear radiations, Classification of nuclear radiations: Electromagnetic radiations and Particle radiations: X-rays: Bremsstrahlung x-rays and Characteristic x-rays, Gamma rays, electron, proton, neutron, Secondary radiations, alpha, beta, gamma rays, heavy ions, Important characteristics of nuclear radiations, Interaction of nuclear radiations with detector material, energy loss.

(No. of lectures: 8)

Module II: Detectors and Accelerators

Important properties of Nuclear radiation detectors, Gas-filled detectors: GM counters, Semiconductor detectors: Si detectors, Scintillation detectors, Important measurements from radiation detectors, Accelerators: Linear Accelerators, Cyclotron and Synchrotron: Construction, working and Mathematical Formulation. **(No. of lectures: 9)**

Module III: Elementary Particle Physics

Introduction to the Standard Model and Limitations, Elementary particles and their Classification: hadrons and leptons, Quantum Numbers and their conservations: Lepton, Baryon, Strangeness, Isospin, third component of Isospin, Parity, Hypercharge, Charge conjugation and CP symmetry, Eight-fold way, relativistic kinematics, Basics of SU (2) - SU (3) multiplets, quark model, Gell-Mann Nishijima formula. **(No. of lectures: 11)**

Module IV: Nuclear Physics

Nuclear Structure, Nuclear force and properties, Nuclear binding energy and curve, Nuclear Models: Liquid Drop model, Nuclear Shell Model and Collective Nuclear model, Deuteron Problem, Nuclear reactions, Nuclear Decays: Alpha, Beta, Gamma decays, Nucleon-Nucleon scattering, Nuclear Reactor Physics: Nuclear Fusion and Fission and applications.

(No. of lectures: 11)

Text Books

1. Introductory Nuclear Physics: Kennath S Keane (Wiley).
2. Techniques for Nuclear and Particle Physics Experiments: W.R. Leo (Springer, 1994).
3. Radiation Detection and Measurement: G. F. Knoll (John Wiley, 1989). 4.
4. Introduction to Elementary Particle Physics: David Griffith (Wiley).

References books

5. Introduction to High Energy Physics: Donald H. Perkins (Cambridge University Press).
6. Concepts of Modern Physics: Aurthur Beiser (Mc GrawHill)
7. Particle Physics Reference Library (Detectors for Particles and Radiation) Publisher: Springer
8. Radiation and Detectors: Introduction to the Physics of Radiation and Detection Devices by Lucio Cerrito, Springer International Publishing AG (2017).

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DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHT602	**Solid State Physics**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE - None

COURSE OBJECTIVE(s)

This course aims to provide the students basic concepts and formalism of Solid-State Physics. Additional topics discussed will be structural, electrical, and magnetic behavior of different types of solids.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Review of basic crystal structures and bondings in solids, symmetries in solids, point groups and space groups, X-ray diffraction and reciprocal lattice, electron and neutron diffraction, lattice vibrations: dispersion relations and their interpretation for one dimensional mono and diatomic lattice types, concept of phonons Einstein and Debye models.

(No. of lectures: 12)

Free electron theory, Bloch theorem, energy bands in solids: Kronig-Penney model, nearly free electron (NFE) model, tight binding approximation, concept of Fermi level and Fermi surfaces, Semiconductor Junctions: homo and heterojunctions. Examples of band structures of common materials

(No. of lectures: 10)

Dielectric properties and losses, Thermal conductivity and thermal expansion, concept of thermoelectrics, phase transformations: classification.

(No. of lectures: 8)

Classical and quantum Hall effect, Superconductivity: BCS theory and Josephson effect, classical theory of magnetism, quantum theory of magnetism: para- and ferromagnetism, antiferro- and ferrimagnetic materials, Heisenberg model.

(No. of lectures: 9)

Recommended Readings

Text books –

1. Introduction to Solid State Physics: C. Kittel, 7th Ed. (John Wiley and Sons).
2. Solid State Physics: N. Ashcroft and N.D. Mermin (Holt, Rinehart and Winston).
3. Solid State Physics: A.J. Dekker (Prentice Hall of India, New Delhi).
4. Magnetism in Condensed Matter: Stephen Blundel (Oxford Master Series in Condensed Matter Physics).

Reference books –

1. Solid State Physics: Azaroff (McGraw Hill).
2. Solid State Physics: M.S. Rogalski and S.B. Palmer (Gordon & Breach Science Pub.).
3. Introductory Solid-State Physics: H.P. Myers (Viva books Pvt. Ltd.).
4. Solid State Physics: Wahab (Narosa).
5. Solid State Physics: Gerald Burns (Academic Press).
6. Introduction to Nanotechnology: Poole Jr. and Owens (J. Wiley and Sons).

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DETAILS OF THE COURSE

Course code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHP503	Electronics Lab	4	0	0	8	0

COURSE CONTENTS

1. To determine the Offset voltage, Offset current, and Bias Current of an op-amp
2. To study the application of op-amps as Inverting Amplifier, Non-inverting Amplifier, and Summing Amplifier
3. To study the application of op-amps as Integrator and Differentiator
4. To study the characteristics of Filters: Low pass, High Pass, and Band Pass
5. To study Astable, and Monostable Multivibrator
6. To study the application of op-amps as Comparator, Function Generation, and The Triangle-Square generator
7. To study the Wien Bridge Oscillator
8. To design Active Half-Wave and Full-wave Rectifier
9. To design and study Unregulated and Regulated Power supply
10. To study the behavior of Basic flip-flops
11. To study Counter and Shift register
12. To study D/A and A/D convertor
13. To perform 8 Bit Addition, Subtraction, Multiplication and Division by using MICROPROCESSORS (8086 Assembly Language Programming)

TEXT BOOKS

1. Electronics Principles, A. P. Malvino (McGraw-Hill Education)
2. The art of electronics, P. Horowitz and W. Hill (Cambridge University Press)
3. Digital Electronics, S. Ghoshal (Cengage India Private Limited)
4. Op-Amps and Linear Integrated Circuits, R. A. Gayakwad (PHI)

REFERENCE BOOKS

1. Fundamentals of Digital Circuits, A. Anand Kumar (Prentice-Hall of India Pvt. Ltd)
2. Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashdsky (PHI)
3. Digital Fundamentals, Floyd & Jain (Pearson Education)
4. Operational Amplifiers & Linear Integrated Circuits: Theory and Application Laboratory Manual/3E, James M. Fiore (Dissidents)

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DETAILS OF THE COURSE

Course code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHP509	**Nuclear Physics and Spectroscopy Lab**	**4**	**0**	**0**	**8**	**0**

COURSE CONTENTS

1. To calibrate and determine the resolution of the Gamma ray spectrometer.
2. Experimental studies of gamma ray spectrometer.

(a) To calibrate the energy of the spectrometer.

(b) To identify the unknown source.

3. (a) To study the characteristics of the GM tube and determine its operating voltage, plateau length and slope with determination of efficiency for beta and gamma radiation.

   (b) To determine the linear and mass attenuation coefficients using gamma source using GM counter.
4. To study the electron spin resonance and to determine the Lande's g- factor.
5. To study normal Zeeman effect in transverse and longitudinal configurations.
6. To study the optical properties of polymer thin films grafted by fluorescence dye.
7. To measure the emission spectra of Hydrogen atom.
8. Lifetime of a short-lived radioactive source.
9. Compton Scattering Experiment to measure the scattering angle of scattered photons.
10. Resolving Time of G. M. Counter set-up.
11. Simulated Experiments in Nuclear and Particle Physics based on detectors and radiations.

TEXT BOOKS

1. Introduction to experimental nuclear physics, R. M. Singru (Wiley Eastern Pvt.Ltd.)
2. Introductory Nuclear Physics: K. S. Keane (Wiley).
3. Fundamentals of Molecular Spectroscopy: C. N. Banwell and E. M. McCash (McGraw)

REFERENCE BOOKS

1. Techniques for Nuclear and Particle Physics Experiments: W. R. Leo (Springer, 1994).
2. Molecular Spectroscopy: K. V. Raman, R. Gopalan and P.S. Raghavan (Thomson).

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DETAILS OF THE COURSE

Course code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
21PHP603	Solid State Physics Lab	4	0	0	8	0

COURSE CONTENTS

1. (a) To plot the I-V characteristics of a solar cell and measure the short circuit current, open circuit voltage and maximum power point.
   (b) To calculate the energy conversion efficiency of a solar cell.
2. (a) To measure the Hall coefficient of a given material.
   (b) To study the temperature dependence of Hall coefficient of a given material.
3. To study the Gaussian nature of laser beams and carry out the diffraction experiments.
4. To study the speed of ultrasonic velocity in liquids and measure elasticity parameters.
5. To record a Frank Hertz curve for Mercury and measure the energy emission of free electrons in a gas filled triode.
6. To measure the magnetic susceptibility of paramagnetic solution by Quincke's method and to find the ionic molecular susceptibility and magnetic moment.
7. To determine the Curie temperature of a given solid and study the magnetic transition.
8. To study Bragg's law by microwave diffraction.
9. To study the Faraday Effect and calculate the Verdet's constant.
10. To study the performance of different rechargeable batteries by using Battery tester.
11. To measure the band gap of a semiconductor material using four-probe method

TEXT BOOKS

1. Introduction to Solid State Physics: C. Kittel, 7th Ed. (John Wiley and Sons)
2. Magnetism in Condensed Matter: Stephen Blundel (Oxford Master Series in Condensed Matter Physics).

REFERENCE BOOKS

1. Solid State Physics: A.J. Dekker (Prentice Hall of India, New Delhi).
2. Solid State Physics: N. Ashcroft and N.D. Mermin (Holt, Rinehart and Winston).