Department of Physics

Core papers

1. Mechanics
2. Mechanics Lab
3. Electricity and Magnetism
4. Electricity and Magnetism Lab
5. Thermal Physics and Statistical Mechanics
6. Thermal Physics and Statistical Mechanics Lab
7. Waves and Optics
8. Waves and Optics Lab

Discipline Specific Elective Course

1. Solid State Physics
2. Solid State Physics Lab
3. Atomic molecular and laser physics
4. Atomic molecular and laser physics Lab
5. History and Philosophy of sciences
6. History and Philosophy of sciences Lab
7. Elements of Modern Physics
8. Elements of Modern Physics Lab
9. Quantum Mechanics
10. Quantum Mechanics Lab
11. Nuclear and Particle Physics
12. Nuclear and Particle Physics Lab
13. Digital and analog electronic circuit and instrumentation
14. Digital and analog electronic circuit and instrumentation Lab

Skill Enhancement Course

1. Computational Physics Skills
2. Applied Optics
3. Mobile communications
4. Renewable Energy and Energy harvesting
5. Physics Workshop Skills
6. Basic Instrumentation Skills

1. Name of the Department: Physics						
2. Course Name	Mechanics	**L**	**T**		**P**	
3. Course Code	09010113	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the fundamental concept of mechanics and their subsequent development in applications in various field like oscillations and waves, elastic properties of materials, rest in motion and relative motion etc.

9. Course Objectives:

The aim of this course is to understand the basic concepts for the development of mechanics such as mathematical concept in physics, oscillations and waves, elastics properties of materials, rest in motion and relative motion etc.

10. Course Outcomes (COs):

After going through this course the student will be able to implement, the elastic properties of the materials in everyday life, understand the mechanism of satellite motion, latest developments in theory of relativity.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Vectors**

Vectors: Vector algebra, Scalar and vector products, Derivatives of a vector with respectto a parameter,

Ordinary Differential Equations: 1storder homogeneous differential equations, 2ndorder homogeneous differential equations with constant coefficients.

Oscillations: Simple harmonic motion, Differential equation of SHM and its solutions,Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Laws of Motion**

Laws of Motion: Frames of reference, Newton's Laws of motion, Dynamics of asystem of particles, Centre of Mass.

Momentum and Energy: Conservation of momentum, Work and energy, Conservationof energy, Motion of rockets.

Rotational Motion: Angular velocity and angular momentum, Torque, Conservation ofangular momentum,

Gravitation: Newton's Law of Gravitation, Kepler's Laws (statement only), Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS),

Unit - 3	**Number of lectures = 13**	**Title of the unit: Elasticity**

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation betweenelastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder

Unit - 4	**Number of lectures = 13**	**Title of the unit: Special Theory of Relativity**

Special Theory of Relativity: Constancy of speed of light, Postulates of SpecialTheory of Relativity, Length contraction, Time dilation, Relativistic addition of velocities.

12. Books Recommended

1. University Physics, FW Sears, MW Zemansky and HD Young13/e, 1986, Addison-Wesley
2. Mechanics Berkeley Physics course,v,1: Charles Kittel, et, Al, 2007, Tata McGraw-Hill,
3. Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn,, 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole,

1. Name of the Department: Physics						
2. Course Name	Mechanics Lab	**L**	**T**		**P**	
3. Course Code	09010114	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 40**			

8. Course Description:

The experiment has been designed in such a way the student can measure distance uptomicrometer scale, can determine elastic constant of different materials and calculate moment of inertia of regular and irregular bodies.

9. Course Objectives:

The aim of this paper is that the student performs the experiment based on the description and calculates the results. Compare the result with the standard value wherever applicable and know how to calculate different type of errors also he/she understand how the theoretical concepts are verified experimentally.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to verify

1. The theoretical formulas by performing experiment
2. Demonstrate the practical application of properties of materials etc. in actual practice

11. List of Experiments

1. Moment of Inertia of a fly-wheel.
2. M.I. of an irregular body using a torsion pendulum.
3. Surface Tension by Jeager's method.
4. Young modulus by bending of beam.
5. Modulus of rigidity by Maxwell's needle.
6. Elastic constants by Searle's method.
7. Viscosity of water by its flow through a uniform capillary tube.
8. Thermal conductivity of a good conductor by Searle's method.
9. Mechanical equivalent of Heat by Callender's and Barne's method.
10. 'g' by Bar pendulum.

12. Book Recommended

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

1. Name of the Department: Physics						
2. Course Name	Electricity and magnetism	**L**	**T**		**P**	
3. Course Code	09010212	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

The course will teach about the vector analysis of electric field and magnetic field , integral and differential form of Maxwell equations and electromagnetic wave propagation.

9. Course Objectives:

To impart knowledge about electrostatics, magnetism, and Maxwell's equations and their practical applications.

10. Course Outcomes (COs):

After successful completion of this course, students will have understanding of

1. basic principle of electricity and magnetism, and their everyday life applications
2. propagation of electromagnetic radiation in different medium like vacuum, isotropic dielectric medium etc.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Vector Analysis**

Review of vector algebra (Scalar and Vector product), gradient,divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only)

Unit - 2	**Number of lectures = 13**	**Title of the unit: Electrostatics**

Electrostatic Field, electric flux, Gauss's theorem of electrostatics,Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor, Electric potential as line integral of electric field, Energy per unit volume in electrostatic field, Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric,

Unit - 3	**Number of lectures = 13**	**Title of the unit: Magnetism**

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para-and ferro-magnetic materials,

Electromagnetic Induction:Faraday's laws of electromagnetic induction, Lenz's law,self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Maxwell`s equations and Electromagnetic wave propagation**

Equation of continuityof current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

12. Book Recommended:

1. Electricity and Magnetism, Edward M, Purcell, 1986, McGraw-Hill Education
2. Electricity and Magnetism, J,H, Fewkes& J, Yarwood, Vol, I, 1991, Oxford Univ, Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole
5. D,J, Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, BenjaminCummings

1. Name of the Department: Physics						
2. Course Name	Electricity and magnetism Lab	**L**	**T**		**P**	
3. Course Code	09010213	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments include the fundamental characteristics of DC power supply, RC coupled amplifier, Melde's experiment, electronic voltmeter, compound pendulum etc.

9. Course Objectives:

To understand the working principles of different types of transistors and diodes like JFET, MOSFET, LED and Photo diodes and implement them into practically working equipment which are helpful in our daily life.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to:

1. Apply the concepts of basic electronic devices to design various electronic circuits.
2. Understand operation of diodes, transistors in order to design basic circuits.
3. Measure the oscillations of a mass under different combination of springs.

11. List of Experiments

1. To draw common base and common emitter characteristics of a transistor and calculate transistor and calculate transistor characteristics parameters.
2. To study the ripple factor in a D.C. power supply.
3. To draw frequency response curve of transistorised R.C. coupled amplifier.
4. To find out the frequency of a tuning fork by Melde's experiment.
5. Study of series and parallel resonance circuits.
6. Electronic Voltmeter measurement of peak, average & R .M.S. values of signal.
7. Study of voltage doubler and trippler circuits.
8. Study of a compound pendulum.
9. Study of oscillations of a mass under different combinations of springs.
10. Study of oscillations under a bifilar suspension.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

1. Name of the Department: Physics						
2. Course Name	Thermal Physics and Statistical Mechanics	**L**	**T**		**P**	
3. Course Code	09010312	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will deepen your understanding of basics of thermodynamic principles, thermodynamic potentials, and the kinetic theory of gases.

9. Course Objectives:

To study the different laws of thermodynamics and their practical applications, basics of law of equipartition of energy and its applications to specific heat of gases such as monoatomic and diatomic gases.

10. Course Outcomes (COs):

After completion of this course, students will have understanding of

1. different laws of thermodynamics and their practical applications
2. Maxwell's law of distribution of velocities, conduction and diffusion phenomenon etc.
3. Fermi-Dirac distribution law, electron gas,Bose-Einstein distribution law, photon gas and comparison of their statistics

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Thermodynamic Description of system**

Zeroth Law of thermodynamics andtemperature, First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Thermodynamic Potentials**

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Kinetic Theory of Gases**

Derivation of Maxwell's law of distribution of velocities andits experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Statistical Mechanics**

Phase space, Macrostate and Microstate, Entropy andThermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

12. Books Recommended:

1. Thermal Physics, S, Garg, R, Bansal and C, Ghosh, 1993, Tata McGraw-Hill,
2. A Treatise on Heat, MeghnadSaha, and B,N, Srivastava, 1969, Indian Press,
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications,
4. Heat and Thermodynamics, M,W,Zemasky and R, Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F,W,Sears&G,L,Salinger, 1988
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole,
7. Thermal Physics, A, Kumar and S,P, Taneja, 2014, R, chand Publications

1. Name of the Department: Physics						
2. Course Name	Thermal Physics and Statistical Mechanics Lab	**L**	**T**		**P**	
3. Course Code	09010313	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

The experiment has been designed in such a way the student can learn about thermo-electric effect, conduction of heat through metals and use of potentio meter fore calibration etc.

9. Course Objectives:

To understand the working principles of thermocouples and various effects associated with thermocouple. Also they will learn about the various processes of transmission heat and basic principle of thermodynamics

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

1. Apply the concepts of basicthermodynamic principle to design the different type's thermocouples for daily life applications such as a refrigerator, cooling etc.
2. Understand the mechanism of flow of heat through different medium.

11. List of Experiments

1. To study the variation of thermo emf across two junction of a thermo couple with temperature.
2. To determine the coefficient of thermal conductivity of copper by Searl's apparatus.
3. To determine mechanical equivalent of heat by Callender and Barne's constant flow method.
4. Determination of wave length of Na light and the number of lines per centimeter using a diffraction grating.
5. Calibration of a thermocouple by potential meter
6. Wavelength by Newton's Rings.
7. Resolving power of telescope.
8. Comparison of Illuminating Powers by a Photometer.
9. Measurement of (a) Specific rotation (b)concentration of sugar solution using polarimeter.
10. Ordinary and extra ordinary refractive indices for calcite or quartz.

12.Book Recommended

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

1. Name of the Department: Physics						
2. Course Name	Waves and Optics	**L**	**T**		**P**	
3. Course Code	09010410	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about different types of simple harmonic motion and their superposition, flow of fluids, free forced and resonant oscillation and the phenomenon of interference, diffraction and polarization.

9. Course Objectives:

To impart knowledge about harmonicoscillations, and their superposition, various fluids phenomenon, propagation of sound, and different optical phenomenon.

10. Course Outcomes (COs):

After completion of this course, students will have understanding of

lissajous figures, phenomenon of viscosity, surface tension, musical notes, acoustics of buildings, interference diffraction and polarization.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Harmonic oscillations**

Superposition of Two Collinear Harmonic oscillations: Linearity and SuperpositionPrinciple, (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats),

Superposition of Two Perpendicular Harmonic Oscillations: Graphical andAnalytical Methods, Lissajous Figures with equal an unequal frequency and their uses.

Waves Motion- General: Transverse waves on a string, Travelling and standing waveson a string, Normal Modes of a string, Group velocity, Phase velocity, Plane waves, Spherical waves, Wave intensity,

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem- Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale, Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Fluids**

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure -Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method, Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication, Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Wave Optics**

Wave Optics: Electromagnetic nature of light, Definition and Properties of wave front,Huygens Principle

Interference: Interference: Division of amplitude and division of wavefront, Young'sDouble Slit

experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes), Newton's Rings: measurement of wavelength and refractive index,

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determinationof wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Diffraction and Polarization**

Diffraction: Fresnel Diffraction, Fraunhofer diffraction: Single slit, double Slit Multiple slits &Diffractiongrating, Resolving and Dispersive Power of grating.

Polarization: Transverse nature of light waves, Plane polarized light – production andanalysis, Circular and elliptical polarization

12. Books Recommended

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B,K, Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H,R, Gulati and D,R, Khanna, 1991, R, Chand Publication
4. University Physics, FW Sears, MW Zemansky and HD Young 13/e, 1986, Addison-Wesley.

1. Name of the Department: Physics						
2. Course Name	Waves and Optics Lab	**L**	**T**		**P**	
3. Course Code	09010411	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

In this paper the experiments based on a theoretical concepts of light has been introduced such as determination of wavelength by Biprism, Newton's ring and gratings.

9. Course Objectives:

To understand the working principles of various instruments such as spectrometer, telescope, laser and their use in determination of physical quantities like wavelength, refractive index and resolving power.

10. Course Outcomes (COs):

After performing these experiment, students will be able to implement and demonstrate the use of optical instruments , indetermination of various physical quantities related to light and materials

11. List of Experiments

1. Wave length of Sodium light by Fresnel's biprism.
2. Velocity of ultrasonic waves by grating formation in CC14.
3. Diameter of Lycopodium powder particles by Carona rings.
4. To study double slit interference by He-Ne laser.
5. Diameter of a thin wire by diffraction method (using He-Ne Laser).
6. Young's modulus by Newton's Rings method.
7. Resolving power of a prism.
8. Thickness of a thin plate using air wedge.
9. Resolving Power of plane transmission grating.
10. Rydberg constant by Hydrogen gas spectrum.

12. Book Recommended:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986, Addison-Wesley

1. Name of the Department: Physics						
2. Course Name	Solid State Physics	**L**	**T**		**P**	
3. Course Code	09010511	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course will deepen your understanding of the different types of crystal structures and that will help you to analyse the electrical, mechanical, optical, and magnetic properties of the solids.

9. Course Objectives:

1. To study the basics of crystallography
2. To study the basic of origin of band gap in different types of solids
3. To analyse the electrical and thermal properties of metals
4. To understand the diamagnetic, paramagnetic and ferromagnetic properties of the materials
5. To get familiar with superconducting phenomenon and its applications.

10. Course Outcomes (COs):

After successful completion of the course, students will

1. have a basic knowledge of crystal systems and spatial symmetries
2. understand the concept of reciprocal space and be able to use it as a tool to know the significance of Brillouin zones
3. be able to calculate thermal and electrical properties in the free-electron model
4. know the fundamental principles of semiconductors, including pn-junctions, and be able to estimate the charge carrier mobility and density
5. know basic models of magnetism
6. be able to outline the importance of solid state physics in the modern society

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Crystal Structure**

Crystal Structure: Solids: Amorphous and Crystalline Materials, Lattice TranslationVectors, Lattice with a Basis – Central and Non-Central Elements, Unit Cell, Miller Indices, Reciprocal Lattice, Types of Lattices, Brillouin Zones, Diffraction of X-rays by Crystals, Bragg's Law.

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomicand Diatomic Chains, Acoustical and Optical Phonons, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, T^3 law

Unit - 2	**Number of lectures = 13**	**Title of the unit: Magnetic Properties of Matter**

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials,Classical Langevin Theory of dia – and Paramagnetic Domains, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Dielectric Properties of Materials**

Dielectric Properties of Materials: Polarization, Local Electric Field at an Atom,Depolarization Field, Electric Susceptibility, Polarizability, ClausiusMosotti Equation, Classical Theory of ElectricPolarizability, Normaland Anomalous Dispersion.

Unit - 4	Number of lectures = 13	Title of the unit: Elementary band theory and superconductivity

Elementary band theory: Kronig Penny model, Band Gaps, Conductors,Semiconductors and insulators, P and N type Semiconductors, Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient,

Superconductivity: Experimental Results, Critical Temperature, Critical magnetic field,Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect.

12. Books Recommended

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed,, 2004, Wiley India Pvt, Ltd,
2. Elements of Solid State Physics, J,P, Srivastava, 2nd Ed,, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V, Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, Neil W, Ashcroft and N, David Mermin, 1976, Cengage Learning
5. Solid State Physics, Rita John, 2014, McGraw Hill
6. Solid-state Physics, H, Ibach and H Luth, 2009, Springer
7. Elementary Solid State Physics, 1/e M, Ali Omar, 1999, Pearson India
8. Solid State Physics, M,A, Wahab, 2011, Narosa Publications

1. Name of the Department: Physics						
2. Course Name	Solid State Physics Lab	**L**	**T**		**P**	
3. Course Code	09010512	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 0	**Tutorials = 0**	**Practical = 40**

8. Course Description:

Experiments include the fundamental of materials used in making solar cell, semiconductor diodes, laser diode etc.

Course Objectives:

To understand the working of solar cell, semiconductor diode laser diode etc. and application of their characteristics in making solid state devices.

10. Course Outcomes (COs):

After performing the experiment, the student will be able to convert solar energy into electrical energy using solar cell, laser diode and design circuits rectifier, amplifier etc.

11. List of Experiments

1. Verification of inverse square law by photo-cell.
2. To study the characteristics of a solar cell.
3. To draw forward and reversed bias characteristics of a semiconductor diode.
4. Zener Diode voltage regulation characteristics.
5. E.C.E. of hydrogen using Ammeter.
6. Low resistance by Carey Foster's Bridge with calibration.
7. Frequency of A.C. mains and capacity by electrical vibrator.
8. Frequency of A.C. mains by sonometer using an electromagnet.
9. Measurement of angle dip by earth Inductor.
10. High resistance by substitution method.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Ed., 2011, KitabMahal, New Delhi
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

1. Name of the Department: Physics						
2. Course Name	Atomic, Molecular and Laser Physics	**L**	**T**		**P**	
3. Course Code	09010513	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

Atom and molecule are the fundamental unit for all matters in universe. Matter, whatever the states, is made of atoms. The properties of all matters are governed by the electronic structure of atom and molecule. They have individual properties like electronic, magnetic and optical properties, which are quite different from the collective properties of matter made of atoms and molecules. This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field.

9. Course Objectives:

1. Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum.
2. Molecular spectroscopy.
3. Theory of magnetic energy, Anomalous Zeeman's effect and Landue splitting.factor.
4. Working principle of different types of laser and its applications.

10. Course Outcomes (COs):

1. State and explain the key properties of many electron atoms and the importance of the Pauli exclusion principle
2. Explain the observed dependence of atomic spectral lines on externally applied electric and magnetic fields
3. State and justify the selection rules for various optical spectroscopies in terms of the symmetries of molecular vibrations

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Atomic spectroscopy**

Basic concept of atom model and need of vector atom model, Vector atom model, Quantum numbers associated with vector atom model, Penetrating & non- penetrating orbits, Alkali spectra (Description), Spectral lines in different series of alkali spectra, Spin orbit interaction and doublet term separation, LS coupling and jj coupling description, Expression for interaction energy in LS coupling, Expression for interaction energy in jj coupling.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Molecular Spectroscopy**

Normal Zeeman effect, Anomalous Zeeman Effect, Zeeman pattern of D_1 and D_2 lines of Na atom, Paschen Back effect of a single valance electron system, Weak field Stark effect of H-atom, Discrete set of electronic energies of molecules, Quantization of vibrational energies, Quantization of rotational energies, Raman effect (Quantitative Description), Stokes and Anti-stokes lines.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Basics of lasers**

Main features of Laser (Directionality and Intensity), Main features of Laser (Monochromaticity and Coherence), Einstein coefficients and possibility of amplification, Momentum transfer & life time of a level absorption, Kinetics of optical, Laser pumping.

Unit - 4	Number of lectures = 13	Title of the unit: Working of lasers
RUBY Laser (Principle, construction & working), He-Ne Laser (Principle, construction & working), CO_2 Laser (Principle, construction & working), Semiconductor Laser (Principle, construction & working), Application of Laser in the field of medicine and industry.		

12. Books Recommended

1. Jain, V,K, Introduction to Atomic and Molecular Spectroscopy, New Delhi: Narosa,
2. White, H,B, Introduction to Atomic Spectra,
3. Herzberg, G, Atomic Spectra,
4. Herzberg, G, Molecular Spectra and Molecular Structure,
5. Banwell, Colin N, and Elaine M, McCash, Fundamentals of Molecular Spectroscopy,
6. Thiagrajan and Ajay Ghatak, Lasers, Theory and Applications, 2nd ed,
7. Laud, B,B, Laser and Nonlinear Optics, 2nd ed,
8. Pedrotti, Frank L, and Lens S, Pedrotti, Introduction to Optics, New York: Prentice-Hall, 1987

1. Name of the Department: Physics						
2. Course Name	Atomic, Molecular and Laser Physics Lab	**L**	**T**		**P**	
3. Course Code	09010514	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments based on atomic and molecular physics and related topics such as determination of e/m ratio by Thamson method, basic characteristics of G.M counter etc.

9. Course Objectives:

To learn by performing experiment based on G.M. Counter, cathode ray oscilloscope, spectrometer etc..

10. Course Outcomes (COs):

After performing these experiment students will be able to demonstrate the experiment and their practical applications.

11. List of Experiments

1. e/m by Thomson method.
2. To draw the Plateau of G.M. Counter
3. To determine the Mass attenuation coefficient by G.M. Counter.
4. Transistor as voltage Amplifier in C-B configuration.
5. Transistor as voltage Amplifier in C-E configuration.
6. Study of B-H Curve by C.R.O.
7. Study of Hartley Oscillator (Calibration of Gang Condenser).
8. Measurement of Energy Gap of Four Probe Method.
9. Characteristics of PNP transistor.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Ed., 2011, KitabMahal, New Delhi
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

1. Name of the Department: Physics						
2. Course Name	History and Philosophy of Science	**L**	**T**		**P**	
3. Course Code	09010515	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The course will teach about historical development of science and associated philosophical concepts.

9. Course Objectives:

To understand about the views of different philosopher about the science and its development

10. Course Outcomes (COs):

After completing this course Students will able to know the names of different philosopher and scienctis who contributed in the development of science and also they will understand the conceptual development of science by criticism and hypothetical consideration

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Development of science**

The history of the development of science can affect our view of science and the philosophy of science, Present-day histories of knowledge and science describe the origins of science as exclusively Western, Critiques of such histories are available, Adequate histories of science in China, India, Africa, South American (Maya), Iran, Arabia, Korea, etc,, are now readily available, These accounts suggest major original scientific activity in several of these countries and continents.

These scientific contributions will be discussed through specific instances, ideas or

techniques originating from different parts of the world:

a) Gunpowder and Chinese science

b) The printing press and Korea

c) Arithmetic, algebra, trigonometry, calculus and probability from India

d) The calendar from Mayan civilization

e) Geometry from Egypt

f) The House of Wisdom (Baghdad)

g) The Hospital (Jandishapur/Iran)

h) The Alkashi Observatory from Samarkhand and its influence

The discussions will examine origins and transmissions of key scientific ideas and inventions across continents including geometry and emphasizing the Indian achievements in science, especially achievements in mathematics, astronomy, and medicine.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Primary, secondary and tertiary sources**

Primary, secondary and tertiary sources, What kind of source is Wikipedia? Can one easily correct Wikipedia? Examination of the history of science in school texts and evidence for it, Is the claim of Greek origins of mathematics and science sustainable? Primary evidence for Euclid, Claudius Ptolemy, Archimedes, Eratosthenes, Aristotle, Case of “Pythagorean” proposition in Egypt, Iraq, and India, Greek

and Roman arithmetic and its defects, How they are reflected in defects of the Greek and Roman calendars, How could the Greeks have done science without knowledge of arithmetic? How history was churchified during the Crusades, Transmission of knowledge and its appropriation, Case of Toledo and the beginning of Western universities, The appropriation of Arabic knowledge the example of Copernicus, Appropriation of Indian knowledge, the case of Ptolemy, and trigonometric values, The navigation problem as the biggest scientific problem in Europe,The case of calculus, Later cases, vaccination vs inoculation, Recent cases of appropriation.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Basic concepts of science-working**

Basic concepts of science-working including testability, Popper's criterion and experimental methods, Examples of experimental methods and challenges to superstition in Indian tradition, Payasi, Lalla, Vateshwar with examples from various traditions will be discussed including various strategies and tricks relied upon by scientists to avoid testing or to resist testability, This discussion will enable the students to understand the difference between science and non-science,Why is mathematics metaphysics? Indian ganitavs Western mathematics, Plato's religious philosophy of mathematics as a means of arousing the soul, The rejection of the empirical in the church theology of reason and its relation to the rejection of the empirical in present-day philosophy of formal mathematics, Does this add to the practical value of mathematics? The practical philosophy of math in sulba sutra and Aryabhata, Zeroism.

Examples of testability in science: the round earth versus flat earth theory and measurement of the earth's size, Students will experiment to measure the circumference of the earth, Summarise the discussion on moving earth, including Galileo.

Example for discussion of science as inference: Length of the day, Summarise the discussion.

Unit - 4	**Number of lectures = 13**	**Title of the unit: General popular discussion**

As a general popular discussion in terms of its relevance to their own lives, the ethics of science will enable students to voice their opinions on the remaking of the world according to science and its negative impacts on the environment as well.

12. Books Recommended

1. Kuhn, T, S, 1957/2003, The Copernican Revolution: Planetary Astronomy in the Development ofWestern Thought, Cambridge: Harvard University Press,
2. Nasr, SeyyedHossein, 1968, Science and Civilization in Islam, Cambridge: Harvard University Press
3. Needham, J,1981, The Shorter Science and Civilization in China, Vol, 2 (Abridgement by C,A,Ronan), Cambridge University Press,
4. Raju, C, K, 2009, Is Science Western in Origin? Penang: Multiversity and Citizen's International,Also,Daanish Books, Delhi,
5. Raju C,K, 2012, Euclid and Jesus, India, Other India Press,
6. Raju C, K, 2007 Cultural Foundation of Mathematics, Pearson Longman, 2007
7. Alvares, Claude**,** 1991, Decolonising History: Technology and Culture in India, China and the West1492 to the Present Day, Goa: The Other India Press, India,
8. Selin, Helaine (Ed,), 2016, Encyclopaedia of the History of Science, Technology, and Medicine inNon-Western Cultures, Dordrecht: Springer,
9. Dharampal, Indian Science and Technology in the 18th Century, OIP, India
10. Dharampal, The Beautiful Tree, Indigenous Indian Education in the Eighteenth Century
11. Broad W, and Wade, N,, Betrayers of the Truth: Fraud and Deceit in the Halls of Science, Simon and Schuster, 1982,
12. James George, Stolen Legacy: Greek Philosophy is Stolen Egyptian Philosophy, 1952, reprint ClassicHouse Books, New York, 2009, 2016,
13. Salim T,S, Al-Hassani, (2011), ed, 1001 Inventions: Muslim Heritage in Our World (2nd ed,),London:Foundation for Science Technology and Civilization,

1. Name of the Department: Physics						
2. Course Name	History and Philosophy of ScienceLab	**L**	**T**		**P**	
3. Course Code	09010516	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments include the Basic concepts of science-working including testability, Popper's criterion and experimental methods.

9. Course Objectives:

To understand the Basic concepts of science-working including testability, Popper's criterion and experimental methods etc.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to implement the basic concepts of science-working including testability, Popper's criterion and experimental methods in practical life.

11. List of Experiments

Basic concepts of science-working including testability, Popper's criterion and experimental methods, Examples of experimental methods and challenges to superstition in Indian tradition, Payasi, Lalla, Vateshwar with examples from various traditions will be discussed including various strategies and tricks relied upon by scientists to avoid testing or to resist testability, This discussion will enable the students to understand the difference between science and non-science. And other experiments related to history and philosophy of science.

12. Book Recommended:

1. Kuhn, T, S, 1957/2003, The Copernican Revolution: Planetary Astronomy in the Development of Western Thought, Cambridge: Harvard University Press,
2. Nasr, SeyyedHossein, 1968, Science and Civilization in Islam, Cambridge: Harvard University Press,
3. Needham, J,1981, The Shorter Science and Civilization in China, Vol, 2 (Abridgement by C,A,Ronan), Cambridge University Press,
4. Raju, C, K, 2009, Is Science Western in Origin? Penang: Multiversity and Citizen's International,AlsoDaanish Books, Delhi,
5. Raju C,K, 2012, Euclid and Jesus, India, Other India Press,
6. Raju C, K, 2007 Cultural Foundation of Mathematics, Pearson Longman, 2007
7. Alvares, Claude**,** 1991, Decolonising History: Technology and Culture in India, China and the West,1492 to the Present Day, Goa: The Other India Press, India,

1. Name of the Department: Physics						
2. Course Name	Elements of modern physics	**L**	**T**		**P**	
3. Course Code	09010611	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

The course will includes the planck quantum concepts of particle and wave natures, atomic models, uncertainty principle, operators, radio activity and nuclear reactions.

9. Course Objectives:

The aim of this course is to understand the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, source of nuclear energy and related devices.

10. Course Outcomes (COs):

After completing this course Students will be able to explain the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, source of nuclear energy and related devices.

11. Unit wise detailed content

Unit-1	**Number of lectures** = 13	**Title of the unit:**

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering, De Broglie wavelength and matter waves; Davisson-Germer experiment, Position measurement- gamma ray microscope thought experiment, Wave particle-duality, and Heisenberg uncertainty principle impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Unit - 2	**Number of lectures = 13**	**Title of the unit:**

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Unit - 3	**Number of lectures = 13**	**Title of the unit:**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Unit - 4	**Number of lectures = 13**	**Title of the unit:**

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α-decay; β-decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission, Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons, Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

12. Books Recommended

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R, Taylor, Chris D, Zafiratos, Michael A,Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A, Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course Vol,4, E,H, Wichman, 2008, Tata McGraw-Hill Co,
5. Modern Physics, R,A, Serway, C,J, Moses, and C,A,Moyer, 2005, Cengage Learning
6. Modern Physics, G, Kaur and G,R, Pickrell, 2014, McGraw Hill.

1. Name of the Department: Physics						
2. Course Name	Elements of modern physics Lab	**L**	**T**		**P**	
3. Course Code	09010612	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments include the Basic concepts of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

9. Course Objectives:

To understand the working principles of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

10. Course Outcomes (COs):

After performing these experiments, students will be able to implement and demonstrate the photoelectric effect that is how radiation can be converted into electric energy, effect of stress on materials to develop potential difference etc.

11. List of Experiments

1. To determine value of Planck's constant using LEDs of at least 4 different colours
2. To determine value of Boltzmann constant using V-I characteristic of PN diode.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the ionization potential of mercury.
5. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
6. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
7. To study Hall effect.
8. To determine I-V characteristics of PNP transistors.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

1. Name of the Department: Physics						
2. Course Name	Quantum Mechanics	**L**	**T**		**P**	
3. Course Code	09010613	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will includes the planck quantum concepts of particle and wave natures, atomic models, uncertainty principle, operators, Schrodinger wave equation and its applications.

9. Course Objectives:

The aim of this course is to understand the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, time dependent and time independent Schrodinger wave equations and its solution for hydrogen atom and many electron atoms.

10. Course Outcomes (COs):

After completing this course Students will be able to explain the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, time dependent and time independent Schrodinger wave equations and its solution for hydrogen atom and many electron atoms

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Time dependent Schrodinger equation**

Time dependent Schrodinger equation: Time dependent Schrodinger equation anddynamical evolution of a quantum state; Properties of Wave Function, Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions, Normalization, Linearity and Superposition Principles, Eigenvalues and Eigen functions, Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum, Wave Function of a Free Particle,

Time independent Schrodinger equation-Hamiltonian, stationary states and energyeigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states.

Unit - 2	**Number of lectures = 13**	**Title of the unit: General discussion of bound states in an arbitrary potential**

General discussion of bound states in an arbitrary potential- continuity of wavefunction, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions,

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation inspherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Orbital angular momentum quantum numbers l and m; s, p, d,..shells (idea only).

Unit - 3	**Number of lectures = 13**	**Title of the unit: Atoms in Electric and Magnetic Fields**

Atoms in Electric and Magnetic Fields: - Electron Angular Momentum, SpaceQuantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment,**Atoms in External Magnetic Fields**:- Normal and Anomalous Zeeman Effect.

Unit - 4	Number of lectures = 13	Title of the unit: Many electron atoms
Many electron atoms:- Pauli's Exclusion Principle, Symmetric and AntisymmetricWave Functions, Periodic table, Fine structure, Spin orbit coupling, Spectral Notations for Atomic States, Total Angular Momentum, Vector Model, Spin-orbit coupling in atoms-L-S and J-J couplings.		
12. Books Recommended		
1. A Text book of Quantum Mechanics, P,M, Mathews & K, Venkatesan, 2nd Ed,, 2010, McGraw Hill 2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn,, 2002, Wiley, 3. Quantum Mechanics, Leonard I, Schiff, 3rdEdn, 2010, Tata McGraw Hill, 4. Quantum Mechanics, G, Aruldhas, 2ndEdn, 2002, PHI Learning of India, 5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning,		

1. Name of the Department: Physics						
2. Course Name	Quantum mechanics Lab	**L**	**T**		**P**	
3. Course Code	09010614	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments include the basic concepts of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

9. Course Objectives:

To understand the working principles of measurement of Planck's constant using LEDs, tunnelling current in backward diode or tunnel diode, work function, hall coefficient etc.

10. Course Outcomes (COs):

After performing these experiments, students will be able to implement and demonstrate the photoelectric effect that is how radiation can be converted into electric energy, effect of magnetic field to develop potential difference etc.

11. List of Experiments

1. To determine value of Planck's constant using LEDs of at least 4 different colours
2. To determine I-V characteristics of PNP transistors.
3. To study Hall effect.
4. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
5. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
6. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.
7. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
8. To determine value of Boltzmann constant using V-I characteristic of PN diode.
9. To determine work function of material of filament of directly heated vacuum diode.

12. Books Recommended:

1. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
2. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
3. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
4. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
6. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

1. Name of the Department: Physics						
2. Course Name	Nuclear and particle physics	**L**	**T**		**P**	
3. Course Code	09010615	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The syllabus is divided into four units i.e. general properties of nuclei and nuclear models, radioactive decay and nuclear reactions, interaction of nuclear radiation with matter, and particle accelerator.

9. Course Objectives:

In this course students will learn about the phenomenon involve in the interaction of nuclear radiation with matters, working principles and characteristics of different types of nuclear detectors, radioactive decay processes and basics of high energy physics

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. Understand the science involved with interaction of nuclear radiations with matter.
2. Explain the characteristics of GM counter, gamma ray spectroscopy and high purity germanium detectors.
3. Explain the basic concepts of isospin, nuclear forces, Coulomb excitation, nuclear kinematics etc
4. Describe the basic features involved in high energy physics.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: General Properties of Nuclei and Nuclear Models**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties,quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Nuclear Models: Liquid drop model approach, semi empirical mass formula andsignificance of various terms, condition of nuclear stability, Two nucleon separation energies, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Radioactivity decay and Nuclear reaction**

Radioactivity decay:(a) Alpha decay: basics ofα-decay processes, theory ofα-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy, (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis, (c) Gamma decay: Gamma rays emission &kinematics, internal conversion.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions,Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

Unit - 3	**Number of lectures = 13**	**Title of the unit: Interaction of Nuclear Radiation with matter**

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula),

energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter,

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobilityof particle, for ionization chamber and GM Counter, Basic principle of Scintillation, Detectors and construction of photo-multiplier tube (PMT), Semiconductor Detectors (Si &Ge) for charge particle and photon detection (concept of charge carrier and mobility).

Unit - 4	**Number of lectures = 13**	**Title of the unit: Particle Accelerators**

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator(Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons,

Particle physics: Particle interactions; basic features, types of particles and its families,Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons,

12. Books Recommended

1. Introductory nuclear Physics by Kenneth S, Krane (Wiley India Pvt, Ltd,, 2008),
2. Concepts of nuclear physics by Bernard L, Cohen, (Tata Mcgraw Hill, 1998),
3. Introduction to the physics of nuclei & particles, R,A, Dunlap, (Thomson Asia, 2004)
4. Introduction to Elementary Particles, D, Griffith, John Wiley & Sons
5. Quarks and Leptons, F, Halzen and A,D, Martin, Wiley India, New Delhi
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K, Heyde (IOP- Institute of Physics Publishing, 2004),
7. Radiation detection and measurement, G,F, Knoll (John Wiley & Sons, 2000),
8. Theoretical Nuclear Physics, J,M, Blatt &V,F,Weisskopf (Dover Pub,Inc,, 1991)

1. Name of the Department: Physics						
2. Course Name	Nuclear and particle physics Lab	**L**	**T**		**P**	
3. Course Code	09010616	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials =0**	**Practical = 40**			

8. Course Description:

Experiments based on atomic and molecular physics and related topics such as determination of e/m ratio by Thamson method, basic characteristics of G.M counter etc

9. Course Objectives:

To learn by performing experiment based on G.M. Counter, cathode ray oscilloscope, spectrometer etc..

10. Course Outcomes (COs):

After performing these experiment students will be able to demonstrate the experiment and their practical applications.

11. List of Experiments

1. e/m by Thomson method.
2. Study of B-H Curve by C.R.O.
3. Study of Hartley Oscillator (Calibration of Gang Condenser).
4. Measurement of Energy Gap of Four Probe Method.
5. To draw the Plateau of G.M. Counter.
6. To determine the Mass Attention Coefficient by G.M. Counter.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Ed., 2011, KitabMahal, New Delhi
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

13. Name of the Department: Physics						
14. Course Name	Digital and analog electronic circuit and instrumentation	**L**	**T**		**P**	
15. Course Code		4	0		0	
16. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
17. Pre-requisite (if any)		**18. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
19. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**		**Practical = 0**		

20. Course Description:

The course will teach about the fundamental concept of digital electronics, semiconductor devices, operational amplifiers and their subsequent development in applications in various field like integrated circuit design, constant power supply design etc.

21. Course Objectives:

The aim of this course is to understand the basic concepts for the development of different types of digital electronic circuits, semiconductor devices, and operational amplifiers.

22. Course Outcomes (COs):

After going through this course the student will be able to implement, the basic concepts of digital electronics, semiconductor devices, operational amplifiers s in everyday life, understand the working of logic circuits, LEDs, Photodiode, differential amplifiers etc.

23. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Digital Circuits**

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates, De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products: Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition. Binary Subtraction using 2's Complement Method).Half Adders and Full Adders and Subtractors,

Unit - 2	**Number of lectures = 14**	**Title of the unit: Semiconductor Devices and Amplifiers**

Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Operational Amplifiers**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2)

Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations.Determination of Frequency of RC Oscillator

Unit - 4	**Number of lectures = 10**	**Title of the unit: Instrumentations**

Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.

24. Books Recommended

6. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
7. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
8. Microelectronic Circuits, M.H. Rashid, 2nd Edn.,2011, Cengage Learning.
9. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning
10. Digital Principles & Applications, A.P. Malvino, D.P. Leach &Saha, 7th Ed.,2011, Tata McGraw Hill
11. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
12. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
13. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

1. Name of the Department: Physics						
2. Course Name	Digital and analog electronic circuit and instrumentation Lab	**L**	**T**		**P**	
3. Course Code		0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 40**		

8. Course Description:

Experiments include the fundamental of different types of digital circuits and their design, V-I characteristics of transistors and diodes, and basics of operational amplifiers.

9. Course Objectives:

To understand the working principles of different types of logic gates, operational amplifiers transistors and diodes like PNP, NPN, LED and Photo diodes and implement them into practically working equipment which is helpful in our daily life.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to:

1. Apply the concepts of basic electronic devices and digital electronics to design various electronic circuits.
2. Understand operation of diodes, transistors in order to design basic circuits.
3. To investigate the use of different types of operational amplifier

11. List of Experiments

1. Adder-Subtractor using Full Adder I.C.
2. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. To minimize a given logic circuit: Half adder, Full adder and 4-bit Binary Adder..
5. To study IV characteristics of PN diode, Zener and Light emitting diode
6. To study the characteristics of a Transistor in CE configuration.
7. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
8. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
9. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
10. To study a precision Differential Amplifier of given I/O specification using Op-amp.
11. To investigate the use of an op-amp as a Differentiator

12. Book Recommended:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th} edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

1. Name of the Department: Physics						
2. Course Name	Computational Physics Skills	**L**	**T**		**P**	
3. Course Code	09010415	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 30	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics,

9. Course Objectives:

To impart knowledge about various computer programming method to solve problems in physics.

10. Course Outcomes (COs):

After completion of this course, students will have understanding of

1. the use of computational methods to solve physical problems
2. Use of computer language as a tool in solving physics problems (applications)
3. Course will consist of hands on training on the Problem solving on Computers,

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Introduction**

Introduction: Importance of computers in Physics, paradigm for solving physicsproblems for solution**,** Usage of linux as an Editor, **Algorithms and Flowcharts:** Algorithm: Definition, properties and development, Flowchart: Concept of flowchart, symbols, guidelines, types, Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal,

Unit - 2	**Number of lectures = 8**	**Title of the unit: Scientific Programming**

Scientific Programming: Some fundamental Linux Commands (Internal and Externalcommands), Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program, Operators: Arithmetic, Relational, Logical and Assignment Operators, Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions, Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic, Examples from physics problems

Unit - 3	**Number of lectures = 8**	**Title of the unit: Control Statements**

Control Statements: Types of Logic (Sequential, Selection, Repetition), BranchingStatements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file, Examples from physics problems,

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN,
3. To print out all natural even/ odd numbers between given limits,
4. To find maximum, minimum and range of a given set of numbers,
5. Calculating Euler number using exp(x) series evaluate d at x=1

Unit - 4	**Number of lectures =** 8	**Title of the unit: Scientific word processing**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor,preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages, **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors,

Visualization: Introduction to graphical analysis and its limitations, Introduction toGnuplot, importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc,
2. To evaluate sum of finite series and the area under a curve,
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series,
5. To write program to open a file and generate data for plotting using Gnuplot,
6. Plotting trajectory of a projectile projected horizontally,
7. Plotting trajectory of a projectile projected making an angle with the horizontally,
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen, Saving it as an eps file and as a pdf file,
9. To find the roots of a quadratic equation,
10. Motion of a projectile using simulation and plot the output for visualization,
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization,
12. Motion of particle in a central force field and plot the output for visualization

12. Books Recommended

1. Introduction to Numerical Analysis, S,S, Sastry, 5thEdn,, 2012, PHI Learning Pvt, Ltd,
2. Computer Programming in Fortran 77", V, Rajaraman (Publisher:PHI),
3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994),
4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
5. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co,

6. Computational Physics: An Introduction, R, C, Verma, et al, New Age International Publishers, New Delhi(1999)
7. A first course in Numerical Methods, U,M, Ascher and C, Greif, 2012, PHI Learning
8. Elementary Numerical Analysis, K,E, Atkinson, 3rdEdn ,, 2007, Wiley India Edition,

1. Name of the Department: Physics						
2. Course Name	Renewable energy and energy harvesting	**L**	**T**		**P**	
3. Course Code	09010418	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 30		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

The course will focus on the physical principles underlying energy processes. The application of these principles for harvesting energy from various sources will also be discussed.

9. Course Objectives:

To teach students the fundamental laws and physical processes that governs the sources, extraction, storage, and uses of energy.

10. Course Outcomes (COs):

Students will have enhanced their abilities to:

1. Understand how physical principles influence energy use.

2. Understand how to solve the problem of energy demand using various alternatives.

11. Unit wise detailed content

Unit-1	**Number of lectures = 7**	**Title of the unit: Fossil fuels and Alternate Sources of energy**

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, theirlimitation, need of renewable energy, non-conventional energy sources, An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Unit - 2	**Number of lectures = 8**	**Title of the unit: Solar energy and Wind Energy harvesting**

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning, Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and differentelectrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Unit - 3	**Number of lectures = 8**	**Title of the unit: Ocean Energy, Geothermal Energy and Hydro Energy**

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristicsand Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.Osmotic Power, Ocean Bio-mass,

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impactof hydro power sources.

Unit - 4	Number of lectures = 14	Title of the unit: Piezoelectric Energy harvesting and Electromagnetic Energy Harvesting

Piezoelectric Energy harvesting: Introduction, Physics and characteristics ofpiezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models.

12. Books Recommended

1. Non-conventional energy sources - G,D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co, Ltd,
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd,
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University,
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J,Balfour, M,Shaw and S, Jarosek, Photovoltaics, Lawrence J Goodrich (USA),
7. http://en,wikipedia,org/wiki/Renewable_energy

1. Name of the Department: Physics						
2. Course Name	Applied Optics	**L**	**T**		**P**	
3. Course Code	09010416	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 30		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The course will teach about different types of light source and detectors, fourier transform spectroscopy, holography and the phenomenon of interference, diffraction and polarization.

9. Course Objectives:

To impart knowledge about different types of light source and detectors, fourier transform spectroscopy, holography and the phenomenon of interference, diffraction and polarization.

10. Course Outcomes (COs):

Students will have understanding of

1. different types of light sources and detectors

2. how to use fourier transform spectroscopy for analyzing various physical phenomenon related to light

11. Unit wise detailed content

Unit-1	**Number of lectures = 8**	**Title of the unit: Sources and Detectors**

Sources and Detectors

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers,

Experiments on Lasers:

Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser,

To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser,

To find the polarization angle of laser light using polarizer and analyzer

Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

V-I characteristics of LED

Study the characteristics of solid state laser

Study the characteristics of LDR

Photovoltaic Cell

Characteristics of IR sensor

Unit - 2	**Number of lectures = 8**	**Title of the unit: Fourier Optics**

Fourier Optics

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens

Experiments on Fourier Optics:

Fourier optic and image processing

Optical image addition/subtraction

Optical image differentiation

Fourier optical filtering

Construction of an optical 4f system

Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science,

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer, The resulting interferogram is the Fourier transform of the power spectrum of the source, Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters, Computer simulation can also be done,

Unit - 3	**Number of lectures = 6**	**Title of the unit: Holography**

Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition

Experiments on Holography and interferometry:

Recording and reconstructing holograms

Constructing a Michelson interferometer or a Fabry Perot interferometer

Measuring the refractive index of air

Constructing a Sagnac interferometer

Constructing a Mach-Zehnder interferometer

White light Hologram

Unit - 4	**Number of lectures = 8**	**Title of the unit: Photonics: Fibre Optics**

Photonics: Fibre Optics

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating

Experiments on Photonics: Fibre Optics

To measure the numerical aperture of an optical fibre

To study the variation of the bending loss in a multimode fibre

To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern

To measure the near field intensity profile of a fibre and study its refractive index profile

To determine the power loss at a splice between two multimode fibre

12. Books Recommended

1. Fundamental of optics, F, A, Jenkins & H, E, White, 1981, Tata McGraw hill,
2. LASERS: Fundamentals & applications, K,Thyagrajan&A,K,Ghatak, 2010, Tata McGraw Hill
3. Fibre optics through experiments,M,R,Shenoy, S,K,Khijwania, et,al, 2009, Viva Books
4. Nonlinear Optics, Robert W, Boyd, (Chapter-I), 2008, Elsevier,
5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer,
6. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt, Ltd,
7. Optoelectronic Devices and Systems, S,C, Gupta, 2005, PHI Learning Pvt, Ltd,
8. Optical Physics, A,Lipson, S,G,Lipson, H,Lipson, 4thEdn,, 1996, Cambridge Univ, Press

1. Name of the Department: Physics						
2. Course Name	Mobile Communications	**L**	**T**		**P**	
3. Course Code	09010417	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 30		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
This course discusses basics of cellular mobile system, frequency management & channel assignment, modulation and access techniques, and digital, wireless systems.						
9. Course Objectives:						
This course would provide an introduction to the fundamental principles involved in mobile communications, the handset and various wireless technologies involved.						
10. Course Outcomes (COs):						
1. Familiarity with fundamental principles of mobile communications 2. Familiarity with components of a mobile handset and wireless communications						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 6**	**Title of the unit: Basics of Cellular Mobile System**				
Basics of Cellular Mobile Systems: A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, overview of generations of cellular systems. Cellular Radio Systems Design and Interference: General description of the problem, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting, consideration of the components of cellular systems, Introduction to co-channel interference, co-channel measurement design of antenna system, antenna parameter and their effects.						
Unit - 2	**Number of lectures = 10**	**Title of the unit: Basics of Frequency Management & Channel Assignment**				
Signal & Antenna Structures: introduction, obtaining the mobile point-to-point mode, propagation over water or flat open area, foliage loss, propagation near in distance, long distance propagation, point-to-point prediction model – characteristics, cell site, antenna heights and signal coverage cells, mobile to mobile propagation, Characteristics of basic antenna structures, antenna at cell site, mobile antennas. Frequency Management & Channel Assignment, Hand Off & Dropped Calls: Frequency Management, fixed channel assignment, non-fixed channel assignment, traffic & channel assignment, hand-off, types of hand-off and their characteristics, dropped call rates & their evaluation.						
Unit - 3	**Number of lectures = 9**	**Title of the unit: Modulation and Access Techniques**				
Methods of Modulation, coding for error detection and correction: Introduction to Digital modulation techniques, modulation methods in cellular wireless systems, OFDM, Block Coding, convolution coding and Turbo coding. Access techniques: FDMA, TDMA, CDMA: Time-division multiple access (TDMA), code division multiple access (CDMA), CDMA capacity, probability of bit error considerations, CDMA compared with TDMA.						
Unit - 4	**Number of lectures = 5**	**Title of the unit: Digital, Wireless systems**				
GSM, D-AMPS, IS-95, basics of 4G, mobile management, voice signal processing and coding.						

12. Books Recommended

1. Mischa Schwartz, “Mobile Wireless Communications”, Cambridge University Press, UK, 2005.

2. William, C. Y. Lee, “Mobile Cellular Telecommunications”, 2nd Edition, McGraw Hill, 1990.

3. “Mobile Communication Hand Books”, 2nd Edition, IEEE Press.

4. Theodore S Rappaport, “Wireless Communication Principles and Practice”, 2nd Edition, Pearson Education, 2002.

5. KavehPahlavan and Prashant Krishnamurthy”, Principles of Wireless Networks”, PHI, 2001.

6. Lawrence Harte, “3G Wireless Demystified”, McGraw Hill Publications, 2001.

1. Name of the Department: Physics						
2. Course Name	Physical Workshop Skills	**L**	**T**		**P**	
3. Course Code	09010419	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 30	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the practical uses of mechanical, electrical and magnetic equipment which has been beneficial for the our everyday life.

9. Course Objectives:

To impart knowledge about various mechanical, electrical and magnetic equipment such as lathe, shaper, drilling, milling and surface machines, Cutting tools, Multimeter, Soldering of electrical circuitshaving discrete components (R, L, C, diode) and ICs on PCB etc.

10. Course Outcomes (COs):

After performing these experiment students will be able to demonstrate the experiment and their practical applications.

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Introduction**

Introduction: Measuring units, conversion to SI and CGS, Familiarization with meterscale, Verniercalliper, Screw gauge and their utility, Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc, Use of Sextant to measure height of buildings, mountains, etc Characteristics of IR sensor

Unit - 2	**Number of lectures = 8**	**Title of the unit: Mechanical Skill**

Mechanical Skill: Concept of workshop practice, Overview of manufacturing methods:casting, foundry, machining, forming and welding, Types of welding joints and welding defects, Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood, Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines, Cutting tools, lubricating oils, Cutting of a metal sheet using blade, Smoothening of cutting edge of sheet using file, Drilling of holes of different diameter in metal sheet and wooden block, Use of bench vice and tools for fitting, Make funnel using metal sheet,

Unit - 3	**Number of lectures = 8**	**Title of the unit: Electrical and Electronic Skill**

Electrical and Electronic Skill: Use of Multimeter, Soldering of electrical circuitshaving discrete components (R, L, C, diode) and ICs on PCB, Operation of oscilloscope, Making regulated power supply, Timer circuit, Electronic switch using transistor and relay,

Unit - 4	**Number of lectures = 8**	**Title of the unit: Introduction to prime movers**

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears withmotor axel, Lever mechanism, Lifting of heavy weight using lever, braking systems, pulleys, working principle of power generation systems, Demonstration of pulley experiment.

12. Books Recommended

1. A text book in Electrical Technology - B L Theraja – S, Chand and Company,

2. Performance and design of AC machines – M,G, Say, ELBS Edn,
3. Mechanical workshop practice, K,C, John, 2010, PHI Learning Pvt, Ltd,
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn,, Editor Newnes
5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland

1. Name of the Department: Physics						
2. Course Name	Basic Instrumentation Skills	**L**	**T**		**P**	
3. Course Code	09010420	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 30	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the practical uses of mechanical, electrical and magnetic equipment which has been beneficial for our everyday life.

9. Course Objectives:

To impart knowledge about various mechanical, electrical and magnetic equipment such, multimeter, AC millivoltmeter, cathode ray oscilloscope, signal generator and analysis of related instruments etc.

10. Course Outcomes (COs):

After performing these experiment students will be able to demonstrate the experiment and their practical applications.

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Basic of Measurement**

Instruments accuracy, precision, sensitivity, resolution rangeetc. Errors in measurements and loading effects. Multimeter**:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Unit - 2	**Number of lectures = 8**	**Title of the unit: Electronic Voltmeter**

Advantage over conventional multimeter for voltagemeasurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter**:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance

Unit - 3	**Number of lectures = 8**	**Title of the unit: Cathode Ray Oscilloscope**

Block diagram of basic CRO. Construction of CRT,Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Unit - 4	**Number of lectures = 8**	**Title of the unit: Signal Generators and Analysis Instruments**

Block diagram, explanation andspecifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis,

Digital Multimeter**:** Block diagram and working of a digital multimeter. Workingprinciple of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

12. Books Recommended

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.

3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, SubrataGhoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India