COURSES OF STUDIES

FOR

MASTER DEGREE COURSE

IN

SCIENCE

M.SC (PHYSICS)

Choice Based Credit System(CBCS)

First & Second Semester Examination – 2021-22

Third & Fourth Semester Examination – 2022-23

GOVERNMENT AUTONOMOUS COLLEGE,
PHULBANI, KANDHAMAL

SYLLABI FOR CBCS COURSE

SEMESTER	CORE COURSE (CC)	CORE ELECTIVE (CE)
I	CC – 1.1	-
	CC – 1.2	-
	CC – 1.3	-
	CC – 1.4	-
	CC – 1.5(P)	-
II	CC – 2.1	-
	CC – 2.2	-
	CC – 2.3	-
	CC – 2.4	-
	CC – 2.5(P)	-
III	CC – 3.1	-
	CC – 3.2	-
	CC – 3.3(P)	-
	-	CE – 3.4
IV	CC – 4.1	-
	-	CE – 4.2
	-	CE – 4.3(P)
	-	CE – 4.4 (Project)

YEAR & SEMESTER-WISE PAPERS & CREDITS AT A GLANCE

Year	Paper Code	Title of the paper	Total Marks (MS+ES)	No. of Credits
FIRST YEAR		**FIRST SEMESTER**	**500**	**30**
	CC– 1.1	Mathematical Physics – I	20+80=100	06
	CC– 1.2	Classical Mechanics	20+80=100	06
	CC– 1.3	Quantum Mechanics – I	20+80=100	06
	CC– 1.4	Electrodynamics	20+80=100	06
	CC– 1.5	Computational Physics (Practical)	100	06
		SECOND SEMESTER	**500**	**30**
	CC– 2.1	Mathematical Physics – II	20+80=100	06
	CC– 2.2	Quantum Mechanics – II	20+80=100	06
	CC– 2.3	Nuclear Physics	20+80=100	06
	CC– 2.4	Atomic and Molecular Physics	20+80=100	06
	CC– 2.5	Modern Physics/EMT/Optics (Practical)	100	06
SECOND YEAR		**THIRD SEMESTER**	**400**	**24**
	CC– 3.1	Advanced Quantum Mechanics	20+80=100	06
	CC– 3.2	Basic Electronics	20+80=100	06
	CC– 3.3	Basic Electronics (Practical)	100	06
	CE– 3.4A	Basic Solid State Physics (Special Paper) – I	20+80=100	06
	CE– 3.4B	Electronics (Special Paper) – I	20+80=100	06
		FOURTH SEMESTER	**400**	**24**
	CC– 4.1	Statistical Mechanics	20+80=100	06
	CE– 4.2A	Condensed Matter & Material Science (Special Paper) – II	20+80=100	06
	CE– 4.2B	Electronics (Special Paper) – II	20+80=100	06
	CE– 4.3A	Condensed Matter & Material Science (Special Paper) – II (Practical)	100	06
	CE– 4.3B	Electronics (Special Paper) – II (Practical)	100	06
	CE– 4.4	Project and Seminar	100	06

CC– **Core Courses,** CE– **Core Elective**

Total Papers=18, Total Marks=1800, Total Credits=108

SEMESTER – I

CC-1.1 : MATHEMATICAL PHYSICS-I

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Complex variable

Cauchy's integral theorem, Cauchy's integral formula, calculus of residue, Cauchy's residue theorem, Evaluation of definite integral

UNIT- II : Differential Equation-I

Legendre Functions:

Legendre's equation, Legendre's polynomials, Generating function for Legendre's polynomials, Rodrigues formula, Recurrence relation among Legendre's polynomials, Integral relation of Legendre's polynomials, Orthogonality of Legendre's polynomials

Hermite Differential Equation: - Hermite polynomials, Generating function for Hermite polynomials (Rodrigues formula), Recurrence relation among Hermite polynomials, Integral representation of Hermite polynomials, Orthonormality of Hermite polynomials

UNIT- III : Differential Equation-II

Bessel's Differential Equation: - Power series solution, Bessel's Function, Bessel's function of 2nd kind, Recurrence relation, Generating function for J_n, integral representation for J_n, Orthogonality condition.

Laguerre's Function: - Laguerre's function, Laguerre's function for different value of n, Recurrence relation, Orthonormality property, Integral representation, Associated Laguerre's equation and it's solution, Generating Function, Associated Laguerre's polynomials

UNIT- IV :

Linear and non-linear partial differential equations with constant coefficients of 2nd order:

Rules for finding C.F., P.I.Non-homogeneous Linear Equations

Application of Partial Differential equations:

Method of Separation of variables, Equation of Vibrating String,1-D and 2-D heat flow

UNIT- V : Tensor Analysis:

Co-ordinate Transformation, Covariant, Contravariant & mixed Tensor, Rank of tensor, Tensor Algebra, Symmetric & Anti-symmetric Tensor, Metric Tensor (g_{pq}), g_{pq}in Cartesian , cylindrical & spherical polar coordinate, Christoffel Symbol

Text books:

1. Mathematical Methods of Physics by Mathews and Walker (W. A. Benjamin Inc.)
2. Elements of Group Theory by A. W. Joshi (New Age International Publisher)
3. Matrices and Tensors in physics by A. W. Joshi (New Age International Publisher)
4. Mathematical Methods for Physicist by G. Arfken and H. Weber, Academic Press (Elsevier)

Reference Books:

- Mathematical Physics by B. D. Gupta (Vikas Publishing House)
- Mathematical Physics by P. K. Chattopadhyaya (New Age International)
- Mathematical Physics by Satyaprakash
- Mathematical Physics by M. Das, P.K. Jena, N. Barik (Srikrishna Publication)

CC-1.2 : CLASSICAL MECHANICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Mechanics of a system of particle:

Basic concepts-constraints, Generalised co-ordinates, Transformation equation, configuration space, Generalized notation, principle of virtual work, D' Alembert's principle. The Langrangian formulation

UNIT- II : The Hamiltonian Formulation

Phase space, the Hamiltonian function H, Hamilton's Equations, physical significance of Hamiltonian function. Cyclic coordinate and Routh's procedure. Application of Hamiltonian Equation. Variational principles. Derivation of Hamilton's equation from modified Hamilton's principle (i.e. Variational principle), Principle of least action

UNIT- III : Canonical transformation:

Canonical transformation, Legendre transformation, Types of generating function. Condition for canonical transformation, Bilinear invariant condition, Integral invariance of Poincare. Poisson's Bracket, Lagrange Bracket, Poisson & Lagrange Bracket as Canonical invariant

UNI - IV : The mechanics of a rigid body:

The independent coordinate of a rigid body, orthogonal transformation. The Eulerian angle, Infinitesimal rotation. Motion of a rigid body about a fixed point. Angular momentum & Kinetic energy of motion about a point. Motion of a Heavy symmetrical top with one point fixed

UNIT - V : Small oscillations:

Problem of small oscillations, examples of two coupled oscillators, General theory of oscillations. Normal co-ordinates & Normal mode of vibrations, free vibrations of a linear triatomic molecule

Text book:

1. Classical Mechanics by H. Goldstein (Addison-Wesley)

Reference books:

- Classical Mechanics by S. N. Biswas, Books and allied Publisher Ltd.
- Classical Mechanics by J.C. Upadhya, (Himalaya Publishing House)
- Classical Mechanics by Landau and Liftshitz (Butter Worth)
- Classical Mechanics by Rana and Joag (TMH)
- Classical Mechanics by Styaprakash

CC-1.3 : QUANTUM MECHANICS –I

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : General principle of Quantum mechanics -I:

Linear vector space, Ket and Bra vectors. Scalar product of vectors & their properties, Linear operators, Adj. operator, Unitary operator, Expectation values of Dynamical variable & physical interpretation of Hermitian operator. Eigen values & Eigen Vectors, Orthogonality of Eigen vector, Probability interpretation, Degeneracy, Schmidt method of Orthogonalisation. Representation of Ket & Bra vector and Operators in matrix form, Unitary transformation of basis vector and operators

UNIT- II : General principle of Quantum mechanics -II:

Expansion theorem, completeness & closure properties of the basis set, Co-ordinate & momentum Representation, Compatible & incompatible observables. Commutator algebra, uncertainty relation as a consequence of non-commutability, min. uncertainty wave packet

UNIT- III : Quantum Dynamics

Time evolution of Quantum states, Time evolution operator & its properties, Schrodinger picture, Heisenberg picture, Interaction (Dirac) pictures. Equation of motion, Operator methods solution of Harmonic oscillator problem. Matrix representation, Expectation values of operators N, a, a^+, x, p, x^2, p^2. Time evolution of creation & annihilation operators. Hydrogen atom

UNIT- IV : Rotation and orbital Angular momentum

Orbital Angular momentum operators as generators of rotation, L_x , L_y, L_z and L^2 and their commutation relation. Raising and lowering operators (L_+ & L_-), L_x, L_y, L_z and L^2 in spherical polar co-ordinate, Eigen values and Eigen function of L_z and L^2(operator method), Matrix representation of L_x, L_y, L_z and L^2

UNIT- V : Spin Angular Momentum:

Spin 1/2 particle, Pauli spin matrices and their properties, Eigen value& Eigen function, Spin & rotations.

Addition of Angular Momentum:

Total Angular momentum J, Eigen value problem of J_z & J^2, Angular momentum matrices. Addition of Angular momentum & C.G. coefficient for the states (i) $j_1=1/2$, $j_2=1/2$ (ii) $j_1=1$ & $j_2=1/2$

Text book:

1. Quantum Mechanics concepts and Applications by Nouredine Zettili, John Wiley and sons Publications

Reference books:

- Quantum Mechanics by L. I. Schiff, International Student edition.
- Quantum Mechanics by D. Griffith, Pearson Publishers.

- ❖ Quantum Mechanics by S. Gasiorowicz, John Wiley edition.
- ❖ Quantum Mechanics by Eugene Merzbacher, Wiley International Edition
- ❖ Quantum Mechanics by Ghatak & Lokanathan (Mc Millan)

CC-1.4 : ELECTRODYNAMICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Maxwell's equations and Potential formulation of ED

Maxwell's equations in free space, Maxwell's equations inside matter, Vector and Scalar Potentials, Gauge Invariance, Wave equation for Potentials ,Lorentz and Coulomb gauge conditions.
Green's function solution of Maxwell's equations

Plane waves in non-conducting media:

Plane electromagnetic waves & their propagation in non-conducting media, Linear & circular polarization in electromagnetic waves. Stokes Parameter

UNIT- II : Dispersion in electromagnetism:

Dispersion in electromagnetism, Lorentz dispersion equation. Frequency dispersion characteristic of dielectric, conductor & plasma. Behavior of waves in a dispersive or conducting medium. Kramer-Kronig relations

UNIT- III : Wave Guide:

Different modes of electromagnetic wave, B.C. for TE & TM waves, TE & TM mode in rectangular wave Guide.

Resonant cavity:

TE & TM mode in rectangular cavity resonator

UNIT- IV : Radiation by moving charges:

Retarded potentials, L.W. potential. Field of a point charge in uniform & accelerated motion, power radiated by an accelerated point charge (Larmor's formula). Radiation due to an oscillating electric dipole, Radiation due to an oscillating electric quadrupole

UNIT- V : Scattering:

Different Scattering cross section, Scattering by a free electron (Thomson scattering), Scattering by a bound electron (Rayleigh scattering), Kirchhoff's formula for diffraction

Text book:

1. Classical Electricity and Magnetism by W. K. H. Panofsky and M. Phillips (Addition-Wesley)

Reference books:

- ❖ Classical Electrodynamics- J.D. Jackson, John Wiley and Sons.
- ❖ Introduction to electrodynamics- D.J. Griffiths, Pearsons Publishers.
- ❖ Classical Electrodynamics by Satyaprakash

CC-1.5 : COMPUTATIONAL PHYSICS (PRACTICAL)

Full Marks: 100
End Sem : 100/6hrs

A) Preliminaries of running computers taking out print out etc.
B) Exercises to study various features of C-Language.
C) Programming using C language

1. Numerical integration by trapezoidal method
2. Numerical integration by Simpson method
3. Solution of first and second order differential equation by Runga Kutta Method
4. Matrix addition, subtraction, multiplication and manipulation
5. Matrix inversion
6. Finding the roots of an equation by Newton-Raphson method
7. Least square fitting of linear parameters
8. Determination of prime numbers.
9. To arrange a set of numbers in increasing or decreasing order

10. Sum of A.P and G.P series, Sine and Cosine series
11. Factorial of a number
12. Evaluation of log and exponentials by summing of series
13. Any other suitable experiments.

Any other experiments that may be set up from time to time

SEMESTER-II

CC-2.1 : MATHEMATICAL PHYSICS-II

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Matrices

Eigen value problem, Determination of Eigen value, Eigen vectors and their properties, Diagonalisation of a matrix, Cayley-Hamilton Theorem, Power of a matrix, Exponential matrix

UNIT- II :

Dirac Delta Function:

Dirac Delta Function, Properties, Fourier Transform**,** Laplace Transform and Derivative of Dirac Delta Function

Green's Function:

Green's Function for 1-D case, Symmetry property of Green's Function, Solution of inhomogeneous partial differential equation by Green's Function method

UNIT- III : Laplace Transform :

Laplace Transform, Properties and examples, Laplace Transform of Derivatives and Integrals, Covolution Theorem and its Application

Inverse Laplace Transform :

Inverse Laplace Transform, Properties and examples, Inverse Laplace Transform of Derivatives and Integrals, Inverse Laplace Transform by Covolution, Solution of Differential equation by Laplace Transform

UNIT- IV : Group Theory:

Definitions of groups, subgroups and classes, Cayley's theorem, Group representations, characters, infinite groups and lie groups, Reducible and irreducible representations of SU(2), SU(3) and O(3) groups

UNIT- V : Numerical Analysis:

Eigen values and eigenvectors of matrices, power and Jacobi method, Finite Differences, Interpolation with equally Spaced and unevenly spaced points (Newton's and Lagrange's method), Forward and Backward Interpolation, Extrapolation, Numerical Integration by trapezoid and Simpson's rule, Solution of first and second order differential equation using Runge-Kutta method.

Text books:

1. Mathematical Methods of Physics by Mathews and Walker (W. A. Benjamin Inc.)
2. Elements of Group Theory by A. W. Joshi (New Age International Publisher)
3. Matrices and Tensors in physics by A. W. Joshi (New Age International Publisher)
4. Mathematical Methods for Physicist by G. Arfken and H. Weber, Academic Press (Elsevier)
5. Fundamentals of Computers by V. Rajaraman (Prentice Hall of India)

Reference Books:

❖ Mathematical Physics by B. D. Gupta (Vikas Publishing House)
❖ Mathematical Physics by P. K. Chattopadhyaya (New Age International)
❖ Mathematical Physics by Satyaprakash
❖ Mathematical Physics by M. Das, P.K. Jena, N. Barik (Srikrishna Publication)
❖ Numerical methods for engineering and scientific computation by M.K. Jain (Wiley Eastern)

CC-2.2 : QUANTUM MECHANICS : II

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Motion in a spherically symmetric field:

Hydrogen atom, reduction to equivalent one body problem, Radial equation, energy eigen values and eigen function, Degeneracy, radial probability distribution. The free particle problem, incoming and outgoing spherical wave, Expression of plane wave in terms of spherical wave, Bound state of 3-D square well potential, particle in a sphere

UNIT- II : Approximation Method:

Stationary perturbation theory, Rayleigh Schrodinger method for non-degenerate case, first and second order perturbation, anharmonic oscillator, general theory for the degenerate case, Removal of degeneracy

UNIT- III : T.D. perturbation theory:

Transition probability, constant and harmonic perturbation, Fermi-golden rule, Harmonic perturbation and constant perturbation.

WKB Approximation Method:

Connection formula, Bohr- Summerfield quantization rule, Application of harmonic oscillator, cold emission

UNIT- IV : Scattering theory:

Scattering amplitude and scattering cross section, Born approximation Application to coulomb and sheened coulomb potential.

Variational Method:

Ground state of the He atom

UNIT- V : Partial wave Analysis:

P.W.A. for elastic and inelastic scattering, effective range and scattering length, Optical theorem, Scattering from a hard sphere, Resonant scattering from a square well potential

Text book:

1. Quantum Mechanics concepts and Applications by Nouredine Zettili, John Wiley and sons Publications

Reference books:

- Quantum Mechanics by L. I. Schiff, International Student edition.
- Quantum Mechanics by D. Griffith, Pearson Publishers.
- Quantum Mechanics by S. Gasiorowicz, John Wiley edition.
- Quantum Mechanics by Eugene Merzbacher, Wiley International Edition
- Quantum Mechanics by Ghatak & Lokanathan (Mc Millan)
- Quantum Mechanics by Sakurai, Pearson Publishers.
- Introduction to Quantum Mechanics by Bransden and Joachain, Pearson Publishers.
- Quantum Mechanics by Griener, (Springer)

CC-2.3 : NUCLEAR PHYSICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Nuclear momentum Theory:

Rotational invariance in 3D, Eigen value and Eigen function of angular momentum operator, Explicit representation of the rotation matrices, addition of angular momenta, C.G. coefficient, irreducible spherical tensor, matrix element of tensor operators, Weigner-Eckart theorem

UNIT- II : Two Nucleon system:

Ground and excited state of the deuteron, Tensor forces and quadrupole moment of deuteron, Photodisintegration of the deuteron

UNIT- III : Nuclear models:

Shell model, analysis of shell predictions, extreme single particle model. Configuration mixing, individual particle model, L.S and J.J coupling scheme

UNIT- IV : Scatters:

Neutron-proton scattering at low energy, scattering C.S. Scattering length, Spin dependence of neutron-proton scattering, Effective range theory

UNIT- V : Nuclear disintegration:

Gamow's theory of alpha decay, Geiger-Nuttal law, Beta decay, Fermi's theory of beta decay, Parity violation, Selection rules for allowed transition

Nuclear Reaction:

Energetics of nuclear reaction, Compound nucleus theory, resonance scattering, Briet-Wigner formula

Text Book:

1. Nuclear Physics by R.R. Roy and B.P. Nigam (John Wiley)

Reference Books:

- Physics of the nucleus by M.A. Preston (Addison Wesley)
- Nuclear Physics by S.S.M. Wong (Prentice Hall)
- Introduction to Nuclear Physics by H. A. Enge (Addison Wesley)
- Introductory Nuclear theory – Elton
- Theoretical Nuclear Physics - Blatt & Weisskopf.
- Nuclear Physics - D.C. Tayal
- Atomic and Nuclear Physics Vol - II by Ghoshal.
- Theory of Nuclear Structure - M.K. Pal
- Introductory Nuclear Physics - Y. R. Waghmare.

CC-2.4 : ATOMIC AND MOLECULAR PHYSICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Magnetic Dipole Moments

Magnetic Dipole Moments, Electron Spin, Vector Atom Model
Spin – orbit Interaction, Hydrogen Fine Structure

UNIT- II : Spectroscopic terms

Spectroscopic terms, spin-orbit coupling, L-S and J-J Coupling

UNIT- III :

Normal and Anomalous Zeemann effect, Paschen Back effect, Stark effect, Hyperfine Structure of Spectral lines

UNIT- IV : Spectra of Alkali elements

Spectra of Alkali elements, Spectra of Alkaline earth elements and Complex Spectra

UNIT- V : Vibrational and Rotational Spectra

Vibrational and Rotational Spectra, Molecule as Harmonic Oscillator, Molecule as an harmonic Oscillator, Vibrational frequency and Force Constant for A.H.O., Isotope effect on vibrational levels, Fine structure of I-R Bands, Molecule as a vibrating Rotator, Diatomic molecule as a symmetric top

Text Book:

1. Atomic and Molecular Spectroscopy by Raj Kumar (Kedar Nath Ram Nath)

Reference Books:

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Modern Physics by S.P. Kuila, NCBA Publication

CC-2.5 : MODERN PHYSICS /EMT/OPTICS (PRACTICAL)

Full Marks: 100
End Sem : 100/6hrs

1. B-H Curve, Oscilloscopic display
2. Determination of 'h' by Photoelectric effect
3. L C R Bridge
4. Optical bench: Biprism, straight edge

5. Spectrometer: Single and double slit
6. Michelson Interferometer: Determination of A and α, thickness of Mica sheet
7. Fabry perot Interferometer.
8. Polarisation: Babinet's Compensator
9. Dielectric Constant of a liquid by electrically maintained tuning fork.

Any other experiments that may be set up from time to time

SEMESTER-III

CC-3.1 : ADVANCED QUANTUM MECHANICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I :

Brief introduction, Mathematical Preliminaries, K.G. equation for free particle and its drawback, K.G. equation for particle in e.m. field, Dirac equation, Properties of Dirac matrices, Solution of Dirac equation for a free particle. Non-relativistic reduction of Dirac equation, Dirac particle in central field

UNIT- II :

Projection operators for energy and spin, Zitterbewegurg, Hole Theory, Magnetic moment, Spin-orbit coupling

UNIT- III :

Covariant form of Dirac equation, Bilinear covariant, Properties of Gamma matrices.

UNIT- IV :

Field Theory:

Continuous systems and fields, Transition from discrete to continuous system, Lagrangian and Hamiltonian formulation, Noether's Theorem

UNIT- V :

Lorenz transformation, CPT symmetry

Text Books:

1. Relativistic quantum field theory by J.D. Bjorken and S.D. Drell, Mc Graw-Hill Book Company
2. Relativistic Quantum Mechanics - J.D. Bjorken and S.D. Drell
3. Relativistic Quantum Fields - J.D. Bjorken and S.D. Drell

Reference Books:

- Lectures on Quantum Field Theory, Ashok Das, (World Scientific Publishing Co. Pvt. Ltd).
- Introduction to quantum field theory by P. Roman
- Quantum Mechanics and Field Theory by B.K. Agarwal, Asia Publishing House.
- Advanced Quantum Mechanics - J.J. Sakurai
- Quantum Field Theory - F. Mandl and G. Shaw
- Quantum Field Theory - C. Itzykson and J. Zuber
- Quantum Field Theory - M. E. Peskin and D. V. Schroeder
- Quantum Field Theory - L. H .Ryder
- Quantum Field Theory - S. Weinberg

CC-3.2 : BASIC ELECTRONICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Amplifiers :

Frequency response of linear amplifiers. RC coupled transistor amplifier, Transformer coupled transistor amplifier. Frequency response, Gain, Bandwidth, Gain bandwidth product, Feedback in amplifiers, Effects of negative feedback

UNIT- II :

Oscillator circuits : Feedback criteria for oscillation, Nyquist criterion, Phase shift Oscillator, Wein Bridge Oscillator, Crystal Oscillator, Klystron Oscillator

Multivibrators : Astable, Bistable, Monostable Multivibrators

UNIT- III :

Operational amplifier : Differential amplifier (Circuit configuration and properties, ideal operational amplifier input and output impedances)

Application of OP-AMP : Inverting amplifier, Non-inverting amplifier, adder, substractor, integrator, differentiator, logarithmic amplifier, comparator (Principle, basic circuit operation and theory)

UNIT- IV :

Integrated circuits : Types of components of ICs ,Fabrication of monolithic ICs , Scale of Integration of Circuit Components , Classification of ICs Limitations of ICs

Flip-Flop: RS, Clocked RS, JK, master-slave edge-triggered, Conversion of flip-flops, Application of flip-flops

A/D and D/A converters

Shift registers, Counters: Asynchronous, Synchronous

UNIT- V :

Radio Communication : Modulation and Demodulation, Ionospheric Propagation

Antenna Theory: Antenna: Basic antenna action, current and voltage distribution in linear antenna, dipole antenna, power radiator, radiation resistance and directional pattern. Different types of antenna: (Only descriptive study of practical antenna) Horn antennas, Reflector antennas, Yagi antenna

Text Book:

1. Electronic fundamental and application by J.D. Ryder, PHI, Learning Pvt Ltd.
2. Fundamentals of digital circuits by A. Anand Kumar, PHI, Learning Pvt Ltd.

References:

- Foundation of electronics – Chattopadhyay, Rakshit, Saha and Purkait, New age International publisher
- Electronics principles-Albert Malvino, Tata McGraw-Hill Edition
- Modern Digital Electronics-R.P Jain, Tata McGraw-Hill Edition
- Handlook of Electronics : Gupta Kumar (Pragati)
- Digital Electronics : Gothmann
- Operational Amplifier – Trunde
- Functional Electronics – Ramana
- Microwave Technology – Sarkar

CC-3.3 : BASIC ELECTRONICS (PRACTICAL)

Full Marks: 100
End Sem : 100/6hrs

1. Characteristics of vacuum tubes and transistors
   i) Diode, Triode and Pentode
2. Setting up an oscillator (A.F. & R.F.)
3. Setting up of an amplifier and study of its characteristics
4. Characteristics of Diode and Zener diode
5. Study of logic gates AND, OR, NOT, NAND, NOR, EXOR
6. Making AND, OR, NOT Gates using NAND Gates
7. Verification of Boolean Algebra

8. Study of different flip-flops
9. Verification of Dual nature
10. Characteristics of FET (Field Effect Transistor)

Any other experiments that may be set up from time to time

CE-3.4 : BASIC SOLID STATE PHYSICS (SPECIAL PAPER)-I

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Crystal Binding

Crystals of inert gases, ionic crystals, covalent crystals, metallic binding Hydrogen bonded crystals

UNIT- II : Phonons and lattice vibration

Vibration of monoatomic and diatomic lattices, Dispersion relation, optic and acoustic modes, quantum of lattice vibration and phonon, phonon momentum, inelastic scattering of neutrons and photons by phonons,3-Dimensional lattice vibration

UNIT- III : Thermal properties of insulators

Lattice heat capacity, Debye and Einstein Model, Anharmonic crystal interactions, Thermal conductivity and thermal expansions

UNIT- IV : Free Electron Fermi gas

Density of states in one dimension, Effect of temp. on Fermi-Dirac Distribution, Free electron gas in 3 dimension. Heat capacity of the electron gas, Electrical and thermal conductivity of metals

UNIT- V : Band Theory

Nearly free electron model, Brillouin Zones for square and cubic lattices, Zone schemes, Classification of solids (Conductors, semiconductors and insulators)

Text Books:

1. Introduction of Solid State Physics : C. Kittel (Wiley)

Reference Books:

- Solid State Physics : A Omar (Pearson)
- Solid State Physics : Ashcroft and Mermin (Cengage)
- Solid state Physics : A.J. Dekker
- Solid state Physics : Wahab
- Solid state Physics : S.O. Pillai (New Age)

CE-3.4 : ELECTRONICS (SPECIAL PAPER)-I

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Networks Theorem

Network and Network theorems : Mesh and node circuit analysis, reduction of complicated network, conversion between T and TT section, The bridged T- network, the lattice network, The superposition theorem, The reciprocity theorem, Thevenin theorem, Norton's theorem, the maximum power-transfer theorem

Resonant Circuit : Series resonance and parallel resonance. Behavior of system involving resonant primary and resonant secondary circuit. Microwave Source : Reflex Klystron, Magnetron, Traveling wave tube

UNIT- II : Transmission line

Calculation of line parameters of parallel wire lines and coaxial line. Voltage and current relations on Radio Frequency Transmission line in terms of traveling waves, propagation constant attenuation constant, phase constant. Line distortion and alternative line termination for zero load, finite load and infinite load, standing wave ratio

UNIT- III : Wave Guide and Cavity Resonators

Physical picture of propagation in Rectangular wave guides, circular wave guides, standing wave ratio in wave guides, wave guide behavior at wave lengths greater than cut off, wave guide coaxial coupling, Directional couplers, (Wave guide tee junction, Theorems on Tee junctions, H-Plane Tee, E- Plane Tee, Magic Tee-Microwave) Resonators:- Rectangular resonator, cylindrical resonator, spherical resonator (modes and Q of all resonators) Excitation and coupling of cavities. Application of Resonators

UNIT- IV : Wave shaping circuits

Linear wave shaping – R.C. circuit. High pass and low pass R-C with different input voltage, Non linear wave shaping-shunt diode clippers, series diode clippers, double ended clippers (PN junction diode & Zener diode) D-C Resistor clamping circuit

UNIT- V : Voltage and current sweep generator :

Transistor constant sweep generator, Miller integrating sweep circuit, Boot strap sweep generator current time base generator, Blocking oscillator, Triggered transistors, blocking oscillator

Text Book:

1. Networks, lines and fields :- J.D. Ryder (PHI)

Reference Books :

- Microwave circuits and passive devices : M.L. Sisodia & G.S. Raghuvanshi (Willy Ester Ltd.)
- Handbook of Electronics : Gupta and Kumar (Pragati Prakashan)

SEMESTER-IV

CC-4.1 : STATISTICAL MECHANICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Classical statistical Mechanics:

Postulate of classical statistical mechanics, Liouville's Theorem, MCE, Derivation of thermodynamics, Equipartition Theorem, Classical ideal gas, Gibb's Paradox. CE and energy fluctuation, GCE and density fluctuation, Equivalence of CE and GCE

UNIT- II : Quantum Statistical Mechanics:

Postulate of quantum statistical mechanics, The density matrix, Ensemble in quantum statistical mechanics, Ideal gas in MCE and GCE.MB, BE and FD distribution

UNIT- III :

Equation of state for ideal fermi gas. Theory of white dwarf star. Pauli Para magnetism

UNIT- IV : Phase Transitions

Thermodynamic description of phase transitions, First order and second order phase transition, Phase transition of second kind, Discontinuity of specific heat, Change in symmetry in a phase transition of second kind.

I-sing Model: Definition, 1D I-sing model

UNIT- V :

Ideal Bose gas, Photon and Planck's law, Phonons, B-E Condensation

Text Book:

1. Statistical Mechanics – K. Huang
2. Statistical Mechanics – R. K. Pathria

Reference Books:

- Elementary Statistical Physics – C. Kittel
- Statistical Mechanics – F. Mohling
- Statistical Mechanics – Landau and Lifsitz
- Physics Transitions & Critical Phenomena – H.E. Stanly
- Thermal Physics – C. Kittel
- Fundamentals of Statistical & Thermal Physics – F. Reif

CE-4.2A : CONDENSED MATTER AND MATERIAL SCIENCE (SPECIAL PAPER)-II

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I :

Imperfection in crystals

Classification of imperfection, Crystallographic imperfections, Point defects, Shottkey and Frenkel defect, Colour centre, Line defect, Plane defect

UNIT- II : Energy bands

General Properties of energy bands, Tight binding methods, Orthogonalised plane waves, pseudo potential methods of energy band calculations, de-Hass-Vaan Alphen effect.

Representation of theory

Wannier functions, Equation of motion in Wannier representation, equivalent Hamiltonian and impurity levels

UNIT- III : Semiconductors :

Intrinsic and extrinsic semiconductors, Band gap, law of mass action, intrinsic carrier concentration, Mobility in the intrinsic region, Energy bands in Si and Ge, P-N junctions. Hall effect

UNIT- IV : Superconductivity:

Experimental survey, Meissner effect, Type-I and Type – II superconductors, Thermodynamics of super conductors, London's theory, Josephson effect, flux quantization, BCS theory, High temperature superconductors (elementary ideas).

UNIT- V : Solid state device

Tunnel diode, Solar cells, photo voltaic detectors and cells, Schottky barriers, gun effect oscillators, photo diode, photo resistors, Infrared and ultraviolet detector, Avalanche photodiode, photo transistor.

Text books:

1. Introduction to Solid State Physics - C. Kittel

Reference Books

- Solid State Physics - Aschroft and Mermin
- Solid State Physics - A. Omar
- Solid State Physics - A.J. Dekker
- Introduction to Solid State Physics - C. Kittel
- Solid State Physics - A.O.E. Animalu
- Physics of semiconductor devices - Michael Shur (PHI).
- Quantum theory of solids - C. Kittel.

CE-4.2B : ELECTRONICS (SPECIAL PAPER)-II

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT- I : Application of op-AMP

Scale changing, phase shifting, voltage follower, voltage to current converter, current to voltage converter, analog computation, logarithmic and antilogarithmic amplifier, bridge amplifier, voltage comparator, Schmitt trigger, op-AMP voltage regulator, Sawtooth wave generator, multivibrators, 555 – IC timer, Boot strap sweep generator

UNIT- II : Digital circuit and computer

Half adder, full adder, parallel binary adder, primary subtraction simplification of digital circuits using Kamaugh maps, (Two, three, four variables), Quads, Octets, Don't care condition/ decoder/encoder, BCD to 7 segment decoder, digital computer, multiplexer/demultiplexer, characteristics of logic families. Digital to Analog converter with ladder networks, Analog to Digital converter :- Ramp conversion, Dual slope integration, successive approximation, parallel/series conversion

UNIT- III : Microprocessor

Basic concepts of Microprocessor, Microprocessor architecture, qualitative idea on 8085, Motorola M6800 microprocessors (Block diagram only)

UNIT- IV : Quantum Electronics

Basic principle of Maser operation, spontaneous and stimulated emission, gas maser, solid state maser, optical maser (Laser), Laser oscillation condition-Gain and population inversion- Oscillation frequency frequency-frequency pulling, Ruby laser, Gas laser, application of laser.

Light Source and Display : Electro luminescent, light emitting diode, semiconductor injection laser, LED displays, liquid crystal displays

UNIT- V : Opto electronic device

Photodetector-Photodiodes-Phototransistors, photo field effect transistors, solar cells, infrared detector, ultraviolet detector, photo position detectors, photo conductor.

Opto-isolator : Photoconductor opto-isolator, LED/ phototransistor, opto-isolator.

Text Books:

1. Digital Electronics : Willium H. Gothmann (PHI)
2. Optical electronics –Ajay Ghatak & K. Tyagarajan. (Cambridge University Press.)

Reference Books:-

- Integrated Circuits and Semi conductor devices : Deboo/ Burrous Theory and Application : G.J.C.N. (McGraw Hill)
- Fundamental of Computers : V. Rajaraman (PHI)
- Introduction of Microprocessor : Aditya P. Mathur (McGraw Hill)
- Modern Digital Electronics : R.P. Jain, M.M.S. Anand
- Electronics Fundamentals & Application : D. Chattopadhya & Rakhit
- Handbook of Electronics : Gupta Kumar
- Optoelectronics an Introduction : J. Wilson, J.H. B. Hawkes. Eastern economy edition (Prentice Hall)

CE-4.3A : CONDENSED MATTER AND MATERIALS SCIENCE (SPECIAL PAPER)-II (PRACTICAL)

Full Marks: 100
End Sem : 100/6hrs

1. Determination of energy gap of a given semiconductor by four probe method
2. Determination of Hall constant of a sample and its identification
3. Determination of energy gap by p-n junction method
4. Study of dispersion relation of an electric analog of mono atomic linear chain
5. Study of dispersion relation of an electric analog of diatomic linear chain
6. Determination of specific heat of a given sample using a thermocouple
7. Determination of dielectric constant of a given sample by lecher wire method
8. Determination of B-H curve of a given ferromagnet

Any other experiments that may be set up from time to time

CE-4.3B : ELECTRONICS (SPECIAL PAPER)-II (PRACTICAL)

Full Marks: 100
End Sem : 100/6hrs

1. Study of the various stages of a regulated power supply and find its regulation and ripple factor.
2. Design and assemble of a single stage transistor amplifier and study of its frequency response.
3. Study of phase transition using feed- Back amplifier circuit.
4. Study of multivibrator-Astable.
5. Study of multivibrator-Bistable.
6. Study of multivibrator-Monostable.
7. Design of operational amplifier circuit.

8. Use of operational amplifier for integration and differentiation.
9. Use of operational amplifier for addition and subtraction.
10. Study of various stages of a digital voltmeter.
11. Study of various stages of digital frequency counter.
12. Study of various stages of a CRO and calibrate it for measurement of frequency and amplitude.
13. Determination of Hall voltage and Hall coefficient.
14. Study of different gates.
15. Programming using into 8085 microprocessor.

Any other experiments that may be set up from time to time

CE-4.4 : PROJECT AND SEMINAR

Project: 50 Marks
Seminar: 50 Marks

Students will be assigned topics for project and seminar under the supervision of teachers of the department.

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