3 Yr. Degree Course
(One Major & Two Minor)
based on NEP-2020
PHYSICS

(Effective from Session 2025-26)

(Batch: 2025-2028)

SAMBALPUR UNIVERSITY

JYOTI-VIHAR, BURLA, SAMBALPUR, ODISHA-768019

COURSE AT A GLANCE (NEP-UG)

SUBJECT: PHYSICS *ACADEMIC SESSION:* **2025-28**

CORE-I COURSE

Course Number	Semester	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I	MATHEMATICAL PHYSICS -1	P	4	100
Paper-II		MECHANICS	P	4	100
Paper-III	II	ELECTRICITY AND MAGNETISIM	P	4	100
Paper-IV		MATHEMATICAL PHYSICS -2	P	4	100
Paper-V	III	WAVES AND OPTICS	P	4	100
Paper-VI		MATHEMATICAL PHYSICS-3	P	4	100
Paper-VII		THERMAL PHYSICS	P	4	100
Paper-VIII	IV	ANALOG SYSTEMS	P	4	100
Paper-IX		BASIC INSTRUMENTATIONS	P	4	100
Paper-X		NUCLEAR AND PARTICLE PHYSICS	P	4	100
Paper-XI	V	DIGITAL SYSTEM	P	4	100
Paper-XII		QUATUM MECHANICS AND APPLICATIONS	P	4	100
Paper-XIII		SOLID STATE PHYSICS	P	4	100
Paper-XIV	VI	ELECTRO- MAGNETIC THEORY	P	4	100
Paper-XV		STATISTICAL PHYSICS	P	4	100
Paper-XVI	VII	MATHEMATICALS METHODS IN PHYSICS		4	100
Paper-XVII		CLASSICAL MECHANICS		4	100
Paper-XVIII		QUANTUM MECHANICS- I		4	100
Paper-XIX		COMPUTATIONAL PHYSICS LAB		4	100
Paper-XX	VIII	CLASSICAL ELECTRO DYNAMICS		4	100
Paper-XXI		QUANTUM MECHANICS 2		4	100
Paper-XXII		ELECTRONICS		4	100
Paper-XXIII		OPTICS AND MODERN PHYSICS LAB		4	100

CORE-II/CORE-III COURSE

Course Number	Semester Core-II/ Core-III	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I/II	MECHANICS	P	4	100
Paper-II	III/IV	ELECTICITY AND MAGNETISIM	P	4	100

Paper-III	V/VI	WAVES AND OPTICS	P	4	100
Paper-IV	VII	ANALOG SYSTEM	P	4	100
Paper-V	VIII	DIGITAL SYSTEM	P	4	100

OTHER COURSES

MULTIDISCIPLINARY COURSES (MDC)UNDER NEP-2020

Three courses to be chosen from **baskets of Multidisciplinary courses** for Semester-I/II/III with 3 credits each. Students are advised to choose one course/ Semester from the basket provided. Students are advised to opt for courses outside their discipline. No repetition of courses allowed.

(Ref: University Letter No-3177/Acd. – I, Dated: 15. 07. 2025 & Letter No.3993/Acd-I Dated: 02.09.2025)

SEMESTER: I

Course No.	Semester	Dept. to Teach	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	Semester-I	Chemistry	Environmental Chemistry	NP	3	100
		Botany	Gardening and Vermicomposting	NP	3	100
		Economics	Economics in Everyday Life	NP	3	100
		History	History of Education in Modern India	NP	3	100
		Odia	Tulanatmak Sahitya	NP	3	100
		Pol. Sc.	Political Process in India	NP	3	100
		English	Ethical Literature	NP	3	100
		Commerce	Financial Literacy	NP	3	100
		Education	Educational Psychology	NP	3	100

SEMESTER: II

Course No.	Semester	Dept. to Teach	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-II	Semester-II	Statistics	Survival Analysis and Biostatistics	NP	3	100
		Zoology	Apiculture	NP	3	100
		Education	Gender and Education	NP	3	100
		Geography/Geology	Climatology	NP	3	100
		Philosophy	Vedic Culture	NP	3	100
		Hindi	Vigyapan Avadharana Aur Prayojanmulak Aayam	NP	3	100
		Home Science	Food Science and Processing	NP	3	100
		Commerce	Fundamentals of Entrepreneurship and E-Commerce	NP	3	100
		Economics	Demography	NP	3	100

SEMESTER: III

Course No.	Semester	Dept. to Teach	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-III	Semester-III	Mathematics/Computer Science	Programming in C++	NP	3	100
		Physics	Introduction to Spectroscopy	NP	3	100
		History	Indian Knowledge System	NP	3	100
		Pol. Sc.	Human Rights	NP	3	100
		Sociology	Environmental Issues and Challenges	NP	3	100
		Commerce	Entrepreneurship Development and Start-up	NP	3	100
		Psychology	Health psychology	NP	3	100
		Sanskrit	Philosophy of Bhagavad Gita	NP	3	100

		Botany	Herbarium Preparation	NP	3	100

ABILITY ENHANCEMENT COURSE(AEC) UNDER NEP-2020

Sl. No.	Semester	Course	Credit hour (CH)	Full Mark
Paper-I	I	Odia/Hindi/Sanskrit/Urdu	4	100
Paper-II	II	English	4	100

SKILL ENHANCEMENT COURSES (SEC) UNDER NEP-2020

Three courses to be chosen from the **baskets of SEC** for Semester-II/V/VI respectively with 3 credits each. Student can opt any one of SEC courses in a particular semester from the basket without repetition.

(Ref: University Letter No-3177/Acd. – I, Dated: 15. 07. 2025) NB: All courses are non-practical (NP) papers.

Sl. No.	Semester	Course title	Credit hour (CH)	Marks
Paper-I	II	Personality Development Or Election studies and public opinion Or Quantitative and Logical Thinking Or Analytical Thinking and Logical Reasoning Or Renewable Energy & Energy Harvesting Or Vermicomposting	3	100
Paper-II	V	Yoga in Everyday Life Or Basics of Museum and Achieves Or Working with Communities Or Fundamentals of data science and data management Or Quantitative and Logical Thinking Or Programming With Mathematica	3	100

Paper-III	VI	Life Skill Education Or Quantitative and Logical Thinking Or Income Tax E-return Filing Or Organic Farming Or Biofertilizer Or Type Setting in Latex	3	100

VALUE AIDED COURSES (VAC) UNDER NEP – 2020

(*Ref: University Letter No-3177/Acd. – I, Dated: 15. 07. 2025)*

Sl No	Semester	Paper	Course title	Credit	Marks
Paper-I	I	PAPER I	Environmental Studies and Disaster Management	3	100
Paper-I	III	PAPER II	Ethics & Values	3	100
Paper-I	V	PAPER III	Understanding Odisha	3	100
Paper-I	VI	PAPER IV	Creative Writing	3	100

SUMMER VOCATIONAL COURSE UNDER NEP – 2020

Semester	Course Code	Course Name	Credit	Full Marks
II		Fundamental of Horticulture	4	100
IV		Nursery Management	4	100

Contents

*(Students may choose vocational courses after 2nd Semester and 4th Semester for Certificate Course or Diploma Course respectively with 4 credit each, **to opt for exit**. Student have to pay additional fees for the purpose as specified by the course provider.)*

Community Engagement & Services / Field Work/ Internship----------

(Students have to engage in a field- based learning/Internship under the guidance of an external entity in Semester-IV.)

UG Programme in Physics

Programme Outcomes:

The Undergraduate Programme in Physics is designed to result in:

PO1:	Acquire adequate knowledge of the subject
PO2:	Craft a foundation for higher learning
PO3:	Be initiated into the basics of research
PO4:	Imbibe sound moral and ethical values
PO5:	Become conscious of environmental and societal responsibilities
PO6:	Attain skills for communication and career
PO7:	Learn to tolerate diverse ideas and different points of view
PO8:	Become empowered to face the challenges of the changing universe

Course Outcomes

1: Understand the basic concepts of methodology of science and the fundamentals of mechanics, properties of matter and electrodynamics, Mathematical Physics.
2: Understand the theoretical basis of Mathematical Physics, quantum mechanics, relativistic physics, nuclear physics, optics, spectroscopy, solid state physics, astrophysics, statistical physics, photonics and thermodynamics
3: Understand and apply the concepts of electronics in the designing of different analog and digital circuits
4: Understand the basics of computer programming and numerical analysis
5: Apply and verify theoretical concepts through laboratory experiments

Physics Basket (Core-I)

Semester	Four Year Hons. Without Research	Four Year Hons. With Research	Three Year Degree Course with single Major and Two Minor	Three Year Degree Course with Double Major	Three Year Degree Course with three Core without Major
I	1. (Mathematica Physics-1) 2. (Mechanics)	1. (Mathematical Physics-1) 2. (Mechanics)	1. (Mathematical Physics-1) 2. (Mechanics)	1. (Mathematic al Physics-1) 2. (Mechanics)	1. (Mathematical Physics- 1)
II	3. (Electricity and Magnetism) 4. (MathematicalPhysics-2)	3. (Electricity and Magnetism) 4. (MathematicalPhysics-2)	3. (Electricity and Magnetism) 4. (MathematicalPhysics-2)	3. (Electricity and Magnetism) 4. (MathematicalPhysics-2)	2. (Mechanics)
III	5. (Wave and Optics) 6. (Mathematical-Physics-3) 7. (Thermal Physics)	5. (Wave and Optics) 6. (Mathematical-Physics-3) 7. (Thermal Physics)	5. (Wave and Optics) 6. (Mathematical-Physics-3) 7. (Thermal Physics)	5. (Wave and Optics) 6. (Mathematical-Physics- 3) 7. (Thermal Physics)	3. Quantum Mechanics and aplications 4. Electricity and Magnetism
IV	8. (Analog System) 9. Basic Instrumentation 10. Nuclear and Particle Physics	8. (Analog System) 9. Basic Instrumentation 10. Nuclear and Particle Physics	8. (Analog System) 9. Basic Instrumentation 10. Nuclear and Particle Physics	8. (Analog System) 9. Basic Instrumentation 10. Nuclear and Particle Physics	5. Analog Electronics System

V	11. Digital System 12. Quantum Mechanics and Applications 13. Solid State Physics	11. Digital System 12. Quantum Mechanicsand Applications 13. Solid State Physics	11. Digital System 12. Quantum Mechanics and Applications 13. Solid State Physics	11. Digital System 12. Quantum Mechanics and Applications 13. Solid State Physics	6. Wave and Optics
VI	14. Electro-Magnetic Theory 15. Statistical Physics	14. Electro-Magnetic Theory 15. Statistical Physics	14. Electro-Magnetic Theory 15. Statistical Physics	14. Electro-Magnetic Theory 15. Statistical Physics	7. Solid State Physics
VII	16. Mathematical Methods in Physics 17. Classical Mechanics 18. Quantum Mechanics 1 19. Computational Physics Lab	16. Classical Mechanics 17. Quantum Mechanics 1 18. Computational Physics Lab			
VIII	20. Classical Electrodynamics 21. Quantum Mechanics 2 22. Electronics 23. Optics and Modern Physics Lab	19. Classical Electrodynami cs 20. Optics and Modern Physics Lab			
Total	23X4=92	20X4=80	15X4=60	15X4=60	7X4=28

Note:

One credit is equivalent to one hour of lecture or tutorials or two hours of practical work/field work per week in a semester. One Credit will be generally equivalent to 15 hours of

instructions.

Each semester shall comprise of 15 weeks of academic activities with a minimum of 90 working days.

Credit for different classes			
Credit	**Theory**	**Tutorial**	**Practical/Field**
1	1 Hour	1 Hour	2 Hours

OUTLINE OF SYLLABUS

Physics

Three Year Degree Course with Single Major and Two Minors

Semest er	Core-I	Core-II	Core-III	Multi-disciplinary	AEC	SEC	VAC	Community Engagement & Services / Field Work/ Internship	Total Minimum Credit
I	2X4=8 Mathematical Physics-1 Mechanics	1X4=4 Mechanics		1X3=3	1X4=4 Odia/Hindi/ Sanskrit/Urdu		1X3=3 Environmental Studies and Disaster Management		22
II	2X4=8 Electricity and Magnetism MathematicalPhysics-2		1X4=4 Electricity and Magnetism	1X3=3	1X4=4 English	1X3=3 Renewable Energy and Energy Harvesting			22
***Vocational Course 1: Fundamental of Horticulture (4 Credits)**									**44**

III	3X4=12 Waves and Optics Mathematical-Physics-3 Thermal Physics	1x4=4 Waves and Optics		1x3=3			1x3=3 Ethics & Values		22
IV	3X4=12 .Analog System Basic Instrumentation Nuclear and Particle Physics		1x4=4 Analog System					1x4=4 (Field Work / Internship)	20
***Vocational Course 2: Nursery Management (4 Credits)**									**42**
V	3X4=12 .Digital System Quantum Mechanics and Applications Solid State Physics	1x4=4 Digital System				1x3=3	1x3=3		22
VI	2X4=8 Electromagnetic Theory Statistical Physics		1X4=4 Electromagnetic Theory			1X3=3	1x3=3		18
									40
Total	15X4=60	3X4=12	3X4=12	3X3=9	2X4=8	3X3=9	4X3=12	1X4=4	**126**

In case a student opts for NCC and clears 'C' certificate additional 16 credits shall be awarded and total credit shall be 126+16 = 142 credits

***Vocational Course:**

After 2nd Semester: **Fundamental of Horticulture**

After 4th Semester: **Nursery Management**

(Students may choose vocational courses after 2nd Semester and 4 th Semester for Certificate Course or Diploma Course respectively with 4 credit each opt for exit. Student have to pay additional fees for the purpose as specified by the course provider.)

In case a student opts for NCC and clears 'C' certificate additional 16 credits shall be awarded and total credit shall be 126+16 = 142 credits

***Vocational Course:**

After 2nd Semester: **Fundamental of Horticulture**

After 4th Semester: **Nursery Management**

(Students may choose vocational courses after 2nd Semester and 4 th Semester for Certificate Course or Diploma Course respectively with 4 credit each opt for exit. Student have to pay additional fees for the purpose as specified by the course provider.)

SYLLABUS OF UG PHYSICS (MAJOR) UNDER NEP-2020 CORE COURSE - I

PAPER-I SEMESTER – I

MATHEMATICAL PHYSICS-I

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30hrs)

CO1 Basic understanding of Differential equations and their solutions, conceptual understanding of calculus.

CO2 Basic understanding of vector calculus and its differentiation.

CO3 Use of vector calculus to understand vector integration. Dirac delta function and its properties.

CO4 Understanding of orthogonal curvilinear coordinates and its application in vector differentiation.

CO5 To Understand the basic algorithm in application to functional algebra and error analysis.

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.

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

UNIT-II

Vector algebra: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities. **UNIT-III**

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infitesimal 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) **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

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 in cylindrical and spherical coordinate system.

Text books:

1. Mathematical Methods for Physicists, 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

4. Mathematical Physics, Satya Prakash (Sultan Chand)

5. Mathematical Physics, B. D. Gupta (4th edition, Vikas Publication)

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

7. Mathematical Physics – H.K. Das, Dr. Rama Verma (S. Chand Publishing)

8. Mathematical Physics, B.S. Rajput, (Pragati Prakashan

CORE –I: PAPER-I

LAB: Credit-1

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

- Evaluation done 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 in terms 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 andFundamentals data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data format- ting, Control statements (decision making and looping statements) (If Statement, Ifelse Statement, NestedIfstructure, ElseIfStatement, Ternaryoperator, Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. DoWhile 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 ofπ.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++.J.Hubbard, 2000, Mc Graw–Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K. E. Atkinson, 3 rd Edn. , 2007 , Wiley India Edition.
6. Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier Dover Pub.
7. An Introduction to computational Physics, T.Pang,2ndEdn., 2006,Cam- bridge Un

PAPER-II **SEMESTER – I**

MECHANICS:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30hrs)

CO-1 To Learn the basic concepts of Rigid body dynamics, Radius of Gyration, Moment of Inertia, Non-Inertial Systems

CO-2 To Understand the concept of Elasticity, Fluid motion and Types of Vibration

CO-3 To understand the concept of Newtonian theory through Gravitation, Central force motion, Keplar's laws, GPS

CO-4 To learn the concept of Special theory of Relativity, Michelson- Morley experiment, Lorentz transformation, Relativistic Doppler effect.

CO-5 Apply the basic concepts of Mechanics in experiments.

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, Euler's 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.

UNIT-II

Oscillations:

Damped oscillation. Equation of motion and solution (cases of oscillatory, critically damped and overdamped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor, Bar Pendulum, Katers Pendulum

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

Viscosity: 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, Kepler's Laws of Planetary motion, Satellites. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

UNIT-IV

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, Massless 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. Introduc tion 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)
8. Classical Mechanics, Gupta Kumar & Sharama, (Pragati Prakashan)
9. Classical Mechanics, J.C. Upadhyaya, (Himalaya Publishing Home)

CORE –I: PAPER-II

LAB: Credit-1

(Minimum 4 experiments are to be done):

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 Maxwell's needle.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text ook of Practical Physics, I. Prakash and Ramakrishna, 11thEdn, 2011, Kitab Mahal

PAPER-III SEMESTER – II

ELECTRICITY AND MAGNETISM:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30hrs)

CO-1 To understand the basic concepts of Electricity and Magnetism

CO-2 To Understand the various phenomena in Electricity and Magnetism

CO-3 To Understand Circuit analysis and network theorems

CO-4 To Explain the Dynamics of Charged Particles

CO-5 To Apply the acquired knowledge in Experiment.

UNIT-1

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, Laplace 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, Conductors in an electrostatic Field, Surface charge and force on a conductor.

UNIT-II

Magnetic Field: Magnetic Force, Lorentz Force, Biot Savarts Law, Cur- rent 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 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 Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallel plate, spherical, cylindrical) 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, Lenz's Law, Self -Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's 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: Kirchoff's law for electrical circuits, Ideal Constant-voltage and Constantcurrent 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. F eynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands
5. (Pearson)
6. Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press)
7. Classical Electromagnetism, H.C.Verma, Bharati Bhawan

CORE –I: PAPER-III

LAB: Credit-1

(Minimum 4 experiments are to be done):

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 Bridge.
4. To compare capacitances using DeSauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton 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) Reso- nant 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)
10. Anti-resonance 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

PAPER-IV SEMESTER – II

MATHEMATICAL PHYSICS-II:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h

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.

CO-1: Conceptual understanding of Fourier series and its application in periodic function.

CO-2: Understanding the various special functions and its properties.

CO-3: Understanding various polynomials and special integrations.

CO-4: To learn the applications of partial differential equation.
CO-5: To apply the acquired knowledge to solve problems.

UNIT-I

Fourier Series-I: Periodic functions, Orthogonality 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 Bessel's and Laguerre Equations, Frobenius method and its applications to differential equations: Bessel, Legendre and Hermite Differential Equations, Legendre and Hermite Polynomials: Rodrigues Formula, G enerating 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. Spherical Bessel's Function (1st and 2nd kind).

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. Mathematical Methods for Physicists, 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 Hall India)
4. Complex Variable: 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, Vikas Publication)
8. Mathematical Physics, B.S.Rajput, Pragati Prakashan

CORE –I: PAPER-IV
LAB: Credit-1

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 electric circuits (3meshes), Solution of coupled spring mass systems (3meshes).

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

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

- Classical equations of motion

Second order Differential Equation

- Harmonic oscillator (no friction)
- Damped Harmonic oscillator
- Overdamped
- Critical damped
- Oscillatory
- Forced Harmonic oscillator
- Transient and Steady state solution
- Apply above to LCR circuits also

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.FRiley, M. P. Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge University Press.
2. Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press.
3. First course in complex analysis with applications, D.G.Zill and P.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 free software to Matlab):H. Ramchandran, A.S.Nair.2011S.Chand and Company
7. Scilab Image Processing: Lambert M. Surhone. 2010 Beta script Publishing.

PAPER-V SEMESTER – III

WAVE AND OPTICS:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1 Basic understanding ofpropagation of light, its application and wave nature.

CO-2 To Understand the concepts of wave motion.

CO-3 To Understand the concepts of interference and its application.

CO-4 To Understand the concepts of diffraction and its application.

CO-5 To Apply the acquired knowledge of optics in Experiment

UNIT - I

Geometrical optics: Fermat's 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 Spatial Coherence.

UNIT - 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 Trans- port, 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 Harmonic waves.

UNIT- III

Interference: Division of amplitude and wave front, Young's 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), Newton's Rings: Measurement of wavelength and refractive index. Interferometer : Michelson's Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of fringes, Fabry-Perot interferometer.

UNIT - IV

Fraunhoffer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions, Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, as lit and a wire.

Text Books:

1. A text book of Optics N. Subhramanyam and BrijLal (S.Chand Publishing)
2. Optics - Ajoy Ghatak (McGraw Hill)

Reference Books:

1. Optics- E. Hecht (Pearson)
2. Fundamentals of Optics-F. A. Jenkins and H. E. White(McGraw-Hill)
3. Geometrical and Physical Optics R.S. Longhurst (Orient Blackswan)
4. The Physics of Vibrations and Waves- H. J. Pain (John Wiley)
5. Optics P. K. Chakraborty.
6. Principles of Optics-Max Born and Emil Wolf (Pergamon Press)
7. The Physics of Waves and Oscillations-N. K. Bajaj (Mc Graw Hill

CORE –I: PAPER-V

LAB: Credit-1

(Minimum 5 experiments are to be done)

1. To determine the frequency of an electric tuning fork by Melde' s experiment and verify 2-T law.
2. To plot the I-D curve and to determine the refractive index of a prism
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 Newton' s Rings.
6. To determine wavelength of (1) Na source and (2) spectral lines of Hgsource using plane diffraction grating.
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, 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

PAPER-VI SEMESTER – III

MATHEMATICAL PHYSICS-III

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h CO-

1 :Understanding and application of Complex function variables.

CO-2:Understanding the concept of Fourier Integral transform.

CO-3:To Understand the properties and application of Fourier integral transformation. CO-4:To

Understand the properties and application of Laplace integral transformation.

CO-5:To Apply the acquired knowledge to solve problems.

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation

Euler's 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, Fourier Transform of trigonometric, Gaussian, finite wave train and other functions, Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse Fourier Transform.

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, 7thEdn., Elsevier)
2. Advanced Engineering Mathematics, ErwinKreyszig (WileyIndia)

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 Hall India)
4. Complex• Variable: Schaum's Outlines Series M. Spiegel (2nd Edition, Mc- Graw 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 (4thedition,VikasPublication)
8. Mathematical Physics B.S.Rajput, Pragati Prakashan
9. Mathematical physics-III, (University Physics), Dr. Ranjan Kumar Bhuyan, Himalaya Publishing House

CORE –I: PAPER-VI

LAB: Credit-1

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

. Solve $\frac{dy}{dx} = e^{-x}$ with $y(x = 0) = 0$ simple differential equations like:

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

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

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

Direct Delta Function:

Evaluate , for σ $\int_{-3}^{3} dx \frac{x=3}{\sqrt{2\pi a^2}} e^{-\frac{(x-2)^2}{2\sigma^2}}$ = 0. 1, 0.01, 0.001 and show that it tends to 5.

Fourier Series:

Program to sum; evaluate the Fourier Coefficients of a given periodic function (Square Wave)

Frobenius Method and Special Functions:

$$\int_{-1}^{1} d\mu \; P_n\mu \, P_m\mu = \frac{2}{2n+1}\delta_{m,n}$$

Plot $P_n(x)$, 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 semesters (choose any two)

. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer Programme.

. Evaluation of trigonometric functions e.g. SinΘ, Given Bessel's function at N points, find its value at an intermediate point.

Complex analysis: Calculate $\int \frac{dx}{x^2+2}$ and check it with computer integration.

. Integral transform: FFT of e^{-x}

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. Denneryand A.Krzywicki, 1967, Dover Publications.
3. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB:

Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C.V. Fernndez. 2014 Springer ISBN: 978-3319067896

4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

5. S ilab (AfreesoftwaretoMatlab): H.Ramchandran, A.S.Nair.2011 S.Chand And Company, Scilab Image Processing: Lambert M. Surhone. 2010 Betas cript Publishing.

PAPER-VII SEMESTER – III

THERMAL PHYSICS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1: Basic understanding of thermodynamics and various thermal variables.

CO-2: Understanding various thermodynamics potential applications and their properties.

CO-3: To Understand the concepts of ideal gas and its thermal properties.

CO-4: To Understand the concepts of real gas and its thermal properties.

CO-5: To Apply the acquired knowledge of thermodynamics in Experiments

UNIT-I

Introduction to Thermodynamics Recapitulation of Zeroth and First law of thermodynamics,

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-Planck and Clausius Statements and their Equivalence, Carnot's 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 Carnot's Cycle, Third Law of Thermodynamics, Unattainability of Absolute Zero.

UNIT-II

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables. Internal

Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy, Their Definitions, Properties and Applications, Surface 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 between *Cp and Cv (*3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and. Vander Waal Gases (5) Energy equations (6) Change of Temperature during Adiabatic Process.

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, Kinetic Theory and Statistical Thermodynamics- Sears and Salinger (Narosa)
3. A Treatise on Heat- Meghnad Saha and B.N. Srivastava (The Indian Press) Heat, and 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)
5. Heat, Thermodynamics and statistical physics, Brijlal, Subhramanyam andHemne, S.Chand Publication.

CORE –I: PAPER-VII

LAB: Credit-1

(Minimum 5 experiments are to be done)

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. 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.

PAPER-VIII SEMESTER – IV

ANALOG SYSTEMS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1:Basic understanding of semiconductor diodes, devices and their applications.

CO-2 :To Understand the basic concepts in transistors and amplifiers.

CO-3:To Understand the concept of coupled amplifier and its application in feedback circuit.

CO-4:To Understand the concepts of operational amplifier and its application. CO-5:To Apply the acquired knowledge of electronic circuits in Experiments.

UNIT-1

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-wave Rectifiers. center- tapped and bridge type Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, L and C Filters (2) Zener Diode and Voltage Regulation, Principle and structure of LEDS, 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.

UNIT-III

Classification of class A, B and C amplifiers, Push-pull amplifier (classB).

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 criterian 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.

Applications 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 bridgeoscillator.

Text Books:

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

Reference Books:

1. Electronic devices and circuits R. L. Boylstad(PearsonIndia)

2. Electronic Principles- A.P.Malvino (Tata McGrawHill)
3. Principles of Electronics- V. K. Mehta and Rohit Mehta (S. Chand Pub- lication)
4. OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (PrenticeHall)
5. Physics of Semiconductor devices, DonaldANeamen(PrenticeHall)
6. Analog System and Application: Gupta Kumar, Pragati Prakashan

CORE –I: PAPER-VIII

LAB: Credit-1

(Minimum 5 experiments are to be done)

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. T o study the various biasing configurations of BJT for normal class A operation.
5. T o study the frequency response of voltage gain of a RC-coupled transistor amplifier.
6. To design a Wien bridge oscillator for given frequency using a non-amp.
7. To design a phase shift oscillator of given specifications using BJT.
8. To study the Colpitt's oscillator.

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.

PAPER-IX SEMESTER – IV

BASIC INSTRUMENTATION

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1: Conceptual understanding of different measurement of electronic circuit with measuring devices.

CO-2: Basic understanding of CRO and its applications.

CO-3: Basic understanding of signal generators and its analysis

CO-4.: Basic understanding of digital instruments and their applications.

CO-5: To Apply the acquired knowledge of different electronic measurement-based instruments in Experiments

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 (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.

AC milli voltmeter: Type of AC milli voltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac milli voltmeter, 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.

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

Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

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, wave analysis.

UNIT-IV

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.Chand Publishing)
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)

CORE –I: PAPER-IX

LAB: Credit-1

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

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment.
4. Use of Digital multimeter/VTVM for measuring voltages.
5. Circuit tracing of Laboratory electronic equipment.
6. Winding a coil /transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit.
9. Balancing of bridges.

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.

2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
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/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. MeasurementofdistortionofaRFsignalgeneratorusingdistortionfactor meter.
8. Measurement of R, L and C using a LCR bridge/universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter) More emphasis should be given on hands-on experiments.

Additional Reference Books for Practical papers:

1. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop (Asia Publishing House)
2. Practical Physics-B.B. Swain (Kitab Mahal)
3. Practical Physics-B. Ghosh (Vol. I and II)
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal (Vani Publication)
5. B. Sc. Practical Physics- C. L. Arora (S. Chand Publishing)
6. B.Sc. Practical Physics H. Singh and P.S. Hemne (S. Chand Publishing)

PAPER-X

SEMESTER – IV

NUCLEAR AND PARTICLE PHYSICS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h CO-1: Understanding the properties of atoms in electric and magnetic field.

CO-2: Understanding the concept Nuclear physics.

CO-3: Conceptual understanding nuclear models and nuclear reactions.

CO-4: Conceptual understanding of particle physics.

CO-5: To Apply the acquired knowledge in conducting the experiments.

UNIT- I

Atoms in Electric and Magnetic Fields: Electron angular momentum. Space quantization,

Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin 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 Magnetron. Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect, Paschen back and StarkEffect (qualitative Discussion only).

UNIT- II

Nuclear Physics- : Nuclear composition, charge, size, shape, mass and density of the nucleus;

Nuclear angular momentum; Nuclear magnetic dipole moment; Electric quadrupole moment; Mass defect; Packing fraction and Binding energy; Stability of nuclei (N vs Z curve), Binding e nergy curve. semi empirical mass formula; Nuclear Forces: General concept of nuclear force; Yukawa Meson field theory of nuclear forces; Properties of Nuclear forces.

Radioactive disintegration; Properties of alpha, beta, gamma rays; law of radioactive decay; successive radioactive decay; radioactive equilibrium; Radioisotopes; application of radioactivity (Agriculture, Medicinal, Industrial and Archaeological).

UNIT-III

Nuclear models: Liquid Drop model; Shell model; magic number in the nucleus; Alpha decay: Alpha particles spectra; Gamow's theory of Alpha decay; Beta decay: Shape of Beta ray spectrum; Explanation of Beta decay on the basis of Neutrino and Antineutrino hypothesis; Fermi theory of Beta decay; Selection rules; Gamma ray emission,

Nuclear reactions: Kinds of Nuclear reactions; Nuclear reaction kinematics; Q -value; Compound Nucleus and concept of direct reactions; Conservation laws; Nuclear reaction cross - sections. Nuclear energy: Nuclear Fission; Chain reaction and Critical Mass; Nuclear Reactors and its basic components; Nuclear Fusion; Condition for the maintained Fusion reactions; Energy production in stars; Fusion reaction in Sun, Principle of atomic bomb and hydrogen bomb.

UNIT-IV

Particle Physics

Classification of particles-antiparticles and their interactions; Conservation laws; Charges;

Isospin; Baryon number; Lepton number; Strangeness; Hyper charge; Parity; Charge conjugation; CPT theorem; Conservation laws; Quark as the building blocks of Hadrons; Quark Model; Colour degree of freedom, Symmetry Classification of elementary particles; Higgs Boson Particle (God particle), elementary idea on Large Hadron collider (LHC), The future of universe, Dark matter and dark energy.

Text Books:

1. Concepts of Modern Physics Arthur Beiser (Mc Graw Hill)
2. Modern Physics Murugeshan and Sivaprasad (S.Chand)
3. Cohen B. L., "Concepts of Nuclear Physics", McGraw Hill Education.
4. Tayal D. C., "Nuclear Physics", Himalaya Publishing House.
5. Patel S. B., "Nuclear Physics: An Introduction", New Age International Publishers.
6. Singh Jahan, "Fundamental of Nuclear Physics", Pragati Publications

Reference Books:

1. Quantum Mechanics: Theory and Applications, A.K. Ghatakand S. Lokanathan, (Macmillan)
2. Introduction to Quantum Theory, David Park (DoverPublications)
3. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin- (Tata McGraw-Hill)
4. Modern Physics-Serway (CENGAGE Learnings)
5. Physics of Atoms and Molecules Bransden and Joachim (Pearson India)
6. Atomic and Nuclear Physics-A.B.Gupta (NewCentral)
7. Theoretical Nuclear Physics, J.M.Blatt and V.F. Weisskopf (Springer)

CORE –I: PAPER-X

LAB: Credit-1

(Minimum 4 experiments are to be done)

1. Study of photoelectric effect.
2. Basics of GM counter characteristics and counting statistics.
3. Study of Gamma ray spectroscopy by SCA and MCA.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

6. 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

PAPER-XI SEMESTER – V

DIGITAL SYSTEMS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1: To Understand IC's and scales of Integration, Digital Circuits and their realization, Applications

CO-2: Build strong knowledge about Boolean Algebra, Truth tables, Equivalent Circuits, Theory and application of CRO.

CO-3: Gain a clear understanding of Data processing circuits, Arithmetic Circuits, different types of Timers: IC 555

CO-4: To Explain the knowledge of computer organization, Shift registers and counters.

CO-5: To Apply the acquired knowledge to realize various types of circuits in experiment

UNIT-1

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 Morgan's Theorems: Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms and Maxterms, Conversion of truth table into Karnaugh Map and SOP and POS simplification. Universal logic implementation (NAND & NOR).

UNIT-III

Data Processing Circuits: Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoder **Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2s complement. Half and Full Adders. Half and Full Subtractors, 4-bit binary Adder/Subtractor.

Timers: IC555: 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 Interfacin g, 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 (Tata Mc Graw)

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)
4. Digital Logic and Computer design M. Morris Mano (Pearson)
5. Concepts of Electronics D. C. Tayal (Himalaya Publishing house)
6. Digital System and Application, Gupta Kumar, Pragati Prakashan

CORE –I: PAPER-XI

LAB: Credit-1

(Minimum 6 experiments are to be done)

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO and to test a Diode and Transistor using a Millimeter.
2. To design a switch (NOT gate) using a transistor.
3. To verify and design AND, OR, NOT and XOR gates using NAN Dgates.
4. Half Adder, Full Adder and 4-bit binary Adder.
5. Half Subtractor, Full Subtractor, Adder-Subtractor using Full AdderI.C.
6. To build Flip-Flop (RS, Clocked-RS, D-type and JK) circuits using NAND gates.

7. To design an astable multi vibrator of given specifications using 555Timer.
8. To design a mono stable multi vibrator of given specifications using 555 Timer.

Reference Books:

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

PAPER-XII SEMESTER – V

QUANTUM MECHANICS AND APPLICATIONS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h

CO-1: To understand Properties and physical interpretation of wave function and its application, knowledge in probability current density, significance of momentum space transformation and time dependent Schrödinger equation.

CO-2: To explain Time independent Schrödinger equation, Eigen value, Eigen function, generalized solution of stationary states, knowledge in wave function and discrete energy level. CO-3: Basic knowledge in quantum mechanical operators, Eigen value and Eigen function, Uncertainty relation and Gaussian wave packet.
CO-4: Acquire the knowledge in application of Schrödinger equation in different potential barriers, concept of simple harmonic oscillator.

CO-5: Apply the acquired knowledge to solve various numerical problems.

UNIT- I

Schrodinger equation: Time dependent Schrodinger equation, Properties of Wave Function, Physical interpretation of wave function, Wave function of a free particle, Normalization, Probability current and probability current densities in three dimensions, Linearity and Superposition Principle, Wave Packet, Fourier Transform Theorem, Momentum space wave function and its significance, Representation of position vector in momentum space. Schrodinger equation in momentum space.

UNIT-II

Time Independent Schrodinger equation in 1-D, 2-D and 3-D, 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.

UNIT-III

Operators: Operators, Commutator Algebra, Position, Momentum, Angular Momentum and Energy operators, Hermitian Operators, Expectation Value, Expectation values of position and momentum, Ehrenfest Theorem, Eigenvalues and Eigenfunctions of Hermitian Operator, Energy Eigen Spectrum,

Degeneracy, Orthonormality of Eigen functions, Linear Dependance, Orthogonalisation, Uncertainty Relation- Uncertainty product, minimum uncertainty wave packet- Gaussian Wave Packet.

UNIT-IV

Application to one dimensional problem- One dimensional infinitely rigid Box- Energy Eigen values and Eigen functions, normalization, quantum dot as an example, Quantum mechanical scattering and tunneling in one dimension across a Potential Step and Rectangular Potential Barrier, Finite Square well potential, Quantum mechanics of simple Harmonic Oscillator-Energy Levels and Energy Eigen functions, ground state, zero point energy.

Text Books:

1. Introduction to Quantum Theory David Park (DoverPublications)
2. Introduction to Quantum Theory, D. J. Griffiths(Pearson)
3. Quantum Mechanics: Concepts and applications, N.Zettili, Wiley

Reference Books *:*

1. Quantum Mechanics, Theory and applications A.Ghatak and S.Lokanathan (McMillanIndia)
2. Quantum Mechanics- G. Aruldhas (Printice Hall of India)
1. Quantum Physics–S. Gasiorowicz (Wiley)
2. Quantum Mechanics- G.R. Chatwal and S.K. Anand
3. Quantum Mechanics -J.L. Powell and B. Craseman (Narosa)
4. Introduction to Quantum Mechanics M.Das and P.K.Jena (Shri Krishna Publication).
5.

CORE –I: PAPER-XII

LAB: Credit-1

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 Schrodinger equation for the ground state and the first excited state ofthe Hydrogen atom:

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

Where, 'm' is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is

~ -13.6ev. Take e= 3.795 $\sqrt{(eV\text{Å})}$, ħc= 1973 (eV Å) and m=0.511 × 106 eV/c2.

2. Solve the S-Wave radial Schrodinger equation for an atom:

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

Where, 'm' is the reduced mass of the system (Which can be chosen to be the mass of an electron), for the screened coulomb potential: v $(r) = -\frac{e^2}{r}\ e^{-r/a}$

Find the energy (in eV) of the ground state of the atom to an accuracy of the significant digits.

Also; plot the corresponding wave function. Take e= 3.795 (evÅ) , ħc=

1973(eVÅ) and m=0.511

× 106 eV/c^2, and α =3Å, 5Å, 7Å. The ground state energy is expected to be above -12eV in all three cases.

3. Solve the S-Wave radial Schrodinger equation for a particle of mass m:

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

For the anharmonic Oscillator $(\mathrm{r}) = \frac{kr^2}{2} + \frac{br^3}{3}.$ potential: V

Find the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also,

plot the corresponding wave function. Choose m=940MeV/C^2 , k= 100MeV/fm2, b= (0,

10, 30) MeV/fm3. In these units, c = 197.3 MeV fm. [The ground state energy is expected to lie between 90 and 110 MeV for all three cases].

Solve the S-Wave radial Schrodinger equation for the vibrations of hydrogen molecule:

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

Where, 'm ' is the reduced mas of the two-atom system for the Morse potential

v ( )= D(e−2αr − e−αr)Where r = r-r0 .

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:

m = 940x10^6 ev/c^2, D = 0.755501ev, α = 1.44, r_0 = 0.131349Å m = 940x106ev/c^2, D =

0.755501ev, α = 1.44, r_0 = 0.131349Å

Laboratory based experiments:

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
2. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
3. To show the tunneling effect in tunnel diode using I-V characteristics.
4. Quantum efficiency of CCDs **Reference Books:**

1. Schaum's outline of Programming with C++.J. Hubbard, 2000, McGraw–Hill Publication
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Press etal., 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. Vande Wouwer, P. Saucez, C.V. Fernndez.2014 Springer.
5. Scilab (A Free Software to Matlab): H. Ramchandran, A. S. Nair. 2011 S. Chand and Co.
6. Scilab Image Processing: L.M.Surhone.2010 Beta script Publishing ISBN:9786133459274

PAPER-XIII SEMESTER – V

SOLID STATE PHYSICS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1: To understand the Concept of crystal structure and properties, X-ray Diffraction, Bragg's and Laue's condition.

CO-2: Conceptual understanding of Lattice vibration, Einstein and Debye specific heat theories of solids, knowledge in Band theory, Kroning-Penny model and Hall Effect.

CO-3: Understanding the Concept in magnetic and dielectric properties of materials.

CO-4: Basic knowledge on LASER and its generation, types. Conceptual understanding of superconductivity and its type, London's Equation, Penetration Depth and BCS theory. CO-5: To Apply the acquired knowledge in experiments.

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, Diffraction of X- rays by crystals, Bragg's Law, Laue's Condition, Atomic and Geometrical Factor.

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear, Monoatomic 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, *r* 3 Law.

Elementary band theory: Kroning-Penny model of band Gap, Conductor, Semiconductor (P and N type) and insulator, Conductivity of Semiconductor, mobility, Hall Effect, Measurement of conductivity (four probe method) and Hall Co- efficient.

UNIT-III

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferro- magnetic Materials, Classical

Langevins theory of dia and Paramagnetic Domains, Curies law, Weiss Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B- H Curve, Hysteresis and Energy Loss.

Dielectric Properties of Materials: Polarization Local Electrical Field at an Atom, Depolarization Field, Electric Susceptibility, Polarizability, Clausius Mosotti Equation, Classical theory of Electronic Polarizability.

UNIT-IV

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.

Superconductivity: ExperimentalResults, CriticalTemperature, Critical magnetic field,

Meissner effect, Type-I and Type-II Superconductors, London's Equation and Penetration Depth, Isotope effect, Idea of BCS theory (No derivation).

Text Books:

1. Introduction to Solid State Physics- Charles Kittel (WileyIndia)
2. LASERS: Fundamentals and Applications- Thyagarajan and Ghatak (McMillan India)

Reference Books:

1. Solid State Physics-N.W.Ashcroft and N.D.Mermin (Cengage)

2. Solid State Physics- R.K.Puri and V.K. Babbar (S.Chand Publication)
3. Solid State Physics S. O. Pillai (New Age Publication)
4. Lasers and Non-linear Optics B.B.Laud (Wile yEastern)
5. Elements of Solid State Physics-J.P. Srivastava (Prentice Hall of India)
6. Elementary Solid State Physic s-Ali Omar (Addison Wiley)
7. Solid State Physics, Gupta and Kumar, Pragati Prakashan.

CORE –I: PAPER-XIII
LAB: Credit-1

(Minimum 4 experiments are to be done)

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube- Method)
2. To measure the Magnetic susceptibility of Solids.
3. To measure the Dielectric Constant of a dielectric Materials with frequency
4. To determine the Hall coefficient of a semiconductor sample.
5. To draw the BH curve of Fe using solenoid and to determine the energy loss from Hysteresis
6. To measure the band gap of a given semiconductor by four-probe method.

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.

PAPER-XIV SEMESTER – VI

ELECTROMAGNETIC THEORY

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h

CO-1: Physical significance of Maxwell Equation and its application to free space, Lorentz and Coulomb gauge transformation, poynting theorem, concept of energy density.

CO-2: Analysis of Maxwell's equations in different media and Physical significance of relaxation time, skin depth, Electrical conductivity of ionized gases, plasma frequency.

CO-3: Basic understanding of polarization of EM wave, and different types of crystals, Phase Retardation Plates and Rotatory Polarization.

CO-4: Conceptual understanding of EMW application in bounded media, plane interface, dielectric media, Brewster's law, TIR, Evanescent wave, metallic reflection.

CO-5 :To Apply the acquired knowledge for visualize basic concept of phenomenon of light in various experiments

UNIT-I

Maxwell Equations: Maxwells equations, Displacement Current, Vector and Scalar Potentials, Gauge Transformations: Lorentz and Coulomb Gauge, Wave Equations, Plane Waves in free space and characteristics, Poynting Theorem and Poynting Vector, Electromagnetic (EM) Energy Density, Physical Concept of Electromagnetic Field Energy Density.

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance, Propagation through conducting media, relaxation time, skin depth,

Electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

UNIT-III

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization, uniaxial and biaxial crystals, light propagation in uniaxial crystal, double refr action, polarization by double refraction, Nicol Prism, Ordinary and extraordinary refractive indices, Production and detection of Plane, Circularly and Elliptically polarized l ight,

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.

UNIT IV

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media,

Reflection and Refraction of plane waves at plane interface between two dielectric media, Laws of

Reflection and Refraction, Fresnel's Formulae for perpendicular and parallel polarization cases, Brewster'slaw, Reflection and Transmission coefficients, Total internal reflection, evanescent waves, Metallic reflection (normal Incidence)

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths (Pearson)
2. Principles of Optics-Max Born and E. Wolf.

Reference Books :

1. Classical Electrodynamics by J.D.Jackson.
2. Foundation of electromagnetic theory: Ritz and Milford(Pearson).
3. Electricity and Magnetism : D C Tayal (Himalaya Publication)
4. Optics: A. K. Ghatak
5. Electricity and Magnetism : Chattopadhyaya, Rakhit (NewCentral)
6. Electromagnetic Theory, Gupta and Kumar, Pragati Prakashan

CORE –I: PAPER-XIV

LAB: Credit-1

Minimum 4 experiments are to be done):

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinets compensator.
4. . To determine the refractive index of liquid by total internal reflection using Wollastons air-film.
5. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
6. To study the polarization of light by reflection and determine the polarizing angle for air- glass interface.
7. To verify the Stefan's law of radiation and to determine Stefan's constant.
8. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

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

PAPER-XV SEMESTER – VI

STATISTICAL PHYICS

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30h)

CO-1: Understanding the concept of ensembles and its partition function, phase space and thermodynamic relations, MB distribution law .

CO-2: Conceptual understanding of addition of entropy, Sackur Tetrode equation, Law of equipartition of Energy and its application.

CO-3: Basic postulates and different distribution of Fermi and Dirac particles and B-E condensation.

CO-4: Basic knowledge in thermal and Black body radiation, Concept of different laws of radiation and their experimental verification.

CO-5: Apply the acquired knowledge for analyze the laws radiation and different distribution functions using computational analysis.

UNIT- I

Classical Statistics-I: Macro state and Microstate, Elementary Concept of Ensemble, Micro canonical, 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, Negative Temperature.

UNIT- III

Quantum Statistics: Identical particles, macro states and microstates, Fermions and Bosons, Bose Einstein distribution function and Fermi- Dirac distribution function. Bose- Einstein Condensation, Bose deviation from Planck's law, Effect of temperature on Fermi-Dirac distribution function, degenerate Fermi gas, Density of States Fermi energy.

UNIT-IV

Radiation: Properties of Thermal Radiation, Blackbody Radiation, Pure Temperature dependence, Kirchhoff's law, Stefan Boltzmann law: Thermodynamic proof, Radiation Pressure, Wein's Displacement law, Wien's distribution Law, Saha's Ionization Formula, Rayleigh Jeans Law, Ultra Violet catastrophe.

Planck's Law of Black body Radiation: Experimental verification, Deduction of (1) Wien's Distribution Law, (2) Rayleigh Jean's Law, (3) Stefan Boltzmann Law, (4) Wein's Displacement Law from Planck's Law.

Text Books:

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

Reference Books:

1. Statistical Mechanics, B.K. Agarwal and Melvin Eisner (New Age Inter- national)
2. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: Francis W.Sears and Gerhard L.Salinger (Narosa)

3. Statistical Mechanics: R.K. Pathria and Paul D. Beale (AcademicP ress)
4. Statistical Mechanics: Sharma and Satyal, Kalyani Publishing
5. Basic Statistical Mechanics, Gupta and Kumar, Pragati Prakashan

CORE –I: PAPER-XV

LAB: Credit-1

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wein's.
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) Einstein distribution function, (c)Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
4. Plot Maxwell-Boltzmann distribution function versus temperature.
5. Plot Fermi-Dirac distribution function versus temperature.
6. Plot Bose-Einstein distribution function versus temperature.

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 University Press.
3. Thermodynamic, Kinetic Theory and Statistical Thermodynamics, Fran- cis .Searsand GerhardL. 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: 978613345927

CORE COURSE-II

(Other than Physics Core-I students)

Minor (Paper-I) SEMESTER- I / II

MECHANICS:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30hrs)

CO-1 To Learn the basic concepts of Rigid body dynamics, Radius of Gyration, Moment of Inertia,Non-Inertial Systems

CO-2 To Understand the concept of Elasticity, Fluid motion and Types of Vibration

CO-3 To understand the concept of Newtonian theory through Gravitation, Central force motion, Keplar's laws, GPS

CO-4 To learn the concept of Special theory of Relativity, Michelson- Morley experiment, Lorentz transformation, Relativistic Doppler effect.

CO-5 Apply the basic concepts of Mechanics in experiments.

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, Euler's 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.

UNIT-II

Oscillations:

Damped oscillation. Equation of motion and solution (cases of oscillatory, critically damped and overdamped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor, Bar Pendulum, Katers Pendulum

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

Viscosity: 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, Kepler's Laws of Planetary motion, Satellites. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

UNIT-IV

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, Massless 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. Introduc tion 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)
8. Classical Mechanics , Gupta Kumar & Sharama,(Pragati Prakashan)
9. Classical Mechanics, J.C.Upadhyaya, (Himalaya Publishing Home)

Minor: PAPER-I

LAB: Credit-1

(Minimum 4 experiments are to be done):

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 Maxwell's needle.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text ook of Practical Physics, I. Prakash and Ramakrishna, 11thEdn, 2011, Kitab Mahal

Minor (Paper-II) SEMESTER- III /IV

ELECTRICITY AND MAGNETISM:

(4 Credit, Theory: 45hrs, 1 Credit, Practical: 30hrs)

CO-1 To understand the basic concepts of Electricity and Magnetism

CO-2 To Understand the various phenomena in Electricity and Magnetism

CO-3 To Understand Circuit analysis and network theorems

CO-4 To Explain the Dynamics of Charged Particles

CO-5 To Apply the acquired knowledge in Experiment.

UNIT-1

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, Laplace 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, Conductors in an electrostatic Field, Surface charge and force on a conductor.

UNIT-II

Magnetic Field: Magnetic Force, Lorentz Force, Biot Savarts Law, Cur- rent 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 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 Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallel plate, spherical, cylindrical) 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, Lenz's Law, Self -Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's 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: Kirchoff's law for electrical circuits, Ideal Constant-voltage and Constantcurrent 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. F eynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands
5. (Pearson)
6. Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press) 7. Classical Electromagnetism, H.C.Verma, Bharati Bhawan

Minor: PAPER-I

LAB: Credit-1

(Minimum 4 experiments are to bedone)

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 Bridge.
4. To compare capacitances using DeSauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton 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) Reso- nant 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)
10. Anti-resonance 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

SEMESTER-V/ VI

WAVES AND OPTICS:

Credit-3

CO-1: Basic understanding of propagation of light, its application and wave nature.

CO-2: To Understand the concepts of wave motion.

CO-3: To Understand the concepts of interference and its application.

CO-4: To Understand the concepts of diffraction and its application.

CO-5: To Apply the acquired knowledge of optics in Experiment

UNIT – I

Geometrical optics: Fermat's 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 Spatial Coherence.

UNIT - 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 Trans- port, 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 Harmonic waves.

UNIT- III

Interference: Division of amplitude and wave front, Young's 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), Newton's Rings: Measurement of wavelength and refractive index. Interferometer: Michelson's Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of fringes, Fabry-Perot interferometer.

UNIT – IV

Fraunhoffer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions, Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, as lit and a wire.

Text Books:

1. A text book of Optics N. Subhramanyam and BrijLal (S.Chand Publishing)
2. Optics - Ajoy Ghatak (McGraw Hill)

Reference Books:

1. Optics- E. Hecht (Pearson)
2. Fundamentals of Optics-F. A. Jenkins and H. E. White(McGraw-Hill)
3. Geometrical and Physical Optics R.S. Longhurst (Orient Blackswan)
4. The Physics of Vibrations and Waves- H. J. Pain(John Wiley)
5. Optics P. K. Chakraborty.
6. Principles of Optics-Max Born and Emil Wolf (Pergamon Press)
7. The Physics of Waves and Oscillations-N. K. Bajaj (Mc Graw Hill)

Minor: PAPER-II

LAB: Credit-1

(Minimum 5 experiments are to be done)

1. To determine the frequency of an electric tuning fork by Melde' s experiment and verify 2-T law.
2. To plot the I-D curve and to determine the refractive index of a prism
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 Newton' s Rings.
6. To determine wavelength of (1) Na source and (2) spectral lines of Hgsource using plane diffraction grating.
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, 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