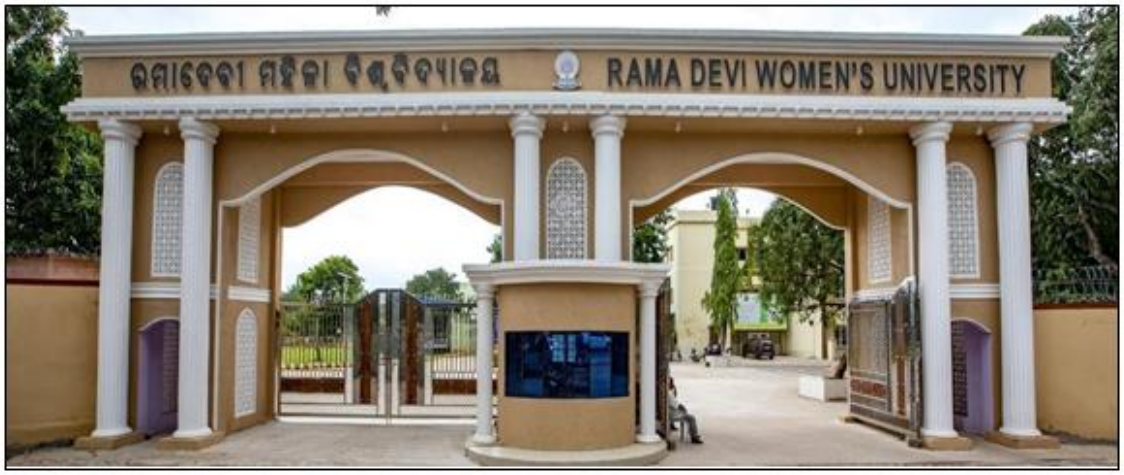
DEPARTMENT OF PHYSICS

SYLLABUS OF UG PROGRAMME (B.Sc.)



SKILLS	
EMPLOYABILITY	
ENTERPRENURESHIP	

RAMA DEVI WOMEN'S UNIVERSITY
Vidya Vihar, Bhubaneswar-751022, Odisha
Website: https://rdwu.ac.in

B.Sc. Physics Syllabus

RAMA DEVI WOMEN'S UNIVERSITY

BHOI NAGAR, BHUBANESWAR, ODISHA, PIN-751022

13.10.23
Controller of Examinations
R.D. Women's University
Bhubaneswar

PROGRAMME OUTCOMES (POs)

PO 1. Understand the basic laws and explore the fundamentals of mechanics, properties of matter and electrodynamics.

PO 2. Understand the theoretical CONCEPTS of quantum mechanics, relativistic physics, nuclear physics, optics, spectroscopy, solid state physics, astrophysics, statistical physics, photonics and thermodynamics.

PO 3. Understand the basics of computer programming and numerical analysis.

PO 4. Understand and apply the concepts of electronics in designing of different analog and digital circuits.

PO 5. To carry out experiments to understand the laws and concepts of Physicsand apply the theories learnt and the skills acquired to solve real time problems through laboratory experiments.

PO 6. Be initiated into the basics of research.

PO 7. Providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, heat, optics, electricity and electronics.

PO 8. Become conscious of environmental and societal responsibilities.

PO 9. To enhance the student's academic abilities, communication skills, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.

PO 10. To motivate the students to pursue PG courses in reputed institutions and holistic development of the student.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1. Gain hands on experience to work in applied fields.

PSO 2. Gain a through grounding in the subject to be able to teach it at college as well as school level.

PSO 3. Viewing physics as a training ground for the mind developing a critical attitude and the faculty of logical reasoning that can be applied to diverse fields.

PSO 4. Learn to carry out experiments in basic as well as certain advanced areas of physics such as nuclear physics, condensed matter physics, nano science, lasers and electronics.

RDWU U.G. SYLLABUS STRUCTURE (w.e.f 2023-24)

Semester-1									
Sl. No	Nature of Course	Course Code	Paper Title	Units	Credits	Marks			
						Mid sem	End sem	Prac	Total
1	Hard core	Core -I	Mathematical Physics-I	4	6	15	60	25	100
2	Hard core	Core II	Mechanics	4	6	15	60	25	100
3	Core elective	Generic Elective	GE-1	4	6	15	60	25	100
4	Soft core	AECC-1	Ability Enhancement Compulsory Course-I	-	4	20	80	-	100
Semester-2									
Sl. No	Nature of Course	Course Code	Paper Title	Units	Credits	Marks			
						Mid sem	End sem	Prac	Total
1	Hard core	Core - III	Electricity and Magnetism	4	6	15	60	25	100
2	Hard core	Core IV	Waves and Optics	4	6	15	60	25	100
3	Core elective	Generic Elective	GE-2	4	6	15	60	25	100
4	Soft core	AECC-2	Ability Enhancement Compulsory Course-I I	-	4	20	80	-	100
Semester-3									
Sl. No	Nature of Course	Course Code	Paper Title	Units	Credits	Marks			
						Mid sem	End sem	Prac	Total
1	Hard core	Core - V	Mathematical Physics-II	4	6	15	60	25	100
2	Hard core	Core VI	Thermal Physics	4	6	15	60	25	100
3	Hard core	Core course-VII	Analog Systems and Applications	4	6	15	60	25	100
4	Core elective	GE-3	Generic Elective -3	4	6	15	60	25	100

5	**Soft core**	**SECC -1**	**Skill Enhancement Compulsory Course-1**	**-**	**4**	**20**	**80**	**-**	**100**
Semester-4									
Sl. No	**Nature of Course**	**Course Code**	**Paper Title**	**Units**	**Credits**	**Marks**			
						Mid sem	**End sem**	**Prac**	**Total**
1	**Hard core**	**Core - VIII**	**Mathematical Physics III**	**4**	**6**	**15**	**60**	**25**	**100**
2	**Hard core**	**Core - IX**	**Elements of Modern Physics**	**4**	**6**	**15**	**60**	**25**	**100**
3	**Hard core**	**Core X**	**Digital Systems and Applications**	**4**	**6**	**15**	**60**	**25**	**100**
4	**Core elective**	**GE-4**	**Generic Elective -4**	**4**	**6**	**15**	**60**	**25**	**100**
5	**Soft core**	**SECC -2**	**Skill Enhancement Compulsory Course -2 SECC -2**	**-**	**4**	**20**	**80**	**-**	**100**
Semester-5									
Sl. No	**Nature of Course**	**Course Code**	**Paper Title**	**Units**	**Credits**	**Marks**			
						Mid sem	**End sem**	**Prac**	**Total**
1	**Hard core**	**Core - XI**	**Quantum Mechanics & Applications**	**4**	**6**	**15**	**60**	**25**	**100**
2	**Hard core**	**Core XII**	**Solid State Physics**	**4**	**6**	**15**	**60**	**25**	**100**
3	**Hard core**	**DSE-1**	**Discipline Specific Elective -1**	**4**	**6**	**20**	**80**	**-**	**100**
4	**Soft core**	**DSE-2**	**Discipline Specific Elective -2**	**4**	**6**	**20**	**80**	**-**	**100**
Semester-6									
Sl. No	**Nature of Course**	**Course Code**	**Paper Title**	**Units**	**Credits**	**Marks**			
						Mid sem	**End sem**	**Prac**	**Total**
1	**Hard core**	**Core - XIII**	**Electro-magnetic Theory**	**4**	**6**	**15**	**60**	**25**	**100**
2	**Hard core**	**Core XIV**	**Statistical Mechanics**	**4**	**6**	**15**	**60**	**25**	**100**
3	**Hard core**	**DSE-3**	**Discipline Specific Elective -3**	**4**	**6**	**20**	**80**	**-**	**100**
4	**Project**	**DSE-4**	**Discipline Specific Elective -4**	**-**	**6**	**-**	**-**	**-**	**100**

Summary

	Credits	Marks
Hard core	**102**	**1700**
Core elective	**24**	**400**
Soft Core	**16**	**400**
Project	**6**	**100**
Total marks		

Summary

SEMESTER	CREDITS	TOTAL MARKS
Sem-I	**22**	**400**
Sem-II	**22**	**400**
Sem-III	**28**	**500**
Sem-IV	**28**	**500**
Sem-V	**24**	**400**
Sem-VI	**24**	**400**
TOTAL	**148**	**2600**

SEMESTER-1

Core course-I: Mathematical Physics-I

COURSE OUTCOME

The students will have understanding of:

CO1. Understand the basic concept of Grad Div and Curl and hence verify Gauss Greens and Stroke's theorem

CO2. Analyze first and second order differential equations, different Techniques to solve differential and integral equations

CO3. Find the basic ideas of complex variables and verify Cauchy's integral and Residue theorem

CO4. Understand the Fourier sine and cosine series and various special functions and important transforms and their applications

CORE PAPER-1
MATHEMATICAL PHYSICS-I

UNIT-I

Calculus -I: Plotting of functions, Intuitive ideas of continuous, differentiable functions and plotting of curves, Approximation: Taylor and binomial series (statements only), First Order Differential Equations and Integrating Factor, Second Order Differential equations:

Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and Uniqueness Theorem for Initial Value Problems,Particular Integral.

UNIT-II

Calculus-II: Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration, Constrained Maximization using Lagrange Multipliers,

Vector algebra: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar tripleproductandtheirinterpretationintermsofareaandvolumerespectively, Scalar and Vector fields.

UNIT-III

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems, Comparison of velocity and acceleration incylindricaland spherical coordinate system

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular Function, Properties of Dirac delta function.

UNIT-IV

Vector Differentiation: Directional derivatives and normal derivative, Gradientofascalarfieldanditsgeometricalinterpretation,Divergenceandcurlof a vector field,Del and Laplacian operators, Vectoridentities

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs)

TextBooks:

1. MathematicalMethodsforPhysicists,G.B.Arfken, H.J.Weber,F.E.Harris (2013,7th Edn.,Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India)

Reference books:

1. Mathematical Physics C. Harper (Prentice Hall India)
2. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition , Mc- Graw Hill Education)
3. Complex variables and applications, J. W. Brown and R.V.Churchill MathematicalPhysics, Satya Prakash (SultanChand)
4. Mathematical Physics, B. D. Gupta (4th edition, Vikas Publication)

MathematicalPhysics and Special Relativity, M. Das, P.K. Jena and B.K.Dash (Srikrishna Prakashan)

5. Mathematical Physics–H.K.Dass, Dr. Rama Verma (S. ChandPublishing)

MAPPING OF COURSE OUTCOME WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	4	5	4	5	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	2	2	4	5	5

Core Course-I Practical/Tutorial: Mathematical Physics-I Lab

COURSE OUTCOME

The students will have understanding of:

CO1. Basic and advanced mathematical tools required for Physics Problems

CO2. This course is designed as revision to basic Mathematics in programing form so that students can easily adapt to the advanced Mathematics and Physics being taught in the PG level.

CO3. The students will be able to write their own C and C+ program, compile and execute.

CO4. The students will be exposed to practical implementation of numerical methods in programming.

CORE PAPER I LAB:

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

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical)in the Lab
- Evaluation d• one not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Introduction and Overview: Computer architecture and organization, memory and Input/output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers , algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow and overflow emphasize the importance of making equations interms of

dimensionless variables, Iterative methods. Algorithm Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations. Systematic and Random Errors, Propagation of Errors, Normal Law of Errors, Standard and Probable Error.

Review of C and C++ Programming: Introduction to Programming, constants, variables and Fundamentals data types, operators and Expressions, I/O statements, scan and print, c in and c out, Manipulators for data format- ting, Control statements(decision making and looping statements) (If Statement, If else Statement, Nested If structure, Else If Statement, Ternary operator , Go to Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects

Programs: Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search

Random number generation: Area of circle, area of square, volume of sphere, value of π.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Schaum'sOutlineofProgrammingwithC++.J.Hubbard,2000,McGraw– HillPub.
3. NumericalRecipesinC:TheArtofScientificComputing,W.H.Pressetal, 3rd Edn. 2007, Cambridge UniversityPress.
4. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007 , Wiley India Edition.
6. Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier DoverPub.
7. AnIntroductiontocomputationalPhysics,T.Pang,2ndEdn., 2006,Cambridge Univ. Press.

MAPPING OF COURSE OUTCOME WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	5	5	5	5	4	2	5	2	5
CO2	4	4	4	4	4	5	5	2	5	4
CO3	4	4	2	4	2	5	4	4	2	4
CO4	5	2	5	4	5	4	5	5	4	5

Core course-II Mechanics

COURSE OUTCOME

CO1. Application of Newton's laws of motion to solve various problems related to day todaylife.

CO2. Understand the definition for centre of gravity in hemisphere, hollow hemisphere etc.,Examples of surface tension in nature and its applications in our day to day life.Concept of viscosity of fluids, Bernoulli's Equation and its applications.

CO3. Analyze the performance of hydrostatic and hydrodynamics

CO4. Understand the negative result of Michelson morley experiment , galilean and lorentz transformation and Concepts like zero work done, conservative forces, mass energy equivalence ($E= mc^2$)

CORE PAPER-II

MECHANICS

UNIT-I

Rotational Dynamics: Centre of Mass, Motion of CoM, Centre of Mass and Laboratory frames, Angular momentum of a particle and system of particles, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Perpendicular and Parallel Axis Theorems, Routh Rule, Calculation of moment of inertia for cylindrical and spherical bodies, Kinetic energy of rotation, Eulers Equations of Rigid Body motion, Motion involving both translation and rotation. Moment of Inertia of a Flywheel.

Non-Inertial Systems: Non-inertial frames and fictitious forces, Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and its applications.

UNIT-II

Elasticity: Relation between Elastic constants, Twisting torque on a Cylinder or Wire, Bending of beams, External bending moment, Flexural rigidity, Single and double cantilever

Fluid Motion: Kinematics of Moving Fluids: Poiseuilles Equation for Flow of a Liquid through a Capillary Tube, Surface tension, Gravity waves and ripple

Viscocity: Poiseuilles Equation for Flow of a Liquid with corrections.

UNIT-III

Gravitation and Central Force Motion: Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Potential and field due to spherical shell and solid sphere, Motion of a particle under a central force field, Two-body problem and its reduction to one-body problem and its solution, Differential Equation of motion with central force and its solution, The first Integrals (two), Concept of power Law Potentials, Keplers Laws of Planetary motion, Satellites:. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS), Physiological effects on astronauts.

UNIT-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Equation of motion and solution (cases of oscillatory, critically damped and over damped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance ; power dissipation and Quality Factor, Bar Pendulum, Katers Pendulum.

Special Theory of Relativity: Michelson-Morley Experiment and its out-come, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity, Frequency and wave number, Relativistic addition of velocities, Variation of mass with velocity, Mass less Particles, Mass-energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics, Transformation of Energy and Momentum.

Text Books:

1. Mechanics, D.S. Mathur (S. Chand Publishing)
2. Introduction to Special Relativity, R. Resnick (John Wiley)

Reference Books:

1. Introduction to Mechanics Daniel Klapnner and Robert Kolenkow, McgrawHill.
2. Mechanics by K.R Simon
3. Mechanics, Berkeley Physics, vol.1, C.Kittel,W.Knight, etal (Tata McGraw- Hill)
4. Physics, Resnick, Halliday and Walker (8/e.2008,Wiley)
5. Theoretical Mechanics-M.R. Spiegel (Tata McGrawHill).
6. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands (Pearson)
7. Mechanics-M.Das, P.K.Jena and R.N. Mishra (SrikrishnaPublications)

MAPPING OF COURSE OUTCOME WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	5	4	2	5	4	4	2	4
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	5	2	4	5	5

Core Course-II Practical/Tutorial Mechanics Lab

COURSE OUTCOME

CO1. Understanding of basic physics of fluids.

CO2. Gaining knowledge to calculate and design engineering applications involving fluid.

CO3. Understanding of analyzing flow systems in terms of mass, momentum, and energy balance.

CO4. Having knowledge about current research topics about fluid mechanics and understand and analyze the features of central forces with respect to planetary motion

CORE PAPER-II LAB

1. To study surface tension by capillary rise method
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuilles method).
6. To determine the Modulus of Rigidity of a Wire by Maxwellsneedle.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Katers Pendulum
9. Young's modulus and rigidity modulus

Reference Books:

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, I.Prakash and Ramakrishna, 11thEdn,2011,Kitab Mahal

MAPPING OF COURSE OUTCOME WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	3	1	3	1	1	2	1	3
CO2	2	3	2	3	2	3	3	1	3	3
CO3	3	3	3	2	1	3	2	2	1	2
CO4	1	2	3	1	3	1	1	2	3	3

Generic Elective -1 GE-1

COURSE OUTCOME

CO1. Understand the process of thermal conductivity, viscosity, and diffusion in gases.

CO2. Understand the basic statistical methods and concepts like probability, random variables, expected value, variance, estimators, and common probability distributions.

CO3. Understand the relation between microscopic and macroscopic description through statistical mechanics; know and can apply the laws of thermodynamics and principles of free energy; describe thermodynamic processes, heat engines, and master the use of the chemical potential to describe diffusive equilibrium, phase equilibrium and chemical processes.

CO4. Understand the efficiency of Carnot's engine and the significance of first law and second of thermodynamics and implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.

Generic Elective-1

UNIT-I

Mechanics and Properties of Matter Moment of Inertia Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points, Relation among elastic constants, depression at free end of a light cantilever, Surface tension, pressure difference across a curved membrane,viscousflow,Poiseulles formula.

UNIT-II

Oscillation and Waves Simple harmonic motion, damped harmonic motion, under damped, over damped and critically damped motion, Forced vibration, Resonance, Wave equation in a medium, Velocity of Longitudinal waves in an elastic medium and velocity of transverse wave in a stretched string, Composition of SHM, Lissajous figures for superposition of two orthogonal simple harmonic vibrations (a) with same frequency, (b) frequency with 2:1.

UNIT-III

Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck, Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension, Maxwell thermodynamic relation (statement only), Clausius Clapeyron equation, Black body radiation, Planck radiation formula (No derivation).

UNIT-IV

Electricity and Magnetism Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution, Magnetic induction B, Lorentz force law, Biot Savarts law, Magnetic induction due to long straight current carrying conductor, and in the axis of a current carrying circular coil, Amperes Circuital law, its differential form, The law of electro magnetice quations, its differential and integral form,

Maxwells electro-magnetic equations and their physical significance, Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance. P-type and N-type semiconductors, PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V-Icurve.

Text Books:

1. Elements of Properties of Matter D.S. Mathur (S. Chand Publication)-2010
2. Heat and Thermodynamics A.B. Gupta and H.B. Ray (New Central Book Agency)-2010
3. A Text Books book of oscillations, waves and acoustics(5thed.)M.
4. Ghosh and D. Bhattacharya (S. Chand Publication)-2018
5. Electricity and magnetism- R. Murugeshan (S.Chand publishing)-2017
6. Fundamentals of Electronics-Raskhit and Chattopadhyay (New age International Publication)-2018

Reference Books:

1. Physics of Degree students Vol.I M. Das, P.K. Jena etal (Sri krishna Prakashan)-2006
2. Physics of Degree students Vol.II M. Das, P.K. Jena etal (Sri krishna Prakashan)-2006
3. Waves and Oscillations (2nd ed) N. Subramaniyam and Brij Lal (Vikas Publications)-1994
4. A Text Books book of Sound (2nd ed) - N. Subramaniyam and Brij Lal (S. Chand Publications)-1999

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	4	5	2	5	2	2	4	2	5
CO2	4	5	4	5	4	5	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	2	2	4	5	5

- Note related: 1
- From What Related: 2
- Nutral: 3
- Moderately Related: 4
- Highly Related: 5

Generic Elective -1 Practical/Tutorial

COURSE OUTCOME

CO1. Students would gain practical knowledge about heat and radiation, thermodynamics, the rmoemf , RTD etc. and perform various experiments.
CO2. Ability to understand the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium.
CO3. Ability to conduct experiments regarding the measurement and calibration of temperatures and pressures in groups.
CO4. Ability to identify the properties of substances on property diagrams and obtain the data from property tables.

Generic Elective Paper 3 Lab-

1. To determine the moment of inertia of a fly wheel.
2. To determine the Young's modulus Y of a wire by Searl's method.
3. To determine the modulus of rigidity of a wire by Maxwell's needle/Torsion Pendulum (Dynamic method).
4. To determine g by bar pendulum.
5. To determine the value of Y of a rubber by using travelling microscope.
6. To determine the Rigidity of modulus by static method.
7. To determine the frequency of a telescope by using Sonometer.
8. Verification of Laws of Vibration of a string by using Sonometer.
9. To compare capacitances using De Sauty bridge.
10. To determine the Law of resistance by using Foster bridge.
11. Compare the specific heat of two liquids by method of Cooling.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flintand H.T.Worsnop, 1971, Asia Publishing House
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal (1985), Vani Publication
3. A Text Books of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition (2011), Kitab Mahal, NewDelhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

SEMESTER-2

Core course-III Electricity and Magnetism

COURSE OUTCOME

CO1. Students will be able to understand the concept of the electric force, electric field and electric potential for stationary charges. They are able to calculate electric potential and electric field by using Gauss's law.

CO2. Student will understand the dielectric phenomenon and effect of electric field on dielectric.

CO3. Study the concept of magnetic field, magnetic field for steady currents using Biot-Savart'sand Ampere's Circuital laws.

CO4. Student will learn magnetic materials and its properties.

CORE PAPER-III ELECTRICITY AND MAGNETISM

UNIT-I

Electric Field and Electric Potential

Electric field: Electric field lines, Electric flux, Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field. Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Potential calculation in different simple cases, Laplaces and Poisson equations, The Uniqueness Theorem, Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.

Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductorsinanelectrostatic Field, Surface charge and for ceonaconductor.

UNIT-II

Magnetic Field: Magnetic Force, Lorentz Force, Biot Savarts Law, Current Loop as a Magnetic Dipole and its Dipole Moment (analogy with Electric Dipole),Amperes Circuital Law and its application to (1) Solenoid (2) Toroid (3) Helmhotz coil, Properties of B:curl and divergence, Vector Potential, Ballistic Galvanometer: Torque on a current Loop, Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping, CDR.

UNIT-III

Dielectric Properties of Matter: Electric Fieldin matter, Polarization,Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallelplate,spherical, cylindricall) filled with dielectric, Displacement vector D, Relations between E, P and D, Gauss Law in dielectrics. Magnetic Properties of Matter: Magnetization vector(M), Magnetic Intensity(H),Magnetic Susceptibility and permeability, Relation between B, H, M, Ferromagnetism, B-H curve and hysteresis.

Electromagnetic Induction: Faradays Law, Lenzs Law, Self Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwells Equations

UNIT-IV

Electrical Circuits: AC Circuits: Kirchhoffs laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit: (1) Resonance (2) Power Dissipation (3) Quality Factor, (4) Band Width, Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources,

Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to DC circuits. Transient Currents Growth and decay of current in RC and LR circuits.

Text Books:

1. Introduction to Electrodynamics – D.J. Griffiths (Pearson, 4th edition, 2015)
2. Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)

Reference Books:

1. Classical Electrodynamics, J. D. Jackson (Wiley).
2. Electricity and Magnetism D. C. Tayal (Himalaya Publishing house)
3. Electricity, Magnetism and Electromagnetic Theory- S. Mahajan and Choudhury (Tata McGraw Hill)
4. Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands (Pear- son) Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Core Course-III Practical/Tutorial Electricity and Magnetism Lab

COURSE OUTCOME

Upon successful completion of this course, students will be able to:

CO1. Understand the characteristics and properties of electric and magnetic fields.
CO2. Understand the behavior and use of dielectrics.
CO3. Understand the Maxwell equation and their usefulness.
CO4. Experiences electricity & magnetism in practice mode

CORE PAPER-III LAB

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, c)DC Current, (d) Capacitances, and (e) Checking electrical fuses.

1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters
4. Bridge. To compare capacitances using DeSautysbridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems, Superposition theorems.
7. To determine self inductance of a coil by Andersons bridge.
8. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
9. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonance frequency and (b) Quality factor Q.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	4	5	4	5	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	2	2	4	5	5

Core course-IV Waves and Optics

COURSE OUTCOME

The course comprises of the study of superposition of harmonic oscillations, waves motion (general), oscillators, sound, wave optics, interference, diffraction, polarization.

CO1. The course is important for the students to make their career in various branches of science and engineering, especially in the field of photonics
CO2. Understand the basic ideas of oscillations and waves
CO3. To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.
CO4. To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.

CORE PAPER-1V: WAVES AND OPTICS

UNlT - I

Geometrical optics : Fermats principle, reflection and refraction at plane interface, Matrix formulation of geometrical Optics, Cardinal points and Cardinal planes of an optical system, Idea of dispersion, Application to thick Lens and thin Lens, Ramsden and Huygens eyepiece. Wave Optics : Electromagnetic nature of light. Definition and properties of wave front Huygens Principle. Temporal and SpatialCoherence.

UNlT - II

Wave Motion : Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Traveling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave. Superposition of two perpendicular Harmonic Oscillations : Graphical and Analytical Methods, Lissajous Figures(1:1 and 1:2) and their uses, Superposition of Nharmonicwaves.

UNlT- III

Interference : Division of amplitude and wave front, Youngs double slit experiment, Lloyds Mirror and Fresnels Bi-prism, 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), Newtons Rings: Measurement of wavelength and refractive index. Interferometer : Michelsons Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility off ringes, Fabry-Perot interferometer.

UNlT - IV

Fraunhofer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnels Assumptions, Fresnels Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnels Integral, Fresnel diffraction pattern of as traightedge, aslitandawire.

TextBooks:

1. AtextbookofOpticsN.SubrahmanyamandBrijLal(S.Chand Publishing)
2. Optics - Ajoy Ghatak (McGraw Hill)

Reference Books:

1. Optics-E.Hecht(Pearson)
2. FundamentalsofOptics-F.A.JenkinsandH.E.White(McGraw-Hill)
3. Geometrical and Physical Optics R.S. Longhurst (OrientBlackswan)
4. ThePhysicsofVibrationsandWaves-H.J.Pain(JohnWiley)
5. Optics P.K.Chakrabarty
6. Principles of Optics- MaxBornandEmilWolf(PergamonPress)
7. ThePhysicsofWavesandOscillations-N.K.Bajaj(McGrawHill)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	4	2	5	4	4	2	4
CO2	4	5	4	5	4	5	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	2	2	4	5	5

Core Course-IV Practical/Tutorial Waves and Optics Lab

COURSE OUTCOME

CO1. To acquire skills allowing the student to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report.

CO2. Able to illustrate the principle of fiber optics communications.

CO3. Able to categorize different waveguides for the utilization in optics communication system

CO4. Able to interpret different fiber sensors and their respective application and can recommend this technique for other new application. To solve nonlinear optical interaction problem in two-level system

CORE PAPER-IV LAB

1. To determine the frequency of an electric tuning for kby Meldesexperiment and verify 2Tlaw.
2. To plot the I-D curve and to determine the refractive index of aprism
3. To determine refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

5. To determine wavelength of sodium light using Newtons
6. To Rings. determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction rating.
7. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics,Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. ALaboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**5**	**5**	**5**	**5**	**5**	**4**	**2**	**5**	**2**	**4**
CO2	**4**	**4**	**5**	**2**	**5**	**2**	**2**	**4**	**5**	**5**
CO3	**5**	**5**	**5**	**4**	**2**	**5**	**4**	**4**	**2**	**4**
CO4	**2**	**4**	**5**	**2**	**5**	**2**	**2**	**4**	**5**	**5**

Generic Elective -2 GE-2

COURSE OUTCOME

CO1. Students will learn the basics of modern Physics and quantum mechanical methods, its application by using Matrix calculations to solve problems, Fourier series and related problem

CO2. Students get the glimpse of fluid mechanics and of relativistic mechanics. Studying the energy convestion from matter, students come to know about the formation of universe and its constituents.

CO3. The students to work with concept of real life problems related with energy harvesting

CO4. Study of relativistic mechanics of a point particle makes the analytic strength of the students stronger.

Generic Elective Paper -II

(Optics, Special Theory of Relativity, Atomic Physics, Quantum Mechanics and Nuclear Physics)

UNIT-I

Optics-I: Elementary ideas of monochromatic aberrations and their minimization, chromatic aberration, achromatic combination, Theory of formation of primary and secondary rainbow, condition of interference, coherent sources, Youngs double slit experiment, biprism and measurement of wave length of light of by it, color of thin films and Newton's rings, Fresnel and Fraunhoffer diffraction, diffraction by single slit plane transmission grating.

Optics-II : Electromagnetic nature of light, polarized and unpolarized light, polarization by reflection and refraction, Brewster's Law, Mauls Law, Double refraction, Ordinary and extraordinary rays.

UNIT-II

Atomic Physics: Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Planck's quantum theory of radiation, particle nature of electromagnetic radiation photo electric effect, Compton effect, dual nature of radiation, wave nature of particles, deBroglie hypothesis, matter wave, wave-particle duality, Davisson- Germer experiment. Bohr's theory of Hydrogen atom, explanation of Hydrogen Spectra, correction for finite mass of the nucleus, Bohrs correspondence principle, limitations of Bohr's theory, Discrete energy, exchange by atom Frank Hertz experiment.

UNIT-III

Quantum Mechanics : Heisenberg's Uncertainty relation, Time dependent Schrodinger's wave equation in one dimension and three dimensions, The physical interpretation of the wave function, Probability density and probability current density, Equation of continuity, Normalization of the Wave function, Expectation value of an observable, Ehrenfest's theorem. Time independent Schrodinger's wave equation in one dimension particle in a box, energy eigen values and eigen functions.

UNIT-IV

Nuclear Physics : Properties of the nucleus Charge, Size, Spin, Magnetic Moment, Mass, Mass defect, Binding energy, Packing fraction, Nuclear force and its characteristics features, Radioactive decay laws, average life, half life, nuclear fission, nuclear fusion, Linear accelerators, and cyclotron.

Relativity: Galilean transformation, Newtonian relativity and its limitation, Michelson Morley experiment and it's consequence, postulates of special theory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energy relation.

Text Books:

1. University Physics, H. D. Young, R. A. Freedman (Person)-2017
2. Fundamentals of Physics, Resnick, Halliday, Walker (WIley)-2015

Reference Books:

1. A Text Books book of Optics N. Subrahmanyam and Brij Lal (S.Chand Publishing)-2006
2. Introduction to Special Relativity-R. Resnick (John Wiley)-2007
3. Concepts of Modern Physics Arthur Beiser (McGraw Hill)-2017
4. Modern Physics H.S. Mani and G.K.Mehta-2018

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5

CO2	**4**	**5**	**2**	**5**	**5**	**5**	**5**	**2**	**5**	**5**
CO3	**4**	**5**	**4**	**5**	**4**	**5**	**5**	**4**	**5**	**5**
CO4	**2**	**2**	**5**	**2**	**5**	**2**	**2**	**4**	**5**	**5**

Generic Elective -2 Practical/Tutorial

COURSE OUTCOME

CO1. In this course the experiments are designed to give glimpse of heat, magnetism, electricity and optics experiments.

CO2. Study of propagation of light in optical media clarifies the knowledge of students regarding the interference, diffraction, polarization and other optical phenomena. Theses train the students to work with different optical media and instruments as well.

CO3. They also develop basic communication skills through working in groups in performing the laboratory experiments.

CO4. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.

Generic Elective Paper II LAB

1. Determination of E.C.E. of a Copper by taking 3readings.
2. Determination of Refractive index of the material of a prism using Sodium light.
3. To determine the wavelength of light using plane diffraction grating.
4. To determine the wavelength of light using Newton's ring.
5. Determination of refractive index of (a) glass and (b) liquid by using travelling microscope.
6. To plot the I-D curve and to determine the refractive index of a prism
7. Determination of radius of curvature of a convex/concave mirror by using Kohlrausch's method.
8. To determine the magnifying power of a given telescope.
9. To Obtain the static characteristics of a P-N-P/N-P-N transistor/Triode Valve.
10. To determine the reduction factor of a tangent Galvanometer.
11. To study the Variation of magnetic field along the axis of a circular coil carrying current.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop, (1971), Asia Publishing House
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal (1985), Vani Publication
3. A Text Books of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition (2011), Kitab Mahal, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

SEMESTER-3

Core course-V Mathematical Physics-II

COURSE OUTCOME

CO1. Understand the basic elements of signals and linear time-invariant systems, including the complex exponential and sinusoidal signals, unit step function and unit impulse function (Dirac delta function), discrete time unit step and unit impulse sequences, continuous and discrete time system, linear time invariant (LTI) systems, continuous time LTI systems, and properties of LTI systems.

CO2. Ability to solve ordinary second order differential equations important in the physical sciences; solve physically relevant partial differential equations using standard methods like separation of variables, series expansion (Fourier-type series) and integral transforms.

CO3. Understand how to expand a function in a Fourier series, and under what conditions such an expansion is valid. You will be aware of the connection between this and integral transforms (Fourier and Laplace) and be able to use the latter to solve mathematical problems relevant to the physical sciences.

CO4. Understand Fourier analysis of continuous-time signals and systems and Students gain competence which will enable them to solve problems in many areas of science and engineering.

CORE PAPER-V MATHEMATICAL PHYSICS-II

UNIT-I

Fourier Series-I: Periodic functions, Orthogonally of sine and cosine functions, Dirichlet Conditions (Statement only), Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients, Complex representation of Fourier series, Expansion of functions with arbitrary period, Expansion of non-periodic functions over an interval, Even and odd functions and their Fourier expansions and Application, Summing of Infinite Series, Term-by-Term differentiation and integration of Fourier Series, Parseval Identity.

UNIT-II

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance, Singularities of Bessels and Laguerre Equations, Frobenius method and its applications to differential equations:Legendre and Hermite Differential Equations,Legendre and Hermite Polynomials: Rodrigues Formula, Generating

Function,Orthogonality.

UNIT-III

Polynomials: Simple recurrence relations of Legendre and Hermite Polynomials, Expansion of function in a series of Legendre Polynomials, Associated Legendre Differential Equation, Associated Legendre polynomials, Spherical Harmonics Some Special Integrals: Beta and Gamma Functions and relation between them, Expression of Integrals in terms of Gamma Functions, Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string

Text Books:

1. MathematicalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013, 7th Edn.,Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India)

Reference Books:

1. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)
2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing)
3. Mathematical Physics C. Harper (Prentice HallIndia)ComplexVariable:
4. Schaum's Outlines Series M. Spiegel (2nd Edition, McGraw Hill Education)
5. Complex variables and applications J.W.Brown and R.V.Churchill
6. Mathematical Physics, Satya Prakash (Sultan Chand)
7. Mathematical Physics B.D.Gupta (4th edition, VikasPublication

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Core Course-V Practical/Tutorial Mathematical Physics-II Lab

COURSE OUTCOME

Students will have understanding of:

CO1. Basic and advanced mathematical tools required for Physics Problems Different Techniques to solve differential and integral equations. Various special functions and important transforms and their applications

CO2. The students will be able to write their own Scilab program, compile and execute.

CO3. Students will learn the basics of Computational Physics and numerical methods, its application by using Matrix calculations to solve problems, Fourier series and related problems

CO4. Writing programs in Fortran to solve numerical analysis program as such solving algebraic, transcendental, and polynomial equations, Solution of differential equations Methods of least squares and curve fitting and Generation of random numbers and their applications in finding values of integrals

CORE PAPER-V LAB

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem.

Topics

Introduction to Numerical computation software Scilab: Introduction to Scilab, Advantages and disadvantages, Scilab computation software Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2),

Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program(2).

Curve fitting, Least square fit Goodness of fit, standard constant Deviation:Ohms law to calculate R, Hookes law to calculate spring constant

Solution of Linear system of equations by Gauss elimination Solution method and Gauss Seidal method. Diagonalization matrices, Inverse of a matrix, Eigen vectors, problems: Solution of mesh equations of electriccircuits(3meshes),Solutionofcoupledspringmasssystems(3masses)

Solution of ODE First order Differential equation Euler, modiftedEuler Runge-Kutta second methods Second order differential equation. Fixed difference method: First order differentialequation

- Radioactivedecay
- Current in RC, LC circuits with DCsource
- Newtons law ofcooling
- Classical equations ofmotion

Second order DifferentialEquation

- Harmonic oscillator (nofriction)
- Damped Harmonicoscillator
- Overdamped
- Criticaldamped
- Oscillatory
- Forced Harmonicoscillator
- Transient and Steady statesolution
- Apply above to LCR circuitsalso

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge UniversityPress
2. Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. Firstcourseincomplexanalysiswithapplications,D.G.ZillandP.D.Shana- han, 1940, Jones and Bartlett
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fern- ndez. 2014 Springer
5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
6. Scilab(A freesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand andCompany
7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	5	5	4	5	2	4	4	2	5
CO2	4	5	2	5	2	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	4	5	4	5	5

Core course-VI Thermal Physics

COURSE OUTCOME

CO1. Understand the process of thermal conductivity, viscosity and diffusion in gases. and the basic statistical methods and concepts like probability, random variables, expected value, variance, estimators and common probability distributions.

CO2. Understand the relation between microscopic and macroscopic description through statistical mechanics; know and can apply the laws of thermodynamics and principles of free energy; describe thermodynamic processes and heat engines and master the use of the chemical potential to describe diffusive equilibrium, phase equilibrium and chemical processes.

CO3. Understand the efficiency of Carnot's engine and the significance of first law and second of thermodynamics and implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.

CO4. Ability to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations and understand the interrelationship between thermodynamic functions and ability to use such relationships to solve practical problems.

CORE PAPER-VI THERMAL PHYSICS

UNIT-I

Introduction to Thermodynamics Recapitulation of Zeroth and First law of thermodynamics, Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-lanck and Clausius Statements and their Equivalence, Carnots Theorem, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy of the Principle of Increase of Entropy, Temperature Entropy diagrams for Carnots Cycle, Third Law of Thermodynamics, Unattainability of AbsoluteZero.

UNIT-II

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables, Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy,Their Definitions, Properties and Applications, Sur- face Films and Variation of Surface Tension with Temperature, Magnetic Work, Cooling due to adiabatic demagnetization

Phase Transitions: First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Maxwells Thermodynamic Relations: Derivations and applications of Maxwells Relations, Maxwells Relations: (1) Clausius Clapeyron equation (2) Relation betweenCpandCv(3)TdS Equations,(4)Joule-Kelvin coefficient forIdeal and Van der Waal Gases (5) Energy equations (6) Change of Temperature during AdiabaticProcess.

UNIT-III

Kinetic Theory of Gases Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Sterns Experiment, Mean, RMS and Most Probable Speeds, Degrees of Freedom, Law of Equipartition of Energy (No proof required), Specific heats of Gases. Molecular Collisions: Mean Free Path, Collision Probability, Estimates of Mean Free Path, Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

UNIT-IV

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation, The Virial Equation, Andrews Experiments on CO2 Gas. Critical Constants, Continuity of Liquid and Gaseous State. Vapour and Gas, Boyle Temperature, Van der Waals Equation of State for Real Gases, Values of Critical Constants, Law of Corresponding States, Comparison with Experimental Curves, P-V Diagrams, Joules Experiment, Free Adiabatic Expansion of a Perfect Gas, Joule- Thomson Porous Plug Experiment, Joule- Thomson Effect for Real and Van der Waal Gases, Temperature of Inversion, Joule-Thomson Cooling

Text Books:

1. Thermal Physics, A. B. Gupta (Books and allied Ltd)
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw- Hill)

Reference Books:

1. Theory and experiments on thermal Physics, P.K.Chakrabarty (New cen-tral book agency limited)
2. Thermodynamics,KineticTheoryandStatisticalThermodynamics-Sears and alinger(Narosa)
3. ATreatise on Heat- Meghnad Saha and B.N.Srivastava (The Indian Press) Heat, Thermodynamics and Statistical Physics, N.Subrahmanyam and Brij Lal (S.Chand Publishing)
4. Thermal and Statistical Physics M.Das, P.K. Jena, S. Mishra, R.N.Mishra (Shri Krishna Publication)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	4	5	4	5	2	4	4	4	5
CO2	4	2	4	5	2	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	4
CO4	4	4	5	5	2	5	2	2	5	5

Core Course-VI Practical/Tutorial Thermal Physics Lab

COURSE OUTCOME

The candidate should be able to:-

CO1. Quantitatively describe systems in thermal equilibrium by methods from thermodynamics and statistical physics

CO2. Design simple heat engines and refrigerators- Perform and analyze basic experiments and measurements within thermal physics

CO3. General competence.

CO4. Development on hand on techniques in day to day life

CORE PAPER-VI LAB

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flow method.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charltons disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To determine J by Caloriemeter
6. To determine the specific heat of liquid by the method of cooling
7. To determine the specific heat of solid by applying radiation of correction.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. AText Book of Practical Physics, I.Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. ALaboratory Manual of Physics for undergraduate classes, D.P.Khandelwal,1985, Vani Pub.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	4	5	2	4	4	2	5
CO2	4	4	5	4	5	4	2	2	5	4
CO3	4	5	4	5	4	5	5	4	5	5
CO4	5	2	5	4	5	4	5	4	5	5

Core course-VII Analog Systems and Applications

COURSE OUTCOME

CO1. Student learns about the varoius applcations of semiconductors in LED, Solar cell devices

CO2. Understand Semiconductor diodes, bipolar junction transistor.

CO3. Sketch, explain and design the amplifier circuit for given specification and analyze them discuss oscillator principles, and frequency stability.

CO4. Analyze the different types of Oscillators

CORE PAPER-VII

ANALOG SYSTEMS AND APPLICATIONS

UNIT I

Semiconductor Diodes: P and N type semiconductors, energy level diagram, conductivity and Mobility, Concept of Drift velocity, PN junction fabrication (simple idea), Barrier formation in PN Junction Diode, Static and Dynamic Resistance, Current flow mechanism in Forward and Reverse Biased Diode, Drift velocity, derivation for Barrier Potential, Barrier Width and current Step Junction.

Two terminal device and their applications: (1) Rectifier Diode: Half-

waveRectifiers.center-tappedandbridgetypeFull-waveRectifiers,Calculation of Ripple Factor and Rectification Efficiency,L and C Filters (2) Zener Diode and Voltage Regulation, Principle and structure of LEDS, (2) Photo diode(3) Solar Cell.

UNIT II

Bipolar Junction Transistors: n-p-n and p-n-p transistors, Characteristics of CB, CE and CC Configurations, Current gains a and b, Relation between a and b, Load line analysis of Transistors, DC Load line and Q-point, Physical mechanism of current flow, Active, Cut-off and Saturation Regions.

Transistors Biasing: Transistor Biasing and Stabilization circuits, Fixed Bias and Voltage Divider Bias. Amplifiers: Transistors as 2-port network h-parameter Equivalent Circuit, Analysis of a single stage CE amplifier using Hybrid Model, Input and Output impedance, Current, Voltage and Power Gains, Classification of class A, B and C amplifiers, Push-pull amplifier (classB)

UNIT-III

Coupled Amplifier: RC-coupled amplifier and its frequency response.

Feedback in Amplifiers: Effect of Positive and Negative Feedback on In- put Impedance, Output Impedance, Gain Stability, Distortion and Noise. Sinusoidal Oscillations: Barkhausens Gaterian for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency, Hartley and Colpitts oscillators.

UNIT-IV

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical OP-AMP (IC741). Open-loop and Closed loop Gain. Frequency Response. CMRR, Slew Rate and concept of virtual ground.

Application of Op-Amps: (1) Inverting and non-inverting amplifiers (2) Adder

(3) Subtractor (4) Differentiator, (5) Integrator (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.

Text Books:

1. Foundations of Electronics-Raskhit and Chattopadhyay (New age International Publication)
2. Concept of Electronics- D.C.Tayal (Himalay Publication)

Reference Books:

1. Electronic devices and circuits R.L.Boylstad (Pearson India)
2. Electronic Principles- A.P.Malvino (Tata McGraw Hill)
3. Principles of Electronics- V. K. Mehta and Rohit Mehta (S. Chand Pub- lication)
4. OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (Prentice Hall)
5. Physics of Semiconductor devices, Donald ANeamen (Prentice Hall)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	4	5	4	5	4	5	5	4	5	4
CO2	5	4	5	5	5	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	4
CO4	5	2	5	5	2	5	4	5	5	2

Core Course-VII Practical/Tutorial Analog Systems & Applications Lab

COURSE OUTCOME

CO1. The students will have practical understanding of the characteristics of various diodes, transistors, Op-Amp, designing concepts of logic gates and digital circuits. They will also be trained in basic elements and measurement using multimeters and utilization of CRO.

CO2. The basic filters will help the student to identify how the frequency depend on resistance and how the signals behave with the frequencies. They can explore how to filter these signals with resistors and capacitors.

CO3. The students can analyse and compare the effect of frequency to the output voltage. They are exposed to the usage of semi-log graph and how to plot with respect to the given values. The experiments related to operational amplifier makes the students to

analyse and working of IC 741 and its characteristics and finding the solution for linear and nonlinear applications using OP-Amp.

CO4. To appreciate and differentiate the working principles. How the resistor capacitor combination affects the uniformity of waveform and to comprehend the difficulties and to overcome that. The study of basic logic gates will help the student to have thorough understanding of the fundamental concept and the various techniques in digital electronics.

CORE PAPER-VII LAB

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I and power curves of solar cells, and find maximum power point and efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
6. To design a Wienbridge oscillator forgiven frequency using anop-amp.
7. To design a phases hiftoscillator of given specifications using BJT.
8. To design OP AMP 741 as integrator / differentiator / inverting and non-inverting amplifier.
9. To study the Colpitt'soscillator.

Reference Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
4. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	5	5	4	5	2	4	4	2	5
CO2	4	5	2	5	2	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	4	5	4	5	5

Generic Elective -3 GE-3

COURSE OUTCOME

CO1. Understand the process of thermal conductivity, viscosity, and diffusion in gases.

CO2. Understand the basic statistical methods and concepts like probability, random variables, expected value, variance, estimators, and common probability distributions.

CO3. Understand the relation between microscopic and macroscopic description through statistical mechanics; know and can apply the laws of thermodynamics and principles of free energy; describe thermodynamic processes, heat engines, and master the use of the chemical potential to describe diffusive equilibrium, phase equilibrium and chemical processes.

CO4. Understand the efficiency of Carnot's engine and the significance of first law and second of thermodynamics and implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.

Generic Elective-3

UNIT-I

Mechanics and Properties of Matter Moment of Inertia Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points, Relation among elastic constants, depression at free end of a light cantilever, Surface tension,pressure,differenceacrossacurvedmembrane,viscousflow,Poiseulles formula.

UNIT-II

Oscillation and Waves Simple harmonic motion, damped harmonic motion, under damped, over damped and critically damped motion, Forced vibration, Resonance, Wave equation in a medium, Velocity of Longitudinal waves in an elastic medium and velocity of transverse wave in a stretched string, Composition of SHM, Lissajous figures for superposition of two orthogonal simple harmonic vibrations (a) with same frequency, (b) frequency with 2:1.

UNIT-III

Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck, Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension, Maxwell thermodynamic relation (statement only), Clausius Clapeyron equation, Black body radiation, Planck radiation formula (No derivation).

UNIT-IV

Electricity and Magnetism Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution, Magnetic induction B, Lorentz force law, Biot Savarts law, Magnetic induction due to long straight current carrying conductor, and in the axis of a current carrying circular coil, Amperes Circuital law,itsdifferentialform,Thelawofelectromagneticequations,itsdifferential and integral form,

Maxwells electro-magnetic equations and their physical significance, Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance. P-type and N-type semiconductors, PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V-Icurve.

Text Books:

1. Elements of Properties of Matter D.S. Mathur (S. Chand Publication)-2010
2. Heat and Thermodynamics A.B. Gupta and H.B. Ray (New Central Book Agency)-2010
3. A Text Books book of oscillations, waves and acoustics(5thed.)M.
4. Ghosh and D. Bhattacharya (S. Chand Publication)-2018
5. Electricity and magnetism- R. Murugeshan (S.Chand publishing)-2017
6. Fundamentals of Electronics-Raskhit and Chattopadhyay (New age International Publication)-2018

Reference Books:

1. Physics of Degree students Vol.I M. Das, P.K. Jena etal (Sri krishna Prakashan)-2006
2. Physics of Degree students Vol.II M. Das, P.K. Jena etal (Sri krishna Prakashan)-2006
3. Waves and Oscillations (2nd ed) N. Subramaniyam and Brij Lal (Vikas Publications)-1994
4. A Text Books book of Sound (2nd ed) - N. Subramaniyam and Brij Lal (S. Chand Publications)-1999

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	5	5	4	5	2	4	4	2	5
CO2	4	5	2	5	2	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	4	5	4	5	5

Generic Elective -3 Practical/Tutorial

COURSE OUTCOME

CO1. Students would gain practical knowledge about heat and radiation, thermodynamics, thermoemf , RTD etc. and perform various experiments.

CO2. Ability to understand the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium.

CO3. Ability to conduct experiments regarding the measurement and calibration of temperatures and pressures in groups.

CO4. Ability to identify the properties of substances on property diagrams and obtain the data from property tables.

Generic Elective Paper 3 Lab-

1. To determine the moment of inertia of a fly wheel.
2. To determine the Young's modulus Y of a wire by Searl's method.
3. To determine the modulus of rigidity of a wire by Maxwell's needle/Torsion Pendulum (Dynamic method).
4. To determine g by bar pendulum.
5. To determine the value of Y of a rubber by using travelling microscope.
6. To determine the Rigidity of modulus by static method.
7. To determine the frequency of a telescope by using Sonometer.
8. Verification of Laws of Vibration of a string by using Sonometer.
9. To compare capacitances using De Sauty bridge.
10. To determine the Law of resistance by using Foster bridge.
11. Compare the specific heat of two liquids by method of Cooling.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flintand H.T.Worsnop, 1971, Asia Publishing House
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal (1985), Vani Publication
3. A Text Books of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition (2011), Kitab Mahal, NewDelhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

SEMESTER-4

Core course-VIII Mathematical Physics III

COURSE OUTCOME

CO1. The three commonly used co-ordinate systems and general curvilinear co-ordinate system.

CO2. Concept of relativity, length contraction, relativistic mass, time dilation and twin paradox. Various methods to solve different differential equations.

CO3. Properties of Legendre polynomials, Hermite polynomials and Bessel function. These are useful to solve the problem of linear simple harmonic oscillator in quantum mechanics.

CO4. Have a good grasp of the basic elements of complex analysis, including the important integral theorems. Students will be able to determine the residues of a complex function and use the residue theorem to compute certain types of integrals.

CORE PAPER-VIII

MATHEMATICAL PHYSICS-III

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation Eulers formula, De Moivres theorem, Roots of complex Numbers, Functions of Complex Variables, Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts, Integration of a function of a complex variable, Cauchys Inequality, Cauchys Integral formula, Simply and multiply connected region, Laurent and Taylors expansion, Residues and Residue Theorem, Application in solving Definite Integrals.

UNIT-II

Integral Transforms-I: Fourier Transforms: Fourier Integral theorem,Fourier Transform,Examples,FourierTransformoftrigonometric,Gaussian,finitewave train and other functions, Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse FourierTransform.

UNIT-III

Integral Transforms-II : Convolution theorem, Properties of Fourier Trans- forms (translation, change of scale, complex conjugation), Three dimensional Fourier transforms with examples, Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat flow Equations.

UNIT-IV

Laplace Transforms: Laplace Transforms (LT) of Elementary functions, Properties of Laplace Transforms: Change of Scale Theorem, Shifting Theorem, LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Text Books:

1. Mathematical Methods for Physicists, G.B.Arfken, H.J.Weber, F.E.Harris (2013,7th Edn.,Elsevier)
2. Advanced Engineering Mathematics,ErwinKreyszig (WileyIndia)

Reference Books:

1. Mathematical Physics and Special Relativity –M.Das, P.K.Jena and B.K.Dash (Sri krishna Prakashan)
2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing)

Mathematical Physics C. Harper (Prentice Hall India)

3. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition , Mc- Graw Hill Education)
4. Complex variables and applications J.W.Brown and R.V.Churchill
5. Mathematical Physics, Satya Prakash (Sultan Chand)
6. MathematicalPhysicsB.D.Gupta(4thedition,VikasPublication)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Core Course-VIII Practical/Tutorial Mathematical Physics-III Lab

COURSE OUTCOME

CO1. Learning Numerical techniques and C programming analytical power is grown within the students. As well as the students get practiced to find accurate and precise values.
CO2. In this laboratory course students get the lessons in computer programming using C++. Students get acquainted with Linux fundamentals as well as Latex fundamentals.
CO3. Students get practiced with Scilab of graph plotting.
CO4. Students learn to solve differential equations by learning Euler methoddetermination of eigenvalues of matrix, inverse of matrix also in C++ and Scilab.

CORE PAPER-VIII LAB

Scilab based simulations (XCos) experiments based on Mathematical Physics problems like:

- **Solve Simple Differential Equations like**

$\frac{dy}{dx} = e^x$, *with* $y(x = 0) = 0$

$\frac{dy}{dx} + e^x = x^2$, *with* $y(x = 0) = 0$, $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = -y$, *with y(x=0)=0, y(x=0)=1*

$\frac{dy}{dx} + e^{-x}\frac{dy}{dx} = -y$, *with* $y(x = 0) = 0$, *y(x=0)=1*

- **Direc Delta Function**

Evaluate $\int_{-3}^{3}$ (x+3) $e^{-\frac{(x-2)^2}{2\sigma^2}}$, for σ = 0.1, 0.01, 0.001 and shoiw that ot tends to $\frac{}{\sqrt{2\pi}}$ σ^2

5.

- **Fourier Series:**

  Program to sum

  Evaluate the Fourier coefficients of a given piriodic function (square wave)

- **Frobenius method and Special functions:**

  $\int_{-3}^{3} P_m(\mu) P_n(\mu) = \frac{2}{2n+1} \delta_{m,n}$

  Plot $P_n(\mu)$, Legendre polynomial of degree n, and $J_n(x)$, Bessel function of first kind.

  - **Show recursion relation**

  ✓ Calculation of error for each data point of observations recorded in experiments done in previous semisters (choose any two).

  ✓ Calculation of least square fitting manually without weightage to error. Confirmation of least square fitting data through computer program.

  ✓ Evaluation of trigonometric functions e.g. $sin\theta$, Given Bessels function at N points find its value at intermediate point.

- **Complex Analysis:**

  Calculate $\int \frac{dx}{(x^2+2)}$ and check it with computer integration.

- **Integral Transform:**

  FFT of e^{-x^2}

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.FRiley, M.P.Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P.Dennery and A.Krzywicki,1967,DoverPublications
3. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C.V. Fernndez. 2014 Springer ISBN: 978-3319067896
4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
5. Scilab (A free soft ware to Matlab):H.Ramchandran,A.S.Nair.2011S.Chand And Company
6. Scilab Image Processing: Lambert M. Surhone. 2010 BetascriptPublishing

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	5	5	5	4
CO2	4	5	5	5	4	2	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	5	5	5	4	2	5	5

Core course-IX Elements of Modern Physics

COURSE OUTCOME

CO1. Students would know about the basic principles in the development of modern physics. The topics covered in the course build a basic foundation of undergraduate physics students to study the advance branches: quantum physics, nuclear physics, particle physics and high energy physics.

CO2. The course contains the study of Planck's hypothesis, photoelectric effect, Compton effect, matter waves, atomic models, Schrodinger wave equations, and brief idea of nuclear physics. Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics, formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions, the spontaneous and stimulated emission of radiation, optical pumping and population inversion, Basic lasing

CO3. The study brings a basic idea on the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear

shell model and mass formula.

CO4. Some interesting topics which are included in this course are decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrino, its properties and its role in theory of beta decay, Fission and fusion: Nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars which helps students to pursue career in research.

CORE PAPER-IX

ELEMENTS OF MODERN PHYSICS

UNIT- I

Atomic Spectra and Models: Inadequacy of classical physics, Brief Review of Black body Radiation, Photoelectric effect, Compton Effect, dual nature of radiation wave nature of particles, Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle, Alpha Particle Scattering, Ruther- ford Scattering Formula, Rutherford Model of atom and its limitations.

Atomic Model: Bohrs Model of Hydrogen atom, explanation of atomic spec- tra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Experiment, Sommer felds modification of BohrsTheory.

UNIT- II

Wave Packet: superposition of two waves, phase velocity and group velocity, wave packets, Gaussian Wave Packet, spatial distribution of wave packet, Localizationofwavepacketintime,Timedevelopmentofawavepacket,Wave Particle Duality,, Complemntarity.

Wave Particle Duality: de Broglie hypothesis, Experimental confirmation ofmatterwave,DavissonGermerExperiment,velocityofdeBrogliewave,wave particle duality,Complementarity.

Uncertainty Principle: Heisenberg Uncertainty Principle, Illustration of the PrinciplethroughthoughtExperimentsofGammaraymicroscopeandelectron diffraction through a slit, Estimation of ground state energy of harmonicoscillator and hydrogen atom, non existence of electron in the nucleus,Uncertainty and complementarities.

UNIT- III

Nuclear Physics- I: Size and structure of atomic nucleus and its relation with atomic weight, Impossibility of an electron being in the nucleus as a con- sequence of the uncertainty principle, Nature of the nuclear force, NZ graph, Liquid Drop model: semi empirical mass formula and binding energy, Nuclear Shell Model and magicnumbers.

UNIT- IV

Nuclear Physics- II: Radioactivity, stability of the nucleus, Law of radioactivedecay,MeanlifeandHalflifeAlphadecay,Betadecay-energyreleased,spectrum and Paulis prediction of neutrino, Gamma ray emission energy-momentum conservation: electron-

positron pair creation by gamma photons in the vicinity of a nucleus, Fission and fusion mass deficit, relativity and generation of energy, Fission- nature of fragments and emission of neutrons, Nuclear reactor: slow neutron interacting with Uranium 235, Fusion and thermonuclear reactions driving stellar energy (brief qualitativediscussion).

Text Books:

1. Concepts of Modern Physics Arthur Beiser (McGrawHill)
2. Modern Physics Murugeshan and Sivaprasad(S.Chand)

Reference Books:

1. QuantumMechanics:TheoryandApplications,A.K.GhatakandS.Lokanathan, (Macmillan)
2. Introduction to Quantum Theory, David Park (DoverPublications)
3. Theory and Problems of Modern Physics, Schaum'soutline,R.Gautreau and W.Savin-(Tata McGraw-Hill)
4. Modern Physics-Serway (CENGAGELearnings)
5. Physics of Atoms and Molecules Bransden and Joachim (PearsonIndia)
6. Atomic and Nuclear Physics-A.B.Gupta (NewCentral)
7. Theoretical Nuclear Physics , J.M.Blatt and V.F. Weisskopf(Springer)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	4	5	4	5	4	5	5	2	5	5
CO2	5	5	5	4	2	5	4	4	2	4
CO3	5	5	5	4	5	4	5	4	4	5
CO4	2	4	5	4	5	4	4	2	5	5

Core Course-IX Practical/Tutorial Elements of Modern PhysicsLab

COURSE OUTCOME

CO1. In this course students would be able to understand Basic experiments of modern physics such as: Determination of Plank's and Boltzmann's constants, Determination of ionization potential, Wavelength of H-spectrum, Single and double slit diffraction, Photo electric effect and determination of e/m

CO2. The students will get opportunity to measure Planck's constant, verify photoelectric effect, determine e/m of electron, Ionization potential of atoms, study emission and absorption line spectra.

CO3. They will also find wavelength of Laser sources by single and Double slit experiment, wavelength and angular spread of He-Ne Laser using plane diffraction grating.

CO4. Students would know about the basic principles in the development of modern physics

CORE PAPER-IX LAB

1. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
2. To determine the wavelength of laser source using diffraction of single slit.
3. To determine the wavelength of laser source using diffraction ofdouble slits.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.

5. Todetermine the Plancks constant using LEDs of at least 4 differentcolours.

6. To determine the value of e/m by(a) Magnetic focusing or (b) Bar magnet.

7. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

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 Books Book of Practical Physics, I.Prakashand Ramakrishna, 11th Edn, 2011,Kitab Mahal

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	5	5	5	4
CO2	4	5	5	5	4	2	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	5	5	5	4	2	5	5

Core course-X Digital Systems and Applications

COURSE OUTCOME

Upon successful completion of this course, students will be able to:

CO1. Gain both theoretical and experimental knowledge about digital electronics.

CO2. Understand computer architecture.

CO3. Verify and design various logic gates.Write programs using 8085 microprocessor.

CO4. This course lays the foundation for understanding the digital logic circuits and their use in combinational and sequential logic circuit design.

CORE PAPER-X

DIGITAL SYSTEMS AND APPLICATIONS

UNIT-I

Integrated Circuits (Qualitative treatment only): Active and Passive Components, Discrete components, Wafer Chip, Advantages and Drawbacks of ICs, Scale of Integration: SSI, MSI, LSI and VLSI (basic idea and definitions only), Classification of ICs, Examples of Linear and Digital ICs.

Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversation, BCD, Octal and Hexadecimal numbers, AND, OR and NOT. Gates (realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.

UNIT-II

Boolean algebra: De Morgans Theorems: Boolean Laws, Simplification of Logic Circuit using

Boolean Algebra, Fundamental Products, Idea of Minterms and Maxterms, Conversion of aTruth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) KarnaughMap.

Introduction to CRO: Block Diagram of CRO, Electron Gun, Deflection system and Time Base, Deflection Sensitivity,

Applications of CRO: (1) Study of Wave Form, (2) Measurement of Volt- age, Current, Frequency and Phase Difference.

UNIT-III

Data Processing Circuits: Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2s complement. Half and Full Adders. Half and Full Subtractors, 4 bit binary Adder/Subtractor.

Timers: IC 555: block diagram and application is Astable multivibrator and Monostable multivibrator.

UNIT-IV

Introduction to Computer Organization: Input/output Devices, Data storage (idea of RAM and ROM), Computer memory, Memory organization and addressing, Memory Interfacing, Memory Map.

Shift registers: Serial-in-serial-out, Serial-in-Parallel-out, Parallel-in-Serial- out and Parallel-in-Parallel-out. Shift Registers (only up to 4 bits)

Counters (4 bits): Ring Counter, Asynchronous counters, Decade Counter. Synchronous Counter.

Text Books:

1. Digital Circuits and Logic design: SamuelC.Lee(PrinticeHall)
2. Digital Principles and Applications - A.P. Malvino, D.P.Leach and Saha (TataMcGraw)

Reference Books :

1. The Art of Electronics by Paul Horowitz and Wilfield Hill ,Cambridge University
2. Electronics by Allan R. Hambley ,Prentice Hall 3. Principles of Electronics V.K.Mehta and Rohit Mehta (S.Chand Publishing)
3. Digital Logic and Computer design M. Morris Mano (Pearson) 5. Concepts of Electronics D.C.Tayal (Himalaya Publishing house)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Core Course-X Practical/Tutorial Digital Systems & ApplicationsLab

COURSE OUTCOME

CO1. In the laboratory students will learn to construct both combinational and sequential circuits by employing NAND as building blocks and demonstrate Adders, Subtractors, Shift Registers, and multivibrators using ICs. They are also expected to use μP 8085 to demonstrate the same simple programme using assembly language.

CO2. Acquire the ability to formulate and solve problems involving Boolean algebra and learn to design digital systems using simple logic elements.

CO3. Develop understanding of digital codes and number systems.

CO4. Develop understanding of sequential logic circuits and their applications. It then builds the concept of Integrated Chips (IC): its classification and uses. Differentiating the Analog and Digital circuits, the concepts of number systems like Binary, BCD, Octal and hexadecimal are developed to elaborate and focus on the digital systems. Sequential Circuits: Basic memory elements Flips-Flops, shift registers and 4-bits counters leading to the concept of RAM, ROM and memory organization.

CORE PAPER--X LAB

1. To measure (a) Voltage, and (b) Time period of a periodic waveform usingCRO and to test a Diode and Transistor using a Millimeter.
2. To design a switch (NOT gate) using atransistor.
3. To verify and design AND, OR, NOT and XOR gates using NANDgates.
4. Half Adder, Full Adder and 4-bit binaryAdder.
5. Half Subtractor, Full Subtractor, Adder-Subtractor using Full AdderI.C.
6. TobuildFlip-Flop (RS,ClockedRS,D-typeandJK)circuitsusingNAND gates.
7. To design an astable multivibrator of given specifications using 555Timer.
8. To design a monostable multivibrator of given specifications using 555 Timer.

Reference Books:

1. Basic Electronics: A Text Books lab manual, P.B. Zbar, A.P. Malvino,
2. M.A. Miller, 1994, Mc-GrawHill.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill. ElectronicDevicesandcircuitTheory,R.L.BoylestadandL.D.Nashelsky,2009, Pearson

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Generic Elective -4 GE-4

COURSE OUTCOME

CO1. Students will learn the basics of modern Physics and quantum mechanical methods, its application by using Matrix calculations to solve problems, Fourier series and related problem

CO2. Students get the glimpse of fluid mechanics and of relativistic mechanics. Studying the energy convestion from matter, students come to know about the formation of universe nad its constituents.

CO3. The students to work with concept of real life problems related with energy harvesting

CO4. Study of relativistic mechanics of a point particle makes the analytic strength of the students stronger.

Generic Elective Paper -IV

(Optics, Special Theory of Relativity, Atomic Physics, Quantum Mechanics and Nuclear Physics)

UNIT-I

Optics-I: Elementary ideas of monochromatic aberrations and their minimization, chromatic aberration, achromatic combination, Theory of formation of primary and secondary rainbow, condition of interference, coherent sources, Youngs double slit experiment, biprism and measurement of wave length of light of by it, color of thin films and Newton's rings, Fresnel and Fraunhoffer diffraction, diffraction by single slit plane transmission grating.

Optics-II : Electromagnetic nature of light, polarized and unpolarized light, polarization by reflection and refraction, Brewster's Law, Mauls Law, Double refraction, Ordinary and extraordinary rays.

UNIT-II Atomic Physics

Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Planck's quantum theory of radiation, particle nature of electromagnetic radiation photo electric effect, Compton effect, dual nature of radiation, wave nature of particles, deBroglie hypothesis, matter wave, wave-particle duality, Davisson- Germer experiment. Bohr's theory of Hydrogen atom, explanation of Hydrogen Spectra, correction for finite mass of the nucleus, Bohrs correspondence principle, limitations of Bohr's theory, Discrete energy, exchange by atom Frank Hertz experiment.

UNIT-III

Quantum Mechanics : Heisenberg's Uncertainty relation, Time dependent Schrodinger's wave equation in one dimension and three dimensions, The physical interpretation of the wave function, Probability density and probability current density, Equation of continuity, Normalization of the Wave function, Expectation value of an observable, Ehrenfest's theorem. Time independent Schrodinger's wave equation in one dimension particle in a box, energy eigen values and eigen functions.

UNIT-IV

Nuclear Physics : Properties of the nucleus Charge, Size, Spin, Magnetic Moment, Mass, Mass defect, Binding energy, Packing fraction, Nuclear force and its characteristics features, Radioactive decay laws, average life, half life, nuclear fission, nuclear fusion, Linear accelerators, and cyclotron. Relativity: Galilean transformation, Newtonian relativity and its limitation, Michelson Morley experiment and it's consequence, postulates of special theory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energy relation.

Text Books:

1. University Physics, H. D. Young, R. A. Freedman (Person)-2017
2. Fundamentals of Physics, Resnick, Halliday, Walker (WIley)-2015

Reference Books:

1. A Text Books book of Optics N. Subrahmanyam and Brij Lal (S.Chand Publishing)-2006
2. Introduction to Special Relativity-R. Resnick (John Wiley)-2007
3. Concepts of Modern Physics Arthur Beiser (McGraw Hill)-2017
4. Modern Physics H.S. Mani and G.K.Mehta-2018

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Generic Elective -4 Practical/Tutorial

COURSE OUTCOME

CO1. In this course the experiments are designed to give glimpse of heat, magnetism, electricity and optics experiments.

CO2. Study of propagation of light in optical media clarifies the knowledge of students regarding the interference, diffraction, polarization and other optical phenomena. Theses train the students to work with different optical media and instruments as well.

CO3. They also develop basic communication skills through working in groups in performing the laboratory experiments.

CO4. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.

Generic Elective Paper IV LAB

1. Determination of E.C.E. of a Copper by taking 3readings.
2. Determination of Refractive index of the material of a prism using Sodium light.
3. To determine the wavelength of light using plane diffraction grating.
4. To determine the wavelength of light using Newton's ring.
5. Determination of refractive index of (a) glass and (b) liquid by using travelling microscope.
6. To plot the I-D curve and to determine the refractive index of a prism
7. Determination of radius of curvature of a convex/concave mirror by using Kohlrausch's method.
8. To determine the magnifying power of a given telescope.
9. To Obtain the static characteristics of a P-N-P/N-P-N transistor/Triode Valve.
10. To determine the reduction factor of a tangent Galvanometer.
11. To study the Variation of magnetic field along the axis of a circular coil carrying current.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop, (1971), Asia Publishing House
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal (1985), Vani Publication
3. A Text Books of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition (2011), Kitab Mahal, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

SEMESTER-5

Core course-XI Quantum Mechanics & Applications

COURSE OUTCOME

CO1. This course provides understanding and knowledge to realize the basics of molecular, atomic and subatomic physics. Concept of wave function and wave packet is introduced. Students get their critical thinking ability developed by studying uncertainty principle.

CO2. Study of probability, expectation value and Ehrenfest's theorem assist students to be enriched with mathematical calculation. The concept of Schrodinger equation creates analytical power of students. The knowledge of quantization is clarified by studying energy levels.

CO3. The study of different potentials nourish them to think about system and its function with the help of mathematical tools. Students get skilled by studying the formalism of

quantum mechanics in describing the systems mathematically and this knowledge becomes very useful for their study of particle physics, spectroscopy and research. By learning the symmetry principles, the visualization about the system gets stronger. Concept of linear vector space help them to write the systems in proper way.

CO4. By studying angular momentum, the conceptual clarity regarding the calculations of the eigen-value and eigen vector. Learning the calculations of CG coefficients students get ready to solve analytical and mathematical problems.

CORE PAPER-XI

QUANTUM MECHANICS AND APPLICATIONS

UNIT- I

Schrodinger equation : Time dependent Schrodinger equation , Properties of Wave Function, Interpretation of wave function, Probability and probability current densities in three dimensions, Conditions for Physical Acceptability of Wave Function, Normalization, Linearity and Superposition Principles. Wave function of a free particle ,Wave Packet, Fourier Transform and momemtum space Wavefunction, Spread of Gaussian Wave packet, Evolution with time, Position and MomentumUncertainty.

UNIT-II

Operators: Operators, Commutator Algebra, Position, Momentum Angular Momentum and Energy operators, Hermitian Operators, Expectation valuesof position and momentum, Ehrenfest Theorem, Eigenvalues andEigenfunctions of Hermitian Operator, Energy Eigen Spectrum, Degeneracy, Orthonormality of Eigen functions, Linear Dependance.Orthogonalisation.

UNIT-III

Time Independent Schrodinger equation in one dimension (1d), 2d and 3d, Hamiltonian, stationary states and energy eigen values, expansion of an arbitrary wave function as a linear combination of energy eigen functions, General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states. General Discussion of Bound states in an arbitrary potential: Continuity of wave function, 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 eigen functions, ground state, zero point energy and uncertainty principle, One dimensional infinitely rigid boxenergy eigen values and eigen functions, normalization, quantum dot as example, Quantum mechanical scattering and tunnelling in one dimension across a step potential and rectangular potential barrier.

UNIT-IV

Atoms in Electric and Magnetic Fields: Electron angular momentum. Spacequantization,ElectronSpinandSpinAngularMomentum,LarmorsTheorem,Spi n Magnetic Moment, Stern Gerlach Experiment, Vector Atom Model, L-S and J-J coupling, Zeeman Effect,

Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect, Paschen back and Stark Effect (qualitative Discussiononly)

Text Books:

1. Introduction to Quantum Theory David Park (DoverPublications)
2. Introduction to Quantum Theory, D. J. Griffiths(Pearson)

Reference Books :

1. QuantumMechanics,TheoryandapplicationsA.GhatakandS.Lokanathan (McMillanIndia)
2. QuantumMechanics-G.Aruldhas(PrinticeHallofIndia)
3. Quantum Physics–S. Gasiorowicz (Wiley)
4. QuantumMechanics-G.R.ChatwalandS.K.Anand
5. Quantum Mechanics -J.L. Powell and B. Craseman(Narosa)
6. Introduction to Quantum Mechanics M.Das and P.K.Jena (Shri Krishna Publication)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Core Course-XI Practical/Tutorial Quantum Mechanics Lab

COURSE OUTCOME

CO1. The students after the course are competent enough to use the knowledge of Quantum Mechanics to different Quantum Mechanical systems encountered in different areas of Physics

CO2. They learn to solve the non-relativistic quantum mechanical problem and can demarcate the problems which are quantum mechanical.

CO3. Identify and understand the kinds of experimental results which are incompatible with classical physics and which required the development of a quantum theory of matter and light

CO4. Interpret the wave function and apply operators to it to obtain information about a particle's physical properties such as position, momentum and energy

CORE PAPER- XI LAB

Use C/C++/ Scilab for solving the following problems based on Quantum Mechanics like (Use finite difference method, matrix method, ODE Solver method in all cases)

1. Solve the s-wave Schrödinger equation for the ground state and the first excited state of hydrogen atom:

$\frac{d^2y}{dx^2} = (r)(r)$, $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, $V(r) = -\frac{e^2}{r}$,

where m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Rememmber that the ground state energy of the hydrogen atom is ~-13.6 eV. Take $e = 3.795\sqrt{(eV\text{Å})}$, $\hbar c = 1973(eV\text{Å})$ and m = $0.511\times10^6\ eV/c^2$.

2. Solve the s-wave Schrödinger equation for an atom:

$\frac{d^2y}{dx^2} = (r)(r)$, $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, where m is the reduced mass of the system (which can be chosen to be the mass of an electrfon), for the screened coulomb potential: $V(r) = -\frac{e^2}{r}e^{-r/a}$

Find the energy (in eV) of the ground state atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take $e = 3.795\sqrt{(eV\text{Å})}$, $\hbar c = 1973(eV\text{Å})$, m = $0.511\times10^6\ eV/c^2$ and a = 3Å, 5Å, 7Å.

The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave Schrödinger equation for a particle of mass m:

$\frac{d^2y}{dx^2} = (r)(r)$, $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, for the anharmonic oscillator potential: $V(r) = \frac{kr^2}{2} + \frac{br^3}{3}$.

Find the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponmding wave function. Chioose $m = 940MeV/c^2$, $k = 100MeV/fm^2$, b = 0, 10, $30MeV/fm^2$. In these Units, c = 197.3 $MeV\ fm$. [The grounhd state energy is expected to lie between 90 and 110 MeV for all three cases.]

4. Solve the s-wave Schrödinger equation for the

$\frac{d^2y}{dx^2} = (r)(r)$, $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, where m is the reduced mass of the two-atom system for the Morse potential $V(r) = D\ (e^{-2ar} - e^{-ar})$, where

$r = r - r_0$. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave functions for the choices given below:

a) $m = 940x\ 10^6\ eV/c^2$, $D = 0.755501eV$, $\alpha = 1.44$, $r_0 = 0.131349$ Å

b) $m = 940x\ 10^6\ eV/c^2$, $D = 0.755501eV$, $\alpha = 1.44$, $r_0 = 0.131349$ Å

Laboratory based experiments:

1. Study of Electron spin resonance- determine magnetic field as a function of the resonancefrequency
2. StudyofZeemaneffect:withexternalmagneticfield;Hyperfinesplitting
3. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
4. Quantum efficiency ofCCDs

Reference Books:

1. Schaumsout line ofProgrammingwithC++.J.Hubbard,2000,McGraw– HillPublication
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
3. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cam- bridge Univ. Press
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C.V. Fernndez.2014 Springer.
5. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011S. Chand andCo.
6. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:9786133459274

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	4	5
CO2	4	5	2	5	5	4	5	4	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	4	5	4	5	5	5

Core course-XII Solid State Physics

COURSE OUTCOME

CO1. Students would be able to understand various types of crystal structures and symmetries and understand the relationship between the real and reciprocal space and learn the Bragg's X-ray diffraction in crystals. Would also learn about phonons and lattice

CO2. Find out the relationship between crystals detector, structure analysis by various methods. Understand the elastic constant of crystals and lattice vibration. Understand the Energy levels and define Electrical conductivity – Hall Effect and free electron model and band gap energy. Analyse the relationship between dielectric and Ferro electric proportion of crystal. Perform and verify the theory and experimental procedure for magnetism and super conductivity phenomenon

CO3. Students will able to study difference between crystalline and amorphous material, crystal structures, miller indices, inter planer distances, interatomic forces and bonds. From this study students get to learn the basics of solid state physics.

CO4. Students will understand Bragg's diffraction, Bragg's law. X-ray diffraction and characterization techniques. With the help of this knowledge students know the principles of structures determination by X-ray diffraction method. This would be helpful in performing experiments in nanotechnology.

CORE PAPER-XII
SOLID STATE PHYSICS
UNIT-I

Crystal Structure: Solids, Amorphous and Crystalline Materials, Lattice translation Vectors, Lattice with a Basis. Central and Non-Central Elements. Unit Cell, Miller Indices, Types of Lattices, Reciprocal Lattice, Brillouin zones, DiffractionofX-raysbycrystals, BraggLaw,Atomic and Geometrical Factor

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear, Monotomic and Diatomic Chains, Acoustical and Optical Phonons, Qualitative Description of the phonon spectrum in solids, Dulong and Petits Law, Einstein and Debye theories of specific heat of solids, T 3 Law

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevins theory of dia and Paramagnetic Domains, Curies law,WeissTheoryofFerromagnetismandFerromagneticDomains,Discussion of B- H Curve, Hysteresis and EnergyLoss.

UNIT-III

Dielectric Properties of Materials: Polarization Local Electrical Field at anAtom,DepolarizationField,ElectricSusceptibility,Polarizability,Clausius Mosotti Equation, Classical theory of ElectronicPolarizability.

Lasers: Einsteins A and B co-efficientnts, Metastable States, Spontaneous and Stimulated emissions, Optical Pumping and population Inversion, Three Level and Four Level Lasers, Ruby Laser and He-Ne Laser.

UNIT-IV

Elementary band theory: Kronig-Penny model of band Gap, Conductor , Semiconductor(PandNtype)andinsulator,ConductivityofSemiconductor, mobility,HallEffect,Measurementofconductivity(04probemethod)andHall Co- efficient.

Superconductivity: Experimental Results, CriticalTemperature, Critical magneticfield,Meissnereffect,TypeIandtypeIISuperconductors,Londons EquationandPenetrationDepth,Isotopeeffect,IdeaofBCStheory(Noderivation)

Text Books:

1. Introduction to Solid State Physics- Charles Kittel (WileyIndia)
2. LASERS:FundamentalsandApplications- ThyagarajanandGhatak(McMil- lanIndia)

Reference Books:

1. SolidStatePhysics-N.W.AshcroftandN.D.Mermin(Cengage)
2. Solid State Physics- R.K.Puri and V.K. Babbar (S.ChandPublication)
3. Solid State Physics S. O. Pillai (New AgePublication)
4. Lasers and Non linear Optics B.B.Laud (WileyEastern)
5. Elements of Solid State Physics-J.P. Srivastava (Prentice Hall ofIndia)
6. Elementary Solid State Physics-Ali Omar (AddisonWiley)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	4	5
CO2	4	5	2	5	5	4	4	4	5	4
CO3	4	5	4	4	5	4	5	4	5	5
CO4	4	4	5	4	4	5	4	5	5	5

Core Course-XII Practical/Tutorial Solid State Physics Lab

COURSE OUTCOME

CO1. To understand Lattice heat capacity and to compare Classical theory, Einstein's theory, Debye's theory of specific heat of solids.

CO2. To apply techniques of X-Ray Diffraction and UV Spectroscopy to study crystals.

CO3. Students can describe and explain the behaviour of permanent magnet including induced magnetism, behaviour of paramagnetic, diamagnetic, ferromagnetic materials in terms of magnetic domain.

CO4. With the help of this knowledge students know the principles of structures determination by X-ray diffraction method. This would be helpful in performing experiments in nanotechnology.

CORE PAPER-XII LAB

1. Measurement of susceptibility of paramagnetic solution (Quincks Tube- Method)
2. To measure the Magnetic susceptibility ofSolids.
3. To measure the Dielectric Constant of a dielectric Materials with frequency
4. To determine the Hall coefficient of a semiconductorsample.
5. To draw the BH curve of Fe using solenoid and to determine theenergy loss fromHysteresis
6. To measure the band gap of a given semiconductor by four-probemethod.

Reference Books:

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 Books Book of Practical Physics, I.Prakashand Ramakrishna, 11 Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice- Hall of India.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	4	5
CO2	4	5	2	5	5	4	4	4	5	4
CO3	4	5	4	4	5	4	5	4	5	5
CO4	4	4	5	4	4	5	4	5	5	5

Discipline Specific Elective -1 Classical dynamics

COURSE OUTCOME

CO1. Application of Lagrangian mechanics to solve various problems related to day to day life.

CO2. Hamiltonian mechanics and its applications

CO3. Understand the concepts of four dimensional space and appy it to solve the collison and decay problems easily

CO4. Understand the negative result of Michelson morley experiment , galilean and lorentz transformation and Concepts like zero work done, conservative forces, mass energy equivalence ($E= mc^2$)

Discipline Specific Elective Paper-1
CLASSICALDYNAMICS
The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Generalised co-ordinates and Velocities, Generalised Force, Principle of virtual work Derivation of Lagranges equation of motion from DAlemberts Principles, Lagrangian and its Application to Simple, Compound and Double Pendulums, Single Particle in Space, Atwoods Machine, Dumb-bell, Linear harmonic oscillator.

UNIT-II

Hamiltons Principle, Calculus of Variation and derivation of Euler-Lagranges equation, Langranges Equations derived from Hamiltons Principles, Hamiltoian and its applications to Shortest Distance between two points in a plane, Geodesic Problem, minimum surface of revolution, Brachistochrone problem, The Equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, canonical momenta, Hamiltions equations of motion, Motion of charged particles in external electric and magnetic fields, Applications to central force motion and coupled oscillators.

UNIT- III

SpecialtheoryofRelativity(Postulatesofspecialtheoryofrelativity),Lorentz transformations, Minkowski space, The invariant interval, light cone and world lines, space time diagrams, Times-dilation, length contraction and Twin paradox, Variation of mass with velocity mass energyrelation

UNIT- IV

Four Vectors: Space Like, Time-like and light-like. Four velocity and acceleration, Four momentum and energy-momentum relation. Doppler effects from a four vector perspective, Concept of four-force, Conservation of four momentum, Application to two body decay of an unstable particle

Text Books:

1.Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko (Pearson)
2.Classical Mechanics N C Rana and P S Joag.

Reference Books :

1. Mechanics-D.S.Mathur (SultanChand)
2. Solved problems in Classical Mechanics, O.L. Delange and J.Pierrus (Ox- ford Press)(2010)
3. Classical Mechanics-M. Das, P.K.Jena, M. Bhuyan, R.N.Mishra (Srikr- ishnaPrakashan)
4. Mathematical Physics with Classical Mechanics-Satya Prakash (Sultan Chand andsons)
5. Introduction to classical dynamics R.K.Takwale and S.Puranik (Tata McGrawHill)
6. Classical Mechanics J.C.Upadhyay (HimalayanPublisher)
7. Classical Dynamics of particles and systems -S.T.Thorton and Marion (Cengagepublication)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	2	5
CO2	4	4	5	2	5	4	4	4	5	4
CO3	4	5	4	4	5	4	5	2	5	5
CO4	4	4	4	5	2	5	4	5	5	5

Discipline Specific Elective -2 Nuclear and Particle physics

COURSE OUTCOME

CO1. To promote background knowledge on atmospheric sciences.
CO2. To make students aware of the concepts of Physics involved in day-to-day life.
CO3. To update the knowledge of students with recent science and technology devices
CO4. Relate Cosmic activity and the environmental effect on the earth's surface.

Discipline Specific Elective-2
Nuclear and Particle Physics
UNIT-I

General properties of Nuclei: Constituents of nucleus and their intrinsic properties, Quantitative facts about mass, radius, charge density (matter density),binding energy,average binding energy and it 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 Physics: Early universe Primordial Nuclear Synthesis (Parabole unclear interactions) stellar nucleosynthesis, concept of Gamow window, heavy element production r- and s process path.

UNIT-II

Interaction of Nuclear Radiation with matter : Energy loss due t ionization (Bethe-block formula) energy loss of electrons, Cerenkov radiation,Gamma ray interactuion through matter, photo electric effect, Comptron scattering pair production, neutron interaction with matter.

UNIT-III

Detector for nuclear radiations: Detector for nuclearradiations: Gas detectors: estimationofelectric field, mobility of particle, for ionization chamber and GM Counter. Basic Principle of Scintillation Detectors and Construction of photo-multipliertube (PMT). Semiconductor Detectors (Si and Ge) for charge Particle and photon detection (Concept of charge carrier and mobility), neutron detector. Particle Accelerators: Van-de Graff generator (Tandem Accelerator), Lin-ear accelerator, Cyclotron, Synchrotrons

UNIT-IV

Particle Physics: Particle interactions, basic features, types of particles and itsfamilies,

Symmetries and conservation laws: Energy and momentum, angular momentum,parity, baryonnumber, Leptonnumber, Isospin, strangeness and charm, Elementary ideas of quarks and gluons.

Text Books:

1. Introduction to Nuclear Physics By Roy and Nigam
2. Atomic and Nuclear Physics- N.Subramanyam, BrijLal and Jivan Seshan (S. Chand Publishing)

Reference Books:

1. IntroductiontoModernPhysics-H.S.ManiandG.K.Mehta(Affilatedeast and west)
2. Introductory nuclear Physics-Kenneth S. Krane (Wiley India Pvt. Ltd)
3. Introduction to Elementary Particles-D. Griffith (John Wiley andSons)
4. Concepts of Nuclear Physics - Bernard L. Cohen. (Tata Mcgraw Hill).
5. Concepts of Modern Physics-Arthur Beiser (McGrawHill)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

SEMESTER-6

Core course-XIII Electro-magnetic Theory

COURSE OUTCOME

CO1. As the paper deals with mathematical detail, the ability of approaching and solving the problems is also nurtured.

CO2. As this course is full of vector, tensor and differential equations, the understanding of mathematical methods can be completed with applications of those topics in electrodynamics.

CO3. The concept of dielectric and the field in material medium are also grown within the students in this course.

CO4. Analytical skill and the realization of the regular electromagnetic phenomena are developed studying the electromagnetic waves. Understanding of Maxwell's equations help students for a complete grip over the subject.

CORE PAPER-XIII
ELECTROMAGNETIC THEORY
UNIT-I

Maxwell Equations:Maxwells equations, Displacement Current, Vector and ScalarPotentials,GaugeTransformations:LorentzandCoulombGauge,Boundary Conditions at Interface between Different Media, Wave Equations, Plane Wavesin Dielectric Media, Poynting Theorem and Poynting Vector, Electro- magnetic (EM) Energy Density, Physical Concept of Electromagnetic Field Energy Density

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuumandisotropicdielectricmedium,transversenatureofplaneEMwaves, refractive index and dielectric constant, wave impedance, Propagation through conducting media, relaxation time, skin depth, Electrical conductivity of ionized gases, plasma frequency, refractiveindex, skindepth, application to propagation through ionosphere.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media, Reflection and Refraction of plane wave satplane interface between two dielectric media, Laws of Reflection and Refraction, Fresnel's Formulae for perpendicular and parallel polarization cases, Brewster's law, Reflection and Transmission coefficients, Total internal reflection, evanescent waves, Metallic reflection (normal Incidence)

UNIT IV

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization, Uniaxial and Biaxial Crystals, Light Propagation in Uniaxial Crystal, Double Refraction, Polarization by Double Refraction, Nicol Prism, Ordinary and extraordinary refractive indices, Production and detection of Plane, Circularly and Elliptically PolarizedLight,

Phase Retardation Plates: Quarter-Wave and Half- Wave Plates. Babinets Compensator and its Uses, Analysis of Polarized Light.

Rotatory Polarization: Optical Rotation, Biots Laws for Rotatory Polarization, Fresnels Theory of optical rotation, Calculation of angle of rotation, Experimental verification of Fresnels theory, Specific rotation, Laurents half- shade polarimeter.

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths (Pearson)
2. PrinciplesofOptics-MaxBornandE.Wolf

Reference Books :

1. Classical Electrodynamics by J.D.Jackson
2. Foundationofelectromagnetictheory:RitzandMilford(Pearson)
3. Electricity and Magnetism : D C Tayal (HimalayaPublication)
4. Optics : A.K.Ghatak
5. Electricity and Magnetism : Chattopadhyaya, Rakhit (NewCentral)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	4	2	5	4	4	2	4
CO2	4	5	4	5	4	5	5	2	5	5
CO3	5	5	5	4	2	5	4	4	2	4
CO4	2	4	5	2	5	2	2	4	5	5

Core Course-XIII Practical/Tutorial Electro-magnetic Theory Lab

COURSE OUTCOME

After completing the course, the students should be able:

CO1. To differentiate different types of coordinate systems and use them for solving the problems of electromagnetic field theory.

CO2. To describe static electric and magnetic fields, their behavior in different media, associated laws, boundary conditions and electromagnetic potentials.

CO3. To use integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory.

CO4. To describe time varying fields, propagation of electromagnetic waves in different media, pyonting theorem, their sources & effects and to apply the theory of electromagnetic waves in practical problems.

CORE PAPER XIII LAB

1. To verify the law of Malus forplanepolarizedlight.
2. To determine the specific rotation of sugar solution usingPolarimeter.
3. To analyze elliptically polarized Light by using a Babinetscompensator.
4. To determine the refractive index of liquid by total internal reflection using Wollastonsair-film.
5. To determine the refractive Index of (1) glass and (2) a liquid bytotal internal reflection using a Gaussianeyepiece.
6. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
7. To verify the Stefan‘slaw of radiation and to determine Stefans constant.
8. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
9. To determine velocity of ultrasonic wave in liquid.

Reference Books:

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 Books Book of Practical Physics, I.Prakashand Ramakrishna, 11 Ed., 2011, Kitab Mahal Electromagnetic Field Theory for Engineers and Physicists, G. Lehner, 2010,Springer

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	5	2	4	5	2	5
CO2	4	2	5	2	5	5	4	4	5	4
CO3	4	5	4	4	5	4	5	5	5	5
CO4	5	4	4	5	2	5	4	4	5	5

Core course-XIV Statistical Mechanics

COURSE OUTCOME

CO1. The course provides an introduction to statistical physics, mainly for systems in thermal equilibrium. The student should understand quantum and classical statistical mechanics for ideal systems, and be able to judge when quantum effects are important.

CO2. The student should understand the connection between microphysics and thermodynamics.

CO3. Skills:The student should be able to perform quantitative calculations on ideal systems, be able to formulate models of more realistic systems, and be able to use standard numerical packages for simulation and analysis of such.

CO4. The student should have acquired a foundation for advanced courses in physics, specially those involving many-particle systems.

CORE PAPER-XIV STATISTICAL MECHANICS

UNIT- I

Classical Statistics-I: Macrostate and Microstate, Elementary Concept of Ensemble, Microcanonical, Canonical and Grand Canonical ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function.

UNIT- II

Classical Statistics-II : Thermodynamic Functions of an Ideal Gas, classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of equipartition of Energy (with proof)- Applications to Specific Heat and its Limitations, Thermodynamic Functions of a two energy levels system, NegativeTemperature.

UNIT-III

Quantum Statistics: Identical particles, macrostates and microstates, Fermions and Bosons, Bose Einstein distribution function and Fermi- Dirac distribution function. Bose- Einstein Condensation, Bose deviation from Plancks law, Effect of temperature on Fermi-Dirac distribution function, degenerate Fermi gas, Density of States Fermienergy.

UNIT-IV

Radiation: Properties of Thermal Radiation, Blackbody Radiation, Pure Temperature dependence, Kirchhoffs law, Stefan Boltzmann law: Thermodynamic proof, Radiation Pressure, Weins Displacement law, Wiens distribution Law, Sahas Ionization Formula, Rayleigh Jeans Law, Ultra Violetcatastrophe.

Plancks Law of Black body Radiation: Experimental verification, Deduction of (1) Wiens Distribution Law, (2) Rayleigh Jeans Law, (3) Stefan Boltzmann Law, (4)Weins Displacement Law from Plancks Law.

Text Books:

1. Introduction to Statistical Physics by Kerson Huang(Wiley).
2. StatisticalPhysics,BerkeleyPhysicsCourse,F.Reif(TataMcGraw-Hill)

ReferenceBooks:

1. Statistical Mechanics, B.K.Agarwal and Melvin Eisner (New Age Inter- national)
2. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: FrancisW.SearsandGerhardL.Salinger(Narosa)
3. Statistical Mechanics: R.K.Pathria and Paul D. Beale (AcademicPress)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	2	5
CO2	4	4	5	2	5	4	4	4	5	4
CO3	4	5	4	4	5	4	5	2	5	5
CO4	4	4	4	5	2	5	4	5	5	5

Core Course-XIV Practical/Tutorial Statistical Mechanics Lab

COURSE OUTCOME

CO1. The students would be able to have strong foundation knowledge and comprehend the basic concepts and principles in Physics.

CO2. The students would be able to progress in their academic performance through structured curricula.

CO3. The students would be able take up competitive exams in different sectors, can be entrepreneur s and succeed in higher education in Physics

CO4. The students would be able to experience a well resourced environment for learning Physics

CORE PAPER-XIV LAB

1. PlotPlanckslawforBlackBodyradiationandcompareitwithWeins
2. Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
3. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Ein steindistributionfunction,(c)Debyedistributionfunctionforhightemperatur e (roomtemperature)andlowtemperatureandcomparethemforthesetwocases
4. Plot Maxwell-Boltzmann distribution function.
5. Plot Fermi-Dirac distribution function.
6. Plot Bose-Einstein distribution function.

Reference Books:

1. Elementary Numerical Analysis, K.E.Atkinson, 3rdEdn. 2007, Wiley India Edition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford UniversityPress.

3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, FrancisW.SearsandGerhardL.Salinger,1986,Narosa.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009,Springer
5. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C.
V. Fernndez. 2014 Springer ISBN: 978-3319067896
6. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
7. Scilab Image Processing:L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	4	2	4	5	2	5
CO2	4	4	5	2	5	4	4	4	5	4
CO3	4	5	4	4	5	4	5	2	5	5
CO4	4	4	4	5	2	5	4	5	5	5

Discipline Specific Elective -3 Nano Materials and Applications

COURSE OUTCOME

CO1. To understand Basics of Nano technology and sciences
CO2. To study the characterization techniques such as Scanning electron microscope, tunneling electron microscope
CO3. Students can describe and explain the behaviour of nano materials in quantum scale
CO4. With the help of this knowledge students know the various applications of nano materials in bio medical field, energy harvesting, sensors and MEMS devices.

Discipline Specific Elective Paper- III
Nano Materials and Applications
UNIT-I
Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, size effects in nano systems, Quantum confinement Applications of Schrodinger equation-infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructure and its consequences.

UNIT-II

Synthesis of Nanostructure Materials: Top down and botton up approach,PhotolithographyBallmilling.Gasphasecondensation,Vacuumdeposition, Physical vapour deposition (PVT): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD), Sol-Gel Electrodeposition,Spraypyrolysis,Hydrothemalsynthesis,Preparationthrough colloidal methods, MBE growth of quantumdots.

UNIT-III

Characterization: X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy

UNIT-IV

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nonmaterial Devices: Quantum dots hetero structure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots- magmetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems(NEMS)

Text Books:

1. S.K. Kulkarni, Nanotechnology: Principles and Practices (Capital PublishingCompany)
2. Nano science and nano technology, K.K.Choudhury(Narosa)

Reference Books:

1. NanoScienceandnanotechnology,SundarSingh(PragatiPrakashan)
2. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt.Ltd.).
3. RichardBooker,EarlBoysen,Nanotechnology(JohnWileyandSons).
4. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier,2007).
5. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	4	5	2	4	5	2	5
CO2	4	4	5	2	5	4	5	4	5	4
CO3	4	5	4	4	5	4	5	2	5	5
CO4	4	4	5	5	2	5	4	5	5	5

Discipline Specific Elective Paper-4

Project

OR

Basic Instrumentation

Discipline Specific Elective -4Project
Course Outcome

CO1. students are exposed to various research areas of intrest and learn to chose a research filed of their intrest by doing proper literature survey.
CO2. A small scale project will be done by student by interacting with research scholars
CO3. Students will learn characterisation techniques and data analysis of the results found during their research project
CO4. Writing a research paper and publish it in a renowned jounal

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	3	2	3	1	2	2	1	3
CO2	2	3	1	3	1	3	1	1	3	3
CO3	2	3	2	3	2	3	3	2	3	3
CO4	1	1	3	1	3	2	3	2	3	3

Discipline Specific Elective Paper-4

Basic Instrumentation

CO1. Student learns about the varoius applcations of Digital storage Oscilloscope and analog Oscilloscope
CO2. Understand Cathode Ray Oscilloscope, Construction of CRT, Electron gun,
CO3. Sketch, explain and design the Signal Generators circuit for given specification and analyze them discussoscillator principles, and frequency stability.
CO4. Analyze the different types of digital multimeter

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

Multimeter: Principles of measurement of dc voltage and dc current, ac volt- age, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage,measurement(blockdiagramonly).SpecificationsofanelectronicVoltmeter/ Multimeter and theirsignificance.

AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

UNIT-II

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 and chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle ofworking.

UNIT-III

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator, Brief idea for testing, specifications, Distortion factor meter, waveanalysis.

UNIT-V

Digital Instruments: Principle and working of digital meters, Comparison of analog and digital instruments, Characteristics of a digital meter, Working principles of digital voltmeter.

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

Text Books:

1. A Text Books book of electrical technology-B.L.Theraja (S.ChandPublishing)
2. Digital circuits and systems Venugopal (Tata McGraw Hill)

Reference Books :

1. Digital Electronics-Subrata Ghoshal (CengageLearning)
2. Electronic Devices and circuits - S. Salivahanan and N. S.Kumar (Tata Mc-GrawHill)
3. Electronic Devices-Thomas L. Floyd (Pearson)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	5	5	2	4	4	2	5
CO2	4	5	2	5	5	5	5	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	2	2	4	5	5

Discipline Specific Elective Paper-4
Practical/Tutorial
Course outcome

CO1. The students will have practical understanding of the characteristics of various diodes, transistors, Op-Amp, designing concepts of logic gates and digital circuits. They will also be trained in basic elements and measurement using multimeters and utilization of CRO.

CO2. The basic filters will help the student to identify how the frequency depend on resistance and how the signals behave with the frequencies. They can explore how to filter these signals with resistors and capacitors.

CO3. The students can analyse and compare the effect of frequency to the output voltage. They are exposed to the usage of semi-log graph and how to plot with respect to the given values. The experiments related to operational amplifier makes the students to analyse and working of IC 741 and its characteristics and finding the solution for linear and nonlinear applications using OP-Amp.

CO4. To appreciate and differentiate the working principles. How the resistor capacitor combination affects the uniformity of waveform and to comprehend the difficulties and to overcome that. The study of basic logic gates will help the student to have thorough understanding of the fundamental concept and the various techniques in digital electronics.

The test of lab skills will be of the following test items:

1. Use of anoscilloscope.
2. CRO as a versatile measuringdevice.
3. Circuit tracing of Laboratory electronicequipment,
4. Use of Digital multimeter/VTVM for measuringvoltages
5. Circuit tracing of Laboratory electronicequipment,
6. Winding a coil /transformer.
7. Study the layout of receivercircuit.
8. Trouble shooting acircuit
9. Balancing ofbridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage acrossalowresistanceandhighresistance.
2. To observe the limitations of a multimeter for measuring highfrequency voltage andcurrents.
3. To measure Q of a coil and its dependence on frequency, using a Q-meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequencycounter.
6. Measurement of rise, fall and delay times using aCRO.
7. MeasurementofdistortionofaRFsignalgeneratorusingdistortionfactor meter.
8. MeasurementofR,LandCusingaLCRbridge/universalbridge.

Open Ended Experiments:

1. Using a Dual TraceOscilloscope
2. Convertingtherangeofagivenmeasuringinstrument(voltmeter,ammeter)

More emphasis should be given on hands-on experiments.

Reference Books for Practical papers

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop(Asia PublishingHouse)
2. Practical Physics-B.B.Swain (KitabMahal)
3. Practical Physics-B.Ghosh (Vol. I andII)
4. Alaboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal (VaniPublication)
5. B.Sc. Practical Physics- C.L.Arora (S.ChandPublishing)
6. B.Sc. Practical Physics H. Singh and P.S. Hemne (S. ChandPublishing)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	5	5	4	5	2	4	4	2	5
CO2	4	5	2	5	2	5	2	2	5	5
CO3	4	5	4	5	4	5	5	4	5	5
CO4	2	2	5	2	5	4	5	4	5	5

- Note related: 1
- From What Related: 2
- Nutral: 3
- Moderately Related: 4
- Highly Related: 5