SCIENCE COLLEGE (AUTONOMOUS)

HINJILICUT, GANJAM, ODISHA

COURSES OF STUDIES

FOR

PHYSICS

First Semester Examination-	**2019-20**
Second Semester Examination-	**2019-20**
Third Semester Examination-	**2020-21**
Fourth Semester Examination-	**2020-21**
Fifth Semester Examination-	**2021-22**
Sixth Semester Examination-	**2021-22**

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN PHYSICS

(Bachelor of Science Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course structure of UG Physics Honors

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I 4 Papers (400 Marks)	Ability Enhancement Compulsory Course-I	(Environmental Science)	4
	Core course-I	Mathematical Physics-I	4
	Core Course-I Practical/Tutorial	Mathematical Physics-I Lab	2
	Core course-II	Mechanics	4
	Core Course-II Practical/Tutorial	Mechanics Lab	2
	Generic Elective -1	GE-1	4/5
	Generic Elective -1	Practical/Tutorial	2/1
II 4 Papers (400 Marks)	Ability Enhancement Compulsory Course-II	MIL (Odia Communication/ Alternative English)	4
	Core course-III	Electricity and Magnetism	4
	Core Course-III Practical/Tutorial	Electricity and Magnetism Lab	2
	Core course-IV	Waves and Optics	4
	Core Course-IV Practical/Tutorial	Waves and Optics Lab	2
	Generic Elective -2	GE-2	4/5
	Generic Elective -2	Practical/Tutorial	2/1
III 5 Papers (500 Marks)	Core course-V	Mathematical Physics-II	4
	Core Course-V Practical/Tutorial	Mathematical Physics-II Lab	2
	Core course-VI	Thermal Physics	4
	Core Course-VI Practical/Tutorial	Thermal Physics Lab	2
	Core course-VII	Analog Systems and Applications	4
	Core Course-VII Practical/Tutorial	Analog Systems & Applications Lab	2
	Skill Enhancement CompulsoryCourse -1	Communicative English	4
	Generic Elective -3	GE-3	4/5
	Generic Elective -3	Practical/Tutorial	2/1

IV 5 Papers (500 Marks)	Core course-VIII	Mathematical Physics III	4
	Core Course-VII Practical/Tutorial	Mathematical Physics-III Lab	2
	Core course-IX	Elements of Modern Physics	4
	Core Course-IX Practical/Tutorial	Elements of Modern Physics Lab	2
	Core course-X	Digital Systems and Applications	4
	Core Course-XPractical/Tutorial	Digital Systems & Applications Lab	2
	Skill Enhancement Compulsory Course -2	Quantitative & Logical Thinking	4
	Generic Elective -4	GE-4	4/5
	Generic Elective -4	Practical/Tutorial	2/1
V 4 Papers (400 Marks)	Core course-XI	Quantum Mechanics & Applications	4
	Core Course-XI Practical/Tutorial	Quantum Mechanics Lab	2
	Core course-XII	Solid State Physics	4
	Core Course-XII Practical/Tutorial	Solid State Physics Lab	2
	Discipline Specific Elective -1	DSE-1	4/5
	Discipline Specific Elective -1	Practical/Tutorial	2/1
	Discipline Specific Elective -2	DSE-2	4/5
	Discipline Specific Elective- 2	Practical/Tutorial	2/1
VI 4 Papers (400 Marks)	Core course-XIII	Electro-magnetic Theory	4
	Core Course-XIII Practical/Tutorial	Electro-magnetic Theory Lab	2
	Core course-XIV	Statistical Mechanics	4
	Core Course-XIV Practical/Tutorial	Statistical Mechanics Lab	2
	Discipline Specific Elective4	DSE-4	4/5
	Discipline Specific Elective -4	Practical/Tutorial	2/1
	Or Discipline Specific Elective-4	(Eligible Students may do a Project in DSE-IV)	6
		Total Credits	148

Generic Elective Papers (GE) (Minor-Physics) for other Departments/Disciplines: (Credit: 06 each)

Depending on their requirements, Universities may choose 2 (two)GE subjects with 2 papers from each subject or only one GE subject with 4 papers from it.

Two papers GE subject will be :

1. **GE-I** (Mechanics & Properties of matter, Oscillation & Waves, Thermal Physics, Electricity and Magnetism & Electronics) + Lab
2. **GE-II** (Optics, Special Theory of Relativity, Atomic Physics, Quantum Mechanics and Nuclear Physics)+ Lab

A student who chooses to read only Physics subject GE will take 4 DSC papers of the Pass Course as below

1. **GE-I** as **DSC-1**(Mechanics)+ Lab
2. **GE-II** as **DSC-2**,(Electricity, Magnetism & Emt))+ Lab
3. **GE-III** as **DSC-3**,(Thermal Physics & Statiscal Mechanics))+ Lab
4. **GE-IV** as **DSC-4** (Waves And Optics))+ Lab

(GE-I same paper as DSC-1,GE-II same as DSC-2 ,GE-III same as DSC-3,GE-IV same as DSC-4)

PHYSICS

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 5 papers suggested)

Generic Elective for Non Physics students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper –

For practical paper: Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

For non practical paper: Midterm : 20 marks, End term : 80 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper –

Practical paper-40 hours theory classes + 20 hours Practical classes

Non Practical paper-50 hours theory classes + 10 hours tutorial

CORE PAPER-1

MATHEMATICAL PHYSICS-I

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen andunseen.

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 UniquenessTheoremforInitialValueProblems,ParticularIntegral.

UNIT-II

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

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

UNIT-III

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems, Comparison of velocity and accelerationincylindricalandsphericalcoordinatesystem

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

UNIT-IV

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

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

TextBooks:

1. Mathem•aticalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013,7th Edn.,Elsevier)
2. Adva•nced Engineering Mathematics, Erwin Kreyszig (Wiley India)

Reference books:

1. Mathem•atical 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 Mathematical Physics, Satya Prakash (SultanChand)
4. Mathematical Physics, B. D. Gupta (4th edition, Vikas Publication) Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K.Dash (Srikrishna Prakashan)
5. Mathematical Physics–H.K.Dass, Dr. Rama Verma (S. ChandPublishing)

CORE PAPER I LAB:

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

- Highlights the use of computational methods to solve physicalproblems
- Thecoursewillconsistoflectures(boththeoryandpractical)intheLab
- Evaluation done not on the programming but on the basis of formulating theproblem
- Aim at teaching students to construct the computational problem to be solved
- StudentscanuseanyoneoperatingsystemLinuxorMicrosoftWindows

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

Basics of scientific computing: Binary and decimal arithmetic, Floating pointnumbers,algorithms,Sequence,SelectionandRepetition,singleanddouble precision arithmetic, underflow and overflow emphasize the importance of makingequationsintermsofdimensionlessvariables,Iterativemethods. Algorithm

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

Review of C and C++ Programming: Introduction to Programming, constants,

variables and Fundamentals data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data format- ting, Control statements (decision making and looping statements) (If Statement,IfelseStatement,NestedIfstructure,ElseIfStatement,Ternaryoperator, Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions,Structures and Unions, Idea of classes andobjects

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•'sOutlineofProgrammingwithC++.J.Hubbard,2000,McGraw–HillPub.
3. NumericalRecipesinC:TheArtofScientificComputing,W.H.Pressetal, 3rd Edn. 2007, Cambridge UniversityPress.
4. A first c•ourse in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning.
5. Element•ary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007 , Wiley India Edition.
6. Numeric•al Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier DoverPub.
7. AnIntro•ductiontocomputationalPhysics,T.Pang,2ndEdn., 2006,Cam- bridge Univ.Press.

CORE PAPER-II
MECHANICS

UNIT-I

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

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

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

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

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

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

UNIT-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Equation of motion and solution(,cases of oscillatory, critically damped and overdamped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance;powerdissipationandQualityFactor,BarPendulum,KatersPendulum

Special Theory of Relativity: Michelson-Morley Experiment and its out- come, Postulates of Special Theory of Relativity, Lorentz Transformations,Simultaneityandorderofevents,Lorentzcontraction,Timedilation, 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 andMomentum.

Text Books:

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

Reference Books:

1. Introduction to Mechanics Daniel Klapnner and Robert Kolenkow, McgrawHill.
2. Mech•anics by K.R Simon
3. Mech•anics, 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)

CORE PAPER-1I LAB

(minimum 5 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 Maxwellsneedle.
7. To determine the value of g using BarPendulum.
8. To determine the value of g using KatersPendulum

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11thEdn, 2011, Kitab Mahal

CORE PAPER-III

ELECTRICITY AND MAGNETISM

UNIT-I

Electric Field and Electric Potential

Electric field: Electric field lines, Electric flux, Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field. Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Potential calculation indifferentsimplecases,LaplacesandPoissonequations,TheUniquenessTheorem,

Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.

Electrostaticenergyofsystemofcharges,Electrostaticenergyofacharged sphere,ConductorsinanelectrostaticField,Surfacechargeandforceonaconductor.

UNIT-II

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

UNIT-III

Dielectric Properties of Matter: Electric Field in matter, Polarization, PolarizationCharges,ElectricalSusceptibilityandDielectricConstant,Capacitor (parallelplate,spherical,cylindrical)filledwithdielectric,Displacementvector 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 andhysteresis.

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

UNIT-IV

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

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

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

Text Books:

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

Reference Books:

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

CORE PAPER-II1

LAB (minimum of 6 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 electricalfuses.

1. To study the characteristics of a series RCCircuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters Bridge. To compare capacitances using DeSautysbridge.
4. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
5. To verify the Thevenin and Norton theorems.

6. To determine self inductance of a coil by Andersons bridge.
7. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
8. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonance frequency and (b) Quality factor Q.

Reference Books:

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

CORE PAPER-1V: WAVES AND OPTICS

UNIT - I

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

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 theiruses,SuperpositionofNharmonicwaves.

UNIT- III

Interference : Division of amplitude and wave front, Youngs double slit experiment, Lloyds Mirror and Fresnels Bi-prism, Phase change on reflection: Stokes treatment, Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes), Fringes of equal thickness (Fizeau Fringes), Newtons Rings: Measurement of wavelength and refractive index. Interferometer : Michelsons Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility ofFringes, Fabry-Perot interferometer.

UNIT - IV

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

TextBooks:

1. AtextbookofOpticsN.SubrahmanyamandBrijLal(S.Chand Publishing)
2. O•ptics - Ajoy Ghatak (McGraw Hill)

Reference Books:

1. Optics-E.Hecht(Pearson)
2. FundamentalsofOptics-F.A.JenkinsandH.E.White(McGraw-Hill)
3. Geometrical and Physical Optics R.S. Longhurst (OrientBlackswan)
4. ThePhysicsofVibrationsandWaves-H.J.Pain(JohnWiley)
5. OpticsP.K.Chakrabarty

6. PrinciplesofOptics-MaxBornandEmilWolf(PergamonPress)
7. ThePhysicsofWavesandOscillations-N.K.Bajaj(McGrawHill)

CORE PAPER-IV LAB

(minimum 5 experiments are to be done)

1. Todeterminethefrequencyofanelectrictuningforkby Meldesexperiment and verify 2 Tlaw.
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 Newtons Rings.
6. To determine wavelength of (1) Na source and (2) spectral lines of Hg source 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

CORE PAPER-V

MATHEMATICAL PHYSICS-II

Theemphasisofthecourseisonapplicationsinsolvingproblemsofinterest to physicists. Students are to be examined on the basis of problems, seen and unseen.

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 OrderLinearDifferentialEquationsandtheirimportance,SingularitiesofBessels and Laguerre Equations, Frobenius method and its applications to differential equations:LegendreandHermiteDifferentialEquations,LegendreandHermite Polynomials: Rodrigues Formula, Generating Function,Orthogonality.

UNIT-III

Polynomials: Simple recurrence relations of Legendre and Hermite Polynomials, Expansion of function in a series of Legendre Polynomials, Associated Legendre Differential Equation, Associated Legendre polynomials, Spherical Harmonics

Some Special Integrals: Beta and Gamma Functions and relation between them, Expression of Integrals in terms of Gamma Functions, Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations using

separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string

Text Books:

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

Reference Books:

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

CORE PAPER-VLAB

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

Topics

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

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

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

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

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

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

Second order DifferentialEquation

- Harmonic oscillator (nofriction)
- Damped Harmonicoscillator
- Overdamped
- Criticaldamped
- Oscillatory
- Forced Harmonicoscillator

- Transient and Steady statesolution
- Apply above to LCR circuitsalso

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge UniversityPress
2. Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. Firstcourseincomplexanalysiswithapplications,D.G.ZillandP.D.Shanahan, 1940, Jones andBartlett
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. Sc ilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand andCompany
7. Scilab Image Processing: Lambert M. Surhone. 2010 BetascriptPublishing

CORE PAPER-VI

THERMAL PHYSICS

UNIT-I

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

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-Planck and Clausius Statements and their Equivalence, Carnots Theorem, Applications of Second Law of Thermodynamics: Thermodynamic ScaleofTemperatureanditsEquivalencetoPerfectGasScale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of

increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy of the Principle of Increase of Entropy, Temperature Entropy diagrams for Carnots Cycle, Third Law of Thermodynamics, Unattainability of AbsoluteZero.

UNIT-II

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables,

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy,GibbsFreeEnergy,TheirDefinitions,PropertiesandApplications,Sur-faceFilmsandVariationofSurfaceTensionwithTemperature,MagneticWork, Cooling due to adiabaticdemagnetization

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$C_p$andC_v(3)TdSEquations,(4)Joule-KelvincoefficientforIdealand Van der Waal Gases (5) Energy equations (6) Change of Temperature during Adiabatic Process.

UNIT-III

Kinetic Theory ofGases

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-ThomsonCooling

Text Books:

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

Reference Books:

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

CORE PAPER-VI LAB

(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 byCaloriemeter
6. Todeterminethespecificheatofliquidbythemethodofcooling
7. Todeterminethespecificheatofsolidbyapplyingradiationofcorrection.

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 forundergraduate classes,D.P.Khandelwal,1985, Vani Pub.

CORE PAPER-VII
ANALOG SYSTEMS AND APPLICATIONS

UNIT-I

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

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

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

UNIT II

Bipolar Junction Transistors: n-p-n and p-n-p transistors, Characterstics 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 mechanismofcurrentflow,Active,Cut-offandSaturationRegions.

Transistors Biasing: Transistor Biasing and Stabilization circuits, Fixed Bias and Voltage DividerBias.

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

UNIT-III

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

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

UNIT-IV

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

Application of Op-Amps: (1) Inverting and non-inverting amplifiers (2) Adder (3) Subtractor (4) Differentiator, (5) Integrator (6) Log amplifier, (7) Zero

crossing detector (8) Wein 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. ElectronicdevicesandcircuitsR.L.Boylstad(PearsonIndia)
2. Electronic Principles- A.P.Malvino (Tata McGrawHill)
3. Principles of Electronics- V. K. Mehta and Rohit Mehta (S. Chand Publication)
4. OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (PrenticeHall)
5. PhysicsofSemiconductordevices,DonaldANeamen(PrenticeHall)

CORE PAPER-VII LAB

(minimum 5 experiments are to bedone)

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I and power curves of solar cells, and find maximum power point and efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
6. TodesignaWienbridgeoscillatorforgivenfrequencyusinganop-amp.
7. Todesignaphaseshiftoscillatorofgivenspecificationsusing BJT.

8. To study the Colpitt'soscillator.

Reference Books:

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

CORE PAPER-VIII

MATHEMATICAL PHYSICS-III

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

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

UNIT-II

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

UNIT-III

Integral Transforms-II : Convolution theorem, Properties of Fourier Trans- forms (translation, change of scale, complex conjugation), Three dimensional Fouriertransformswithexamples,ApplicationofFourierTransformstodifferentialequations: OnedimensionalWaveandDiffusion/HeatflowEquations.

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. MathematicalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013,7th Edn.,Elsevier)
2. AdvancedEngineeringMathematics,ErwinKreyszig(WileyIndia)

Reference Books:

1. MathematicalPhysicsandSpecialRelativity–M.Das,P.K.JenaandB.K. Dash (SrikrishnaPrakashan)
2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing) Mathematical Physics C. Harper (Prentice Hall India)
3. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition , Mc- Graw

Hill Education)

4. Complex variables and applications J.W.Brown and R.V.Churchill
5. Mathematical Physics, Satya Prakash (Sultan Chand)
6. MathematicalPhysicsB.D.Gupta(4thedition,VikasPublication)

CORE PAPER-VIII LAB

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

PRACTICAL-C VIII LAB

20 Classes (2hrs duration each)

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

- Solve simple differential equations like :

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

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

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

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

- Direct Delta Function

Evaluate $\int_{-3}^{3} dx \ \frac{(x+3)}{\sqrt{2\pi\sigma^2}} \ e^{-\frac{(x-2)^2}{2\sigma^2}}$, for $\sigma = 0.1, 0.01, 0.001$ 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 program.

- Evaluation of trigonometric functions e.g. sin θ, Given Bessels 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^2}

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.Hobson and S. J. Bence, 3rd ed., 2006, Cambridge UniversityPress
2. MathematicsforPhysicists,P.DenneryandA.Krzywicki,1967,DoverPublications
3. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN: 978-3319067896
4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
5. Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand

andCompany
6. Scilab Image Processing: Lambert M. Surhone. 2010 BetascriptPublishing

CORE PAPER-IX

ELEMENTS OF MODERN PHYSICS

UNIT- I

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

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

UNIT- II

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

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

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

UNIT- III

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

UNIT- IV

Nuclear Physics- II: Radioactivity, stability of the nucleus, Law of radioactivedecay,MeanlifeandHalflifeAlphadecay,Betadecay-energyreleased,spectrum and Paulis prediction of neutrino, Gamma ray emission energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus, Fission and fusion mass deficit, relativity and generation of energy, Fission- nature of fragments and emission of neutrons, Nuclear reactor: slow neutron interacting with Uranium 235, Fusion and thermonuclear reactions driving stellar energy (brief qualitativediscussion).

Text Books:

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

Reference Books:

1. QuantumMechanics:TheoryandApplications,A.K.GhatakandS.Lokanathan, (Macmillan)
2. Introduction to Quantum Theory, David Park (DoverPublications)
3. TheoryandProblemsofModernPhysics,Schaum‘soutline,R.Gautreau and W.Savin- (Tata McGraw-Hill)
4. Modern Physics-Serway (CENGAGELearnings)
5. Physics of Atoms and Molecules Bransden and Joachim (PearsonIndia)
6. Atomic and Nuclear Physics-A.B.Gupta (NewCentral)

7. Theoretical Nuclear Physics , J.M.Blatt and V.F. Weisskopf(Springer)

CORE PAPER-IX LAB

(minimum 4 experiments are to bedone):

1. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
2. To determine the wavelength of laser source using diffraction of single slit.
3. To determine the wavelength of laser source using diffraction ofdouble slits.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.
5. Todetermine the Plancks constant using LEDs of at least 4 differentcolours.
6. To determine the value of e/m by(a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge ofan 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

CORE PAPER-X

DIGITAL SYSTEMS AND APPLICATIONS

UNIT-I

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

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

UNIT-II

Boolean algebra: De Morgans Theorems: Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms andMaxterms,ConversionofaTruthtableintoEquivalentLogicCircuitby

(1) Sum of Products Method and (2) KarnaughMap.

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

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

UNIT-III

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

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

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

UNIT-IV

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

Shift registers: Serial-in-serial-out, Serial-in-Parallel-out, Parallel-in-Serial- out

and Parallel-in-Parallel-out. Shift Registers (only up to 4 bits)

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

Text Books:

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

Reference Books :

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

CORE PAPER--X LAB

(minimum 6 experiments are to bedone):

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

Reference Books:

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

CORE PAPER-XI

QUANTUM MECHANICS AND APPLICATIONS

UNIT- I

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

UNIT-II

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

UNIT-III

Time Independent Schrodinger equation in one dimension (1d), 2d and 3d, Hamiltonian, stationary states and energy eigen values, expansion of an arbitrary

wave function as a linear combination of energy eigen functions, General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states. General Discussion of Bound states in an arbitrary potential: Continuity of wave function, Boundary condition and emergence of discrete energy levels, Application to one dimensional problem-Square well potential, Quantum mechanics of simple Harmonic Oscillator-Energy Levels and energy eigen functions, ground state, zero point energy and uncertainty principle, One dimensional infinitely rigid boxenergy eigen values and eigen functions, normalization, quantum dot as example, Quantum mechanical scattering and tunnelling in one dimension across a step potential and rectangular potential barrier.

UNIT-IV

Atoms in Electric and Magnetic Fields: Electron angular momentum. Spacequantization,ElectronSpinandSpinAngularMomentum,LarmorsTheorem,SpinMagneticMoment,SternGerlachExperiment,VectorAtomModel,L-S and J-J coupling, Zeeman Effect, Electron Magnetic Moment and Magnetic Energy,GyromagneticRatioandBohrMagneton.AtomsinExternalMagnetic Fields:-NormalandAnomalousZeemanEffect,PaschenbackandStarkEffect (qualitative Discussiononly)

Text Books:

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

Reference Books :

1. QuantumMechanics,TheoryandapplicationsA.GhatakandS.Lokanathan (McMillanIndia)
2. QuantumMechanics-G.Aruldhas(PrinticeHallofIndia)
3. Quantum Physics–S. Gasiorowicz (Wiley)
4. QuantumMechanics-G.R.ChatwalandS.K.Anand

5. Quantum Mechanics -J.L. Powell and B. Craseman(Narosa)
6. Introduction to Quantum Mechanics M.Das and P.K.Jena (Shri Krishna Publication)

CORE PAPER- XILAB

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

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the 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 $e = 3.795\sqrt{(eV\mathring{A})},\ \hbar c = 1973(eV\mathring{A})$ and $m = 0.511 \times 10^6 eV/c^2$

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 three significant digits. Also, plot the corresponding wave function. Take $e = 3.795\sqrt{(eV\mathring{A})},\ \hbar c = 1973(eV\mathring{A})$ and $m = 0.511\times10^6 eV/c^2$, and $a = 3\mathring{A}, 5\mathring{A}, 7\mathring{A}$. The ground state energy is expected to be above -12 eV 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 potential: $V(r) = \frac{kr^2}{2} + \frac{br^3}{3}$.

Find the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940MeV/c^2, k = 100MeV/fm^2, b = 0, 10, 30MeV/fm^3$. In these Units, c = 197.3 MeV fm. [The ground state energy is expected to lie between 90 and 110 M eV for all three cases.]

4. 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 mass of the two-atom system for the Morse potential $V(r) = D(e^{-2\alpha r} - e^{-\alpha r})$, where $r = r - r_0$ Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave functions for the choices given below:

a) $m = 940x10^6 eV/c^2, D = 0.755501eV, \alpha = 1.44, r_0 = 0.131349\mathring{A}$

b) $m = 940x106eV/c^2, D = 0.755501eV, \alpha = 1.44, r_0 = 0.131349\mathring{A}$

Laboratory based experiments:

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

Reference Books:

1. Scha•um'soutlineofProgrammingwithC++.J.Hubbard,2000,McGraw–HillPublication
2. Num•erical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.

3. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cam- bridge Univ. Press
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernndez.2014 Springer.
5. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011S. Chand andCo.
6. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:9786133459274

CORE PAPER-XII

SOLID STATE PHYSICS

UNIT-I

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

UNIT-II

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

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

UNIT-III

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

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

UNIT-IV

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

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

Text Books:

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

Reference Books:

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

CORE PAPER-XII LAB

(minimum 4experiments are to bedone)

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

Reference Books:

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

CORE PAPER-XIII

ELECTROMAGNETIC THEORY

UNIT-I

Maxwell Equations: Maxwells equations, Displacement Current, Vector and ScalarPotentials,GaugeTransformations:LorentzandCoulombGauge,Boundary Conditions at Interface between Different Media, Wave Equations, Plane Wavesin Dielectric Media, Poynting Theorem and Poynting Vector, Electro-magnetic(EM)EnergyDensity,PhysicalConceptofElectromagneticFieldEnergyDensity

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuumandisotropicdielectricmedium,transversenatureofplaneEMwaves, refractive index and dielectric constant, wave impedance, Propagationthrough conductingmedia,relaxationtime,skindepth,Electricalconductivityofionized gases,plasmafrequency,refractiveindex,skindepth,applicationtopropagation throughionosphere.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface betweentwomedia,ReflectionandRefractionofplanewavesatplaneinterface betweentwodielectricmedia,LawsofReflectionandRefraction,Fresnel'sFormulaefor perpendicularandparallelpolarizationcases,Brewster'slaw,ReflectionandTransmiss ioncoefficients,Totalinternalreflection,evanescentwaves, Metallic reflection (normalIncidence)

UNIT IV

Polarization of Electromagnetic Waves: Description of Linear, Circular andEllipticalPolarization,UniaxialandBiaxialCrystals,LightPropagationin UniaxialCrystal,DoubleRefraction,PolarizationbyDoubleRefraction,Nicol Prism,Ordinaryandextraordinaryrefractiveindices,Productionanddetection of Plane, Circularly and Elliptically PolarizedLight,
Phase Retardation Plates: Quarter-Wave and Half- Wave Plates. Babinets Compensator and its Uses, Analysis of Polarized Light.

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

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths (Pearson)

2. PrinciplesofOptics-MaxBornandE.Wolf

Reference Books :

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

CORE PAPER XIII LAB

(minimum 4 experiments are to bedone):

1. ToverifythelawofMalusforplanepolarizedlight.
2. To determine the specific rotation of sugar solution usingPolarimeter.
3. To analyze elliptically polarized Light by using a Babinetscompensator.
4. To determine the refractive index of liquid by total internal reflection using Wollastonsair-film.
5. To determine the refractive Index of (1) glass and (2) a liquid bytotal internal reflection using a Gaussianeyepiece.
6. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
7. ToverifytheStefan'slawofradiationandtodetermineStefansconstant.
8. To determine the Boltzmann constant using V-I characteristics ofPN junctiondiode.

Reference Books:

1. Adva•nced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Adva•nced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Te•xt Books Book of Practical Physics, I.Prakashand Ramakrishna, 11 Ed., 2011, Kitab Mahal Electromagnetic Field Theory for Engineers and Physicists, G. Lehner, 2010,Springer

CORE PAPER-XIV

STATISTICAL MECHANICS

UNIT- I

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

UNIT- II

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

UNIT-III

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

UNIT-IV

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

Plancks Law of Black body Radiation: Experimental verification, Deduction of

(1) Wiens Distribution Law, (2) Rayleigh Jeans Law, (3) Stefan Boltzmann Law, (4)Weins Displacement Law from Plancks Law.

Text Books:

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

ReferenceBooks:

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

CORE PAPER-XIV LAB

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

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

Reference Books:

1. Elem•entary Numerical Analysis, K.E.Atkinson, 3rdEdn. 2007, Wiley India Edition
2. Statis•tical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford UniversityPress.

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

Discipline Specific Elective Paper-1

CLASSICALDYNAMICS

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

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

UNIT-II

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

UNIT- III

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

UNIT- IV

Four Vectors: Space Like, Time-like and light-like. Four velocity and acceleration, Four momentum and energy-momentum relation. Doppler effects from a four vector perspective, Concept of four-force, Conservation of four momentum,Applicationtotwobodydecayofanunstableparticle

Text Books:

1.Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko (Pearson)

2.Classical Mechanics N C Rana and P S Joag.

Reference Books :

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

Discipline Specific Elective Paper-1I

Nuclear and Particle Physics

UNIT-I

General properties of Nuclei: Constituents of nucleus and their intrinsic properties, Quantitative facts about mass, radius, charge density (matter density), binding energy, average binding energy and its variation with mass number,mainfeaturesofbindingenergyversusmassnumbercurve,N/Aplot, angularmomentum,parity,magneticmomentelectricmoments,nuclearexcites states.

Radioactivity decays: (a) Alpha decay: basics of alpha- decay processes, theory ofalpha-emission, Gamow factor, Geiger Nuttall law (b) beta-decay: energy kinematics for beta-decay, positron emission, electron capture, neutrino hypothesis.

(c) Elementary idea of Gammadecay.

UNIT-II

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, conditions of nuclear stability, two nucleon separation energies, evidence for nuclear shell structure, nuclear magic number, basic assumption of shellmodels.

UNIT-III

Detector for nuclear radiations: Detector for nuclear radiations: Gas detectors:estimationofelectricfield,mobilityofparticle,forionizationchamber andGMCounter.BasicPrincipleofScintillationDetectorsandConstructionof photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) forcharge Particleandphotondetection(Conceptofchargecarrierandmobility),neutron detector.

Particle Accelerators: Van-de Graff generator (Tandem Accelerator), Lin- ear accelerator, Cyclotron, Synchrotrons

UNIT-IV

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

Symmetries and conservation laws: Energy and momentum, angular momentum,parity,baryonnumber,Leptonnumber,Isospin,strangenessandcharm, Elementary ideas of quarks andgluons.

Text Books:

1. Introduction to Nuclear Physics By Roy andNigam
2. AtomicandNuclearPhysics-N.Subramanyam,BrijLalandJivanSeshan(S. ChandPublishing)

Reference Books:

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

DisciplineSpecificElectivePaper-II1

Nano Materials and Applications

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Text Books:

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

Reference Books:

1. NanoScienceandnanotechnology,SundarSingh(PragatiPrakashan)
2. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt.Ltd.).

3. RichardBooker,EarlBoysen,Nanotechnology(JohnWileyandSons).
4. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier,2007).
5. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning PrivateLimited).

Discipline Specific Elective Paper-1V

Project

OR

Basic Instrumentation

Basic Instrumentation

UNIT-I

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

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

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

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

UNIT-II

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls.

Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle ofworking.

UNIT-III

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

UNIT-V

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

Digital Multimeter: Block diagram and working of a digital multimeter, Working principle of time interval, frequency and period measurement using universalcounter/frequencycounter,time-basestability,accuracyandresolution.

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

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

Laboratory Exercises:

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

Open Ended Experiments:

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

More emphasis should be given on hands-on experiments.

Text Books:

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

Reference Books :

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

Additional Reference Books for Practical papers :

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

GENERIC ELECTIVE (GE)

Generic Elective Paper I
(Mechanics and Properties of matter, Oscillation and Waves, Thermal Physics, Electricity and Magnetism and Electronics

UNIT-I

Mechanics and Properties of Matter

Moment of Inertia Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points, Relationamongelasticconstants,depressionatfreeendofalightcantilever,Surface tension,pressure,differenceacrossacurvedmembrane,viscousflow,Poiseulles formula.

UNIT-II

Oscillation and Waves

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

UNIT-III

Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck,

Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension, Maxwell thermodynamic relation (statement only), Clausius Clapeyron equation, Black body radiation, Planck radiation formula (Noderivation).

UNIT-IV

Electricity and Magnetism

Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution, Magnetic induction B, Lorentz force law, Biot Savarts law, Magnetic induction due to long straight current carrying conductor, and in the axis of a current carrying circular coil, Amperes Circuital law,itsdifferentialform,Thelawofelectromagneticequations,itsdifferential and integral form, Maxwells electro-magnetic equations and their physical significance, Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance.

P-type and N-type semiconductors, PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V-Icurve.

Text Books:

1. Properties of Matter D.S. Mathur (S. ChandPublication).
2. Heat and Thermodynamics A.B. Gupta and H.B. Ray (New Central BookAgency).
3. A Text Books book of oscillations, waves and acoustics(5thed.) M. Ghosh and D. Bhattacharya (S. ChandPublication).
4. Electricity and magnetism- R. Murugeshan (S.ChandPublishing)
5. Fundamentals of Electronics-Raskhit and Chattopadhyay (New age In-ternationalPublication)

Reference Books:

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

Generic Elective Paper I Lab-

(minimum 6 experiments are to be done)

1. Todeterminethemomentofinertiaofaflywheel.
2. To determine the Youngs modulus Y of a wire by Searlsmethod.
3. Todeterminethemodulusofrigidityofawirebymaxwellsneedle/Torsion Pendulum (Dynamicmethod).
4. To determine g by barpendulum.
5. To determine the value of Y of a rubber by using travellingmicroscope.
6. To determine the Rigidity of modulus by staticmethod.
7. To determine the frequency of a telescope by usingSonometer.
8. VerificationofLawsofVibrationofastringbyusingSonometer.

TEXT BOOKS:

1. To compare capacitances using DeSautybridge.
2. To determine the Law of resistance by using Fosterbridge.
3. Compare the specific heat of two liquids by method ofCooling.

Reference Books:

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop, 1971, Asia PublishingHouse
2. ALaboratoryManualofPhysicsforUndergraduateClasses,D.P.Khandelwal (1985), VaniPublication
3. ATextBooksbookofPracticalPhysics,InduPrakashAndRamakrishna,11th Edition (2011), Kitab Mahal, NewDelhi

Generic Elective Paper -II

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

UNIT-I

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

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

UNIT-II Atomic Physics

Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Plancks quantum theory of radiation, particle nature of electromagnetic radiation photo electric effect, Compton effect, dual nature of radiation, wave nature of particles, de-Broglie hypothesis, matter wave, wave-particle duality, Davisson-Germerexperiment.

Bohrs theory of Hydrogen atom, explanation of Hydrogen Spectra, correction for finite mass of the nucleus, Bohrs correspondence principle, limitations of Bohrs theory, Discrete energy, exchange by atom Frank Hertzexperiment.

UNIT-III

Quantum Mechanics : Heisenbergs Uncertainty relation, Time dependent Schrodingers wave equation in one dimension and three dimensions, The physical interpretation of the wave function, Probability density and probability current

density, Equation of continuity, Normalization of the Wave function, Expectation value of an observable, Ehrenfests theorem. Time independent Schrodingers wave equation in one dimension particle in a box, energy eigen values and eigenfunctions.

UNIT-IV

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

Relativity: Galilean transformation, Newtonian relativity and its limitation, MichelsonMorleyexperimentanditsconsequence,postulatesofspecialtheory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energyrelation.

Text Books:

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

Reference Books :

1. A Text Books book of Optics N.Subrahmanyam and Brij Lal (S.Chand Publishing)
2. Introduction to Special Relativity-R. Resnick (JohnWiley)
3. ConceptsofModernPhysics ArthurBeiser(McGrawHill)
4. Modern Physics H.S. Mani and G.K.Mehta

Generic Elective Paper II LAB

(minimum6experimentsaretobedone):

1. Determination of E.C.E. of a Copper by taking 3readings.
2. DeterminationofRefractiveindexofthematerialofaprismusingSodium light.
3. Todeterminethewavelengthoflightusingplanediffractiongrating.

4. TodeterminethewavelengthoflightusingNewtonsring.
5. Determination of refractive index of (a) glass and (b) liquid by using travellingmicroscope.
6. To plot the I-D curve and to determine the refractive index of aprism
7. Determination of radius of curvature of a convex/concave mirror by using Kohlrauschsmethod.
8. T o determine the magnifying power of a giventelescope.
9. ToObtainthestaticcharacteristicsofa P-N-P/N-P-Ntransistor/ TriodeValve.
10. To determine the reduction factor of a tangentGalvanometer.
11. To study the Variation of magnetic field along the axis of a circular coil carryingcurrent.

Reference Books:

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop, 1971, Asia PublishingHouse
2. ALaboratoryManualofPhysicsforUndergraduateClasses,D.P.Khandel wal (1985), VaniPublication
3. ATextBooksbookofPracticalPhysics,InduPrakashAndRamakrishna, 11th Edition (2011), Kitab Mahal, NewDelhi

Course structure of UG Physics Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Mechanics	04	75
	DSC-I	Practical	02	25
II	DSC-II	Electricity, Magnetism &EMT	04	75
	DSC-II	Practical	02	25
III	DSC-III	Thermal Physics & Statistical Mechanics	04	75
	DSC-III	Practical	02	25
IV	DSC-IV	Waves and Optics	04	75
	DSC-IV	Practical	02	25
V	DSE-I	Digital and Analog Circuits& Instrumentation	04	75
	DSE-I	Practical	02	25
VI	DSE-II	Elements of Modern Physics	04	75
	DSE-II	Practical	02	25
			36	**600**

PHYSICS PAPERS FOR PASS STUDENTS

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

Marks per paper –

Practical paper: Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

For non practical paper: Mid term : 20 marks, End term : 80 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper –

Practical papers:40 hours + 20 hours practical

Non practical papers:50 hours + 10 hours tutorial

Discipline Specific Core Paper 1

MECHANICS

UNIT-I

Rotational Dynamics: Centre of Mass, Motion of CM , Centre of Mass and Laboratory frames. Angular momentum of a particleand 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 frames and fictitious Forces: Uniformely Rotating frame, laws of Physics in rotatingCoordinate system,centrifugalForces,Coriolis force and its applications.

UNIT-II

Gravitation: Newton'sLaw of gravitation. Gravitational field Intensity and Potential,

. Potential and field Applications.

Central Force:

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). Physiological effects on astronauts.

UNIT-III

Elasticity: Relation between Elastic constants. Torsion of a right circularcylinder,torsionalwire,Bending of Beams,External Bending Moment,flexturalrigidity,singleCantilever,double cantilever(weightless cantilever,and with its own weight)

Fluid Properties:

Surface Tension- Express Pressure across a curved membrane, S.T., Quincke's drop, gravity waves and ripple,

Viscocity: Poiseuille's Equation for Flow of a Liquid with corrections.

Unit-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy andtheir time-average values. 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, Kater's Pendulum. Composition of two SHMs propagating perpendicularly to each other(with frequency in the ratio 1:1,2:1) Lissajous figures

Text Books:

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

Reference Books :

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W. Knight, etal (Tata McGraw-Hill)
2. Physics, Resnick-Halliday and Walker (8/e. 2008,Wiley)
3. Theoretical Mechanics-M.R. Spiegel (Tata McGraw Hill).
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands (Pearson)
5. Mechanics-M.Das, P.K.Jena and R.N. Mishra (Srikrishna Publications)

Discipline Specific Core Paper I LAB

(minimum 6 experiments are to be done)

1. To study the random error in observations.
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 igidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. 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, AsiaPublishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, Kitab Mahal

Discipline Specific Core Paper-1I

ELECTRICITY , MAGNETISM AND EMT

UNIT-I

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

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

UNIT-II

Electrostatic Energy Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

UNIT-III

Magnetism:

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

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

UNIT-IV

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity

ofcurrent, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric

medium, transverse nature of EM waves, polarization.

Text:

1. Introduction to Electricity and Magnetism – D.C.Tayal (Himalaya Publishing house)

Reference:

1. Electricity, Magnetism & Electromagnetic Theory- S. Mahajan and Choudhury (Tata McGraw Hill)
2. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands (Pearson)
3. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I (Oxford Univ. Press)
4. Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)

Discipline Specific Core Paper 1I LAB

(minimum 6 experiments are to be done)

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:

(i) Measurement of charge and current sensitivity

(ii) Measurement of CDR

(iii) Determine a high resistance by Leakage Method

(iv) To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and

(b) Quality factor Q

8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

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

Discipline Specific Core Paper III

THERMAL PHYSICS AND STATISTICAL MECHANICS

UNIT-I

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle

&theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamical Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energyfunctions, Maxwell's relations and applications - Joule-Thomson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.

UNIT-II

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

UNIT-III

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density,Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

UNIT-IV

Classical Statistical Mechanics: Macrostate& Microstate, Elementary Concept ofEnsemble,Microcanonical, Canonical and grand canonical ensemble. Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression,Gibbs Paradox.

Text:

1. Thermal Physics, A. B. Gupta (Books and allied Ltd)
2. Theory and experiments on thermal Physics, P.K.Chakrabarty (New central book agency limited)

Reference:

1. Thermal and Statistical Physics – M.Das, P.K. Jena, S. Mishra, R.N.Mishra (Shri Krishna Publication)
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw-Hill)
3. Thermal Physics, S. Garg, R. Bansal and Ghosh-(Tata McGraw-Hill)
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics- Sears & Salinger (Narosa)
5. A Treatise on Heat- Meghnad Saha and B.N.Srivastava (The Indian Press)
6. Heat, Thermodynamics and Statistical Physics-- N.Subrahmanyam and Brij Lal (S.Chand Publishing)

Discipline Specific Core Paper 1II LAB

(minimum 6 experiments are to be done)

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off- Balance Bridge

Reference Books:

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

Discipline Specific Core Paper 1V

WAVES AND OPTICS

UNIT-I

Geometrical optics: Fermat's principle, reflection and refraction at plane interface,Matrixformulation of geometrical Optics. Idea of dispersion.

Cardinal Points and cardinal planes of an optical system,location of cardinal points and cardinal planes of (1)thick lens(2) thin lens and (3) co axial combination of two thin lenses using matrix formulation.

Aberrations: Chromatic Aberration and remedy,Monochromatic Aberration :Spherical

Aberration and remedy,Simple idea on Coma,Distortion,Astigmatism and Curvature and their

Remedy,Huygens eyepiece., Ramsden eye piece and their comparison.

UNIT-II

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves.PlaneProgressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Wave Optics: Electromagnetic nature of light. Definition and properties of wavefrontHuygensPrinciple. Temporal and Spatial Coherence

UNIT-III

Interference-I- Division of amplitude and wavefront. Young's double slit experiment.Lloyd'sMirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment

Interference-II:

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 Interferometer-(1) Idea of form of fringes (No theory required),Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and

Visibility of Fringes. Fabry-Perot interferometer.Fabry Perot etalon with theory.Applications-Determination of wavelength (2) Wavelengthdifference of two sodium d-lines.

UNIT-IV

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope.

Doubleslit. 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, a slit and a wire.

Text:

1. A text book of Optics – N.Subrahmanyam and Brij Lal (S.Chand Publishing)

2. Optics - Ajoy Ghatak (McGraw Hill

Reference:

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 – B.K.Mathur
6. Principles of Optics-Max Born and Emil Wolf (Pergamon Press)

Discipline Specific Core Paper 1V LAB

(minimum 6 experiments are to be done)

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda 2 - T$ Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light
8. To determine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits

Reference Books:

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

Discipline Specific Elective (DSE) - Pass

(two papers are to be selected)

Discipline Specific Elective Paper –I

DIGITAL AND ANALOG CIRCUITSAND INSTRUMENTATION

UNIT-1:

Digital Circuits

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

UNIT-II

Semiconductor Devices and Amplifiers:

Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell.
Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation

UNIT-III

BJT and Amplifiers

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff, and Saturation Regions. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, and C Amplifiers.Class B Push Pull Amplifier.
Feedback in Amplifiers,Positive and Negative feedback,Effects of Feedback
Oscillators:Hartley and Colpitt's Oscillator

UNIT-IV:

Operational Amplifiers (Black Box approach) :

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

Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Instrumentations:
Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Text:

1. Electronics: Fundamentals and applications – D. Chattopadhyay and P.C.Rakshit (New Age international)
2. Digital Principles and Applications - A.P. Malvino, D.P.Leach and Saha (Tata McGraw)
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.

Reference :

1. Principles of Electronics – V.K.Mehta and Rohit Mehta (S.Chand Publishing)
2. Hand book of electronics – Gupta Kumar (Pragati Prakashan)
3. Digital Logic and Computer design – M. Morris Mano (Pearson)
4. Text book of Electronics – B. B. Swain (Kitab Mahal)
5. Concepts of Electronics – D.C.Tayal (Himalaya Publishing house)
6. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.

Discipline Specific Elective Paper –I LAB

DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTS

(minimum 6 experiments are to be done)

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.

6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
13. To study a precision Differential Amplifier of given I/O specification using Opamp.
14. To investigate the use of an op-amp as a Differentiator
15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

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

Discipline Specific Elective Paper II

ELEMENTS OF MODERN PHYSICS

UNIT-I

Planck's quantum, Planck's constant and Compton scattering. De Broglie experiment. light as a collection of photons; Photoelectric effect ,wavelength and matter waves; Davisson-Germer Experiment

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

UNIT-II

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

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

UNIT-III

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

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

UNIT-IV

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

Text:

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

Reference:

1. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, (Macmillan)
2. Introduction to Quantum Mechanics, David J. Griffith (Pearson)
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 (Pearson India)
6. Quantum Mechanics– Satya Prakash (Pragati Prakashan)

7. Atomic and Nuclear Physics-A.B.Gupta (New Central)

DSE II LAB: ELEMENTS OF MODERN PHYSICS

(minimum 6 experiments are to be done)

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensityvariation using Photosensor & compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energyof photo-electrons versus frequency of light
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. 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 PublishingHouse.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted
3. 1985, Heinemann Educational Publishers
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SKILL ENHANCEMENT COMPULSORY COURSES (SECC)

Optional for SECC II paper

Skill Enhancement Compulsory Courses (SECC Option-I)

APPLIED OPTICS

The quest to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. This paper provides the conceptual understanding of these branches of modern optics to the students.

Theory includes only qualitative explanation. Minimum **three** experiments should be performed covering minimum three sections.

Unit-I

(i) Photo-sources and Detectors

Lasers: an introduction, Planck's radiation law (qualitative idea), Energy levels, Absorption process, Spontaneous and stimulated emission processes, Theory of laser action, Population of energy levels, Einstein‟s coefficients and optical amplification, properties of laser beam, Ruby laser, He-Ne laser, and semiconductor lasers; Light Emitting Diode (LED) and photo-detectors.

(ii) Elementary ideas of Fourier Optics

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

Unit-II

Holography

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

Photonics: Fibre Optics

(ii) Photonics: Fibre Optics

Optical fibres: Introduction and historical remarks, Total Internal Reflection, Basic characteristics of the optical fibre: Principle of light propagation through a fibre, the coherent bundle, The numerical aperture, Attenuation in optical fibre and attenuation limit; Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.

Skill Enhancement Compulsory Courses (SECC Option-I) LAB

Minimum **three** experiments should be performed covering minimum two sections.

Experiments on Lasers:

1. To determine the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
2. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
3. To find the polarization angle of laser light using polarizer and analyzer
4. To determine the wavelength and angular spread of laser light by using plane diffraction grating.

Experiments on Semiconductor Sources and Detectors:

1. V-I characteristics of LED
2. Study the characteristics of solid state laser
3. Study the characteristics of LDR
4. Characteristics of Photovoltaic Cell/ Photodiode.
5. Characteristics of IR sensor

Experiments on Fibre Optics

1. To measure the numerical aperture of an optical fibre
2. To measure the near field intensity profile of a fibre and study its refractive index profile

Reference Books:

1. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
2. Introduction to Fiber Optics, A. Ghatak & K. Thyagarajan, Cambridge University Press.
3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
4. Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University Press
5. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.

Skill Enhancement Compulsory Courses (SECC Option-II)

RENEWABLE ENERGY AND ENERGY HARVESTING

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Unit-I

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

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

Unit-II

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

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

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

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

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

Skill Enhancement Compulsory Courses (SECC Option-II)-LAB

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into volta geusing thermoelectric modules.

Reference Books:

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

Faculty Training to be imparted in the following Topics

Computational Physics Lab—C, C++,

Scilab Programming for Core I,C-V,C-VIII,C-XI and C-XIII Practicals.

2. Digital Electronics. Theory and Practicals.

3. Quantum Mechanics Problem Solving

4. Solid State Physics- Elementary Band Theory and Superconductivity

5. Statistical Mechanics.-Quantum Distribution

6. Nanotechnology.

ESSENTIAL LABORATORY EQUIPMENT RECOMMENDED :

Every college must have CRO, Function generator, Laser and Logic Gate packages.