First Semester				**Second Semester**			
Theory				**Theory**			
Code	Subject	Contact Hours	Credit	Code	Subject	Contact Hours	Credit
MPYC-101	Classical Mechanics	45	4	MPYC-201	Quantum Mechanics-II	50	4
MPYC-102	Mathematical Methods-I	45	4	MPYC-202	Statistical Mechanics-I	45	4
MPYC-103	Quantum Mechanics-I	50	4	MPYC-203	Basic Condensed Matter Physics	48	4
MPYC104	Physics of Semiconductor Devices	48	4	MPYC204	Mathematical Method-II	48	4
MPYC105	Fundamentals of computer and Prog. in C	45	4	MPYC204	Nuclear and Particle Physics	48	4
		Total	19			Total	20
Practical/Sessional				**Practical/Sessional**			
Code	Subject	Contact Hours	Credit	Code	Subject	Contact Hours	Credit
MPYF-156	Programming in C Lab		3	MPYF-256	Computational Physics Lab		2
MPYF-151	Electromagnetics and Optics lab		3	MPYF-251	General Physics Lab		3
		GTotal	**25**			**GTotal**	**25**

Third Semester				Fourth Semester			
Theory				**Theory**			
Code	Subject	Contact Hours	Credit	Code	Subject	Contact Hours	Credit
MPYC-301	Adv.Quantum Mechanics & Field Theory	45	4	MPYC-401	Statistical Mechanics-II	50	4
MPYC-302	Basic Electronics	45	4	MPYC-402	Classical Elec.dynamics-II	45	4
MPYC-303	Classical Electrodynamics-I	50	4	MPYC-403	Atomic and molecular Physics	48	4
MPYC304	Seminar	48	3	MPYC405 MPYC406	CoreElective-II (Theory)	48	4
MPYC305 MPYC306	Core Elective-I (Theory) Condensd matter physics Particle Physics	45	4	MPYC404	Dissertation/ Project	48	4
		Total	19			Total	20
Practical/Sessional				**Practical/Sessional**			
Code	Subject	Contact Hours	Credit	Code	Subject	Contact Hours	Credit
MPYE-352	Core Elective Practical		3	MPYE-453	Core elective		3
	Condensd matter physics Lab				Particle Physics Lab		
MPYE-353	Particle Physics Lab			MPYE-452	Condensd matter physics Lab		
MPYF-351	Basic Electronics lab		3	MPYC-451	Modern Phys. Lab.		2
GTotal			**25**	**GTotal**			**25**

Student can offer one of the core electives from below with papers I and II

Core Electives:

1. Advanced Nuclear Physics-I &II (MPYE-307 & MPYE-407)
2. Advanced Condensed Matter Physics-I &II (MPYE-305 & MPYE-405)
3. Particle Physics-I &II (MPYE-306 & MPYE-406)
4. Electronics-I &II (MPYE-308 & MPYE-408)
5. Plasma Physics And Hydrodynamics-I &II (MPYE-309 & MPYE-409)

FIRST SEMESTER

MPYC-101 (CLASSICAL MECHANICS)MARKS-100

UNIT-I Mechanics of a system of particles:

Inertial and non inertial frames of reference. Lagrangian Formulation, Velocity dependent potentials and Dissipation Function , conservation theorems and symmetry properties, Ho-mogeneity and Isotropy of space and Conservation of linear and Angular momentum, Homogeneity of time and conservation of energy.

Hamiltonian Formulation:

Calculus of variations and Euler Lagranges equation, Brachistochrone problem , Hamiltons principle, extension of Hamiltons principle to nonholonomic systems , Legendre transforma-tion and the Hamilton equations of motion, physical significance of Hamiltonian ,Derivation of Hamiltons equations of motion from a variational principle , Rouths procedure , -variation , Principle of least action.(12)

UNITII

Canonical transformations:

Canonical Transformation , types of generating function , conditions for Canonical Transformation , integral invariance of Poincare , poissons theorem , Poisson and Lagrange bracket , Poisson and Lagrange Brackets as canonical invariant , Infinitesimal canonical Transformation and conservation theorems , Liouvilles theorem.

Hamilton -Jacobi Theory:

Hamilton - Jacobi equation for Hamiltons principal function , Harmonic oscillator and Kepler problem by Hamilton - Jacobi method , Action angle variables for completely separable system , Kepler problem in Action angle variables , Geometrical optics and wave mechanics.(15)

UNIT-III

Small oscillation:

Problem of small oscillations , Example of two coupled oscillator , General theory of small oscillations, Normal coordinates and Normal modes of vibration , Free vibrations of a linear Triatomic molecule.

Rigid body motion:

The independent of coordinates of a rigid body, orthogonal transformations , The Eulers angles , The Cayley-Klein parameters , Eulers theorems on the motion of a rigid body , infinitesimal rotations , rate of change of a vector, The Coriolis Force.

Rigid body dynamics:

Angular Momentum and kinetic energy of motion about a point.: The Inertia Tensor and momentum of Inertia , Eigen values of Inertia Tensor and the principal Axis transformation

. The Heavy symmetrical Top with one point Fixed . Elementary idea about non- linearity and chaos. (13)

BOOKS:

1. Classical Mechanics H. Goldstein
2. Classical Mechanics - Landau and Liftshitz
3. Classical Mechanics Corben & Sxztehle
4. Classical Dynamics Marion & Thornton
5. Analytical Mechanics L. Hand and J. Finch
6. Classical Mechanics J.C. Upadhyaya

MPYC -102 (MATHEMATICAL METHODS-I) Full Marks-100

Unit-I

Vector analysis, curvilinear co-ordinates, matrices and vector spaces, Hilbert spaces,Operators in infinite dimensional spaces. Fourier series and fourier transform, Laplace transform.

Line integral of complex function, Cauchy integral theorem, Cauchys integral formula, Calculus of Residues: Cauchys Residue theorem, Singularities of complex functions, simple poles, Evaluation of definite integrals ,Generalised functions,:Dirac delta function .(10)

Unit-II

Taylor series and Laurent series expansion. Linear second order differential equations with variable coeficients: singularities of differential equations and their classification, power series method and Frobenius extended power series method of solving di erential equations: Bessel , Legendre, Hermite.(15)

Unit-III

Groups and Group representation: Definition of groups,Finite groups,example from solid state physics,sub groups and classes,Group Representation, Characters,Infinite groups and Lie groups,Lie algebra,application, Irreducible representation of SU(2),SU(3)and O(3). Beta, gamma functions, Greens function and its application . Partial differential equations.(15)

BOOKS:

1. Mathematical methods of physics J. Mathews & R.L. Walker.
2. Mathematical methods of physics Arfken and Weber.
3. Mathematical methods for physicists Dennery & Krzywicki.
4. Mathematical methods of physics H. K. Das
5. Mathematical methods of physics Dr. Rama verma (s. Chand)
6. Mathematical methods of physics Satyaprakash (S. Chand)
7. Mathematical methods of physics Binoy Bhattacharya. (NCBA Publication)
8. Introduction to Tensor calculus - Goreux S. J.
9. Mathematical methods of physics Dettman J.W.

MPYC -103(QUANTUM MECHANICS-I)MARKS-100

Unit-I

General principle of Quantum mechanics: Linear Vector Space Formulation: Linear vector Space(LVS) and its generality. Vectors:Scalar product, metric space, basis vectors,linear independence, linear superposition of general quan-tum states,completeness and orthogonal relation,Schmidts orthonormalisation procedure, Dual space, Bra and Ket vectors, Hilbert space formalism for quantum mechanics.

Operator: 10

linear,Adjoint,hermitian,,unitary,,inverse,,antilinear operators,Noncommutativity and uncertainty relation, complete set of compatible operators, simultaneous Measurement, Projection operator,eigen value and Eigen vector of linear,hermitian,unitary operators, Matrix representation of vectors and operators, matrix elements,eigen value equation and expectation value, algebraic result on Eigen values, transformation of basis vectors, similarity transformation of vectors and operators,diagonalisation. Vectors of LVS and wave function in co-ordinate, momentum and energy representations . 5

Unit-II

Quantum Dynamics: Time evolution of quantum states, time evoluation of operators and its properties, Schrodinger picture, Heisenberg picture, Dirac/Interaction picture, Equation of motion, Operator method of solution of 1D Harmonic oscillator, time evolution and matrix representation of creation and annihilation operators, Density matrix.

Rotation and orbital angular momentum: Rotation matrix, Angular momentum operators as the generation of rotation, components of angular momentum L_x; L_y; L_z and L^2 and their commutator relations, Raising and lowering operators (L_+ and L), L_x; L_y; L_z and L^2 in spherical polar co-ordinates, Eigen value and eigen function of L_z; L^2(operator method), Spherical harmonics, matrix representation of of L_+; L and L^2, Spin angular momentum: Spin 12 particle,Pauli spin matrices and their prop-erties Eigen values and Eigen function, Spinor transformation under rotation. 15

UNIT-III

Addition of angular momentum:

Total angular momentum J. Eigen value problem of J_z and J^2, Angular momentum matrices, Addition of angular momenta and C.G.Coecients, Angular momentum states for composite system in the angular momenta(1/2,1/2) and (1,1/2).

Motion in Spherical symmetric Field: Hydrogen atom, Reduction to one dimensional one body problem, radial equation, Energy eigen value and Eigen function, degeneracy, radial probability distribution.

Free particle problem: incoming and outgoing spherical waves, expansion of plane waves in terms of spherical waves. Bound states of a 3-D square well, particle in a sphere. 10

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S.N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanathan
7. Advanced Quantum Mechanics P.Roman
8. Quantum Mechanics (Non Relativistic theory) L.D. Landau and E.M. Lifshitz
9. Elementary Theory of Angular Momentum M.E. Rose
10. Principles of Quantum Mechanics P.A.M. Dirac
11. Quantum Mechanics, concepts and application, N Zettili

MPYC-104(PHYSICS OF SEMICONDUCTOR DEVICES)

Unit-I Introduction to the quantum theory of solids:

Formation of energy bands, The k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators. Electrons and Holes in semiconductors: Silicon crystal structure, Donors and acceptors in the band model, electron effective mass, Density of states, Thermal equilibrium, Fermi-Dirac distribution function for electrons and holes, Fermi energy. Equilibrium distribution of electrons & holes: derivation of n and p from D(E) and f(E), Fermi level and carrier concentrations, The np product and the intrinsic carrier concentration. General theory of n and p, Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out. Energy-band diagram and Fermi-level, Variation of E_F with doping concentration and temperature. Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole mobilities, Mechanism of carrier scattering, Drift current and conductivity. Motion and Recombination of Electrons and Holes: Carrier di ffusion: diffusion current, Total current density, relation between the energy diagram and potential, electric field. Einstein relationship between diffusion coeffcient and mobility. Electron- hole recombination, Thermal generation. 12

Unit-II

PN Junction:

Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi- equilibrium boundary condition; current continuity equation; Excess carriers in forward-biased pn junction; PN diode I-V characteristic, Charge storage. 13

Unit-III

The Bipolar Transistor:

Introduction, Modes of operation, Minority Carrier distribution, Collector current, Base cur-rent, current gain, Base width Modulation by collector current, Breakdown mechanism, Equiv

alent Circuit Models - Ebers -Moll Model. Metal-Semiconductor Junction: Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode. Ohmic contacts: tunneling barrier, speci c contact resistance.
MOS Capacitor: The MOS structure, Energy band diagrams, Flat-band condition and at-band voltage, Sur-face accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Qinv in MOSFET. 10
MOS Transistor:

Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-I Characteris-tics, Surface mobilities and high-mobility FETs, JFET, MOSFET Vt, Body effect and steep retrograde doping, pinch-o voltage, 5

BOOKS:

1. Physics of Semiconductor Devices - Donald A. Neamann
2. Physics of Semiconductor Devices - B.B. Swain
3. Physics of Semiconductor Devices - Anjana Acharya
4. Physics of Semiconductor Devices - Calvin Hu.
5. Physics of Semiconductor Devices - Dilip K Roy
6. Fundamentals of Semiconductor Devices- M.K. Achthanand K.N. Bhatt
7. Solid state Electronics Devices Bhattacharya , Rajnish Sharma
8. Semiconductor Materials and Devices J.B. Gupta
9. Physics of Semiconductor Devices - Jivan Jyoti Mohanty.

MPYC105 FUNDAMENTALS OF COMPUTER AND PROGRAMMING IN ‘C’

Module – I [12 Hours]

Algorithm, flowchart, Structured Programming Approach, structure of C program (header files, C pre-processor, standard library functions, etc.),identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, statements and blocks, if and switch statements, loops:-while, do-while and for statements, break, continue, goto, programming examples.

Module – II [12 Hours]

Designing structured programs: - Functions, parameter passing, storage classes- extern, auto, register, static, scope rules, user defined functions, recursive functions. Arrays- concepts, declaration, definition, accessing elements, and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory management functions, command line arguments,

Module – III [12 Hours]

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit fields, C program examples. Input and output – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, C program examples.

Text Books:

1. Balagurusamy : “C Programming” Tata McGraw-Hill
2. P. Dey & M. Ghosh, “Computer Fundamental & Programming in C”- Oxford University Press
3. Deitel -“C How to programme” PHI publication/ Pearson Publication

Reference Books:

1. Y. Kanitkar – “Let us C” BPB Publisher
2. H. Schildt – “C the complete Reference” McGraw-Hill
3. Schaum Series- “C Programming” - Gotterfried

MPYF-156PROGRAMMING IN 'C' LAB

(Minimum 10 programs to be done covering 8 Experiments)

Experiment No. 1

a) Write a C program to find the sum of individual digits of a positive integer.

b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Experiment No. 2

a) Write a C program to calculate the following Sum:

Sum=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!

b) Write a C program to find the roots of a quadratic equation.

Experiment No. 3

a) Write C programs that use both recursive and non-recursive functions

i) To find the factorial of a given integer.

ii) To find the GCD (greatest common divisor) of two given integers.

iii) To solve Towers of Hanoi problem.

Experiment No. 4

a) Write a C program to find both the larges and smallest number in a list of integers.

b) Write a C program that uses functions to perform the following:

i) Addition of Two Matrices

ii) Multiplication of Two Matrices

Experiment No. 5

a) Write a C program that uses functions to perform the following operations:

i) To insert a sub-string in to given main string from a given position.

ii) To delete n Characters from a given position in a given string.

b) Write a C program to determine if the given string is a palindrome or not

Experiment No. 6

a) Write a C program to construct a pyramid of numbers.

b) Write a C program to count the lines, words and characters in a given text.

Experiment No.7

a) Write a C program that uses functions to perform the following operations:

i) Reading a complex number

ii) Writing a complex number

iii) Addition of two complex numbers

iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.) 21

Experiment No.8

a) Write a C program which copies one file to another.

b) Write a C program to reverse the first n characters in a file.

(Note: The file name and n are specified on the command line.)

Book:- PVN. Varalakshmi, Project Using C Scitech Publisher

MPYC-151(ELECTROMAGNETISM AND OPTICS LAB)

1.Michelsons interferometer: determination of wavelength of sodium lines.
2.Febryparrot interferometer:
3.Babinets compensator:
4.Magnetic field measurement by search coil
5.Determination of charge of electron by Milikans oil drop experiment
6.Study of polarization using Malus law
7.Specific rotation by sugar solution using polarimeter
8.Resistance of discrete energy level by frank hertz experiment 9. Brewsters law
9.Ferroelectric transmission point by dielectric constant measurement
e/m measurement

SECOND SEMESTER

MPYC-201(QUANTUM MECHANICS-II)MARKS-100

Unit-I
Approximation Method for stationary states:

Rayleigh Schrodinger Method for Time-independent Non degenerate Perturbation theory, First and second order correction, perturbed harmonic oscillator ,Anharmonic oscillator, The stark e ect, Quadratic Stark Effect and polarizability of hydrogen atom, Degenerate perturbation theory, Removal of Degerancy,parity selection rule, linear stark effect of hydrogen atom, Spin orbit Coupling, Relativistic correction, ne structure of Hydrogen like atom, normal and anomalous Zeeman effect, The strong- field Zeeman effect, The weak-field Zeeman effect and Landes g-factor.Elementary ideas about field quantizition and particle processes.(10)

Unit-II
Variational Methods:

General formalism, Validity of WKB approximation method, Connection Formulas,Bohr quantisation rule, Application to Harmonic oscillator ,Bound states for potential well with one rigid wall and two rigid walls,Tunneling through potential Barrier, Cold emission, Alpha decay and Geiger Nutal relation.

Time dependent perturbation Theory:

Transition probability, constant and harmonic perturbation, Fermi golden rule, and electric dipole Radiation and Selection Rule, Spontaneous emission Einsteins A,B- coefficient, Basic principle of laser and Maser.(15)

Unit-III
Scattering Theory:

Scattering amplitude and Cross section.Born approximation,Application to Columb and Screened coulmb potential,Partial wave analysis for elastic and inelastic Scattering.Effective range and Scattering length,Optical theorem,Black Disc Scattering,Hard-sphere Scattering, Resonance Scattering from square well potential.(15)

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S.N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanathan 7. Advanced Quantum Mechanics P.Roman 8. Quantum Mechanics (Non Relativistic theory) L.D. Landau and E.M.Lifshitz
7. Elementary Theory of Angular Momentum M.E. Rose 10.Principles of Quantum Mechanics P.A.M. Dirac
8. Quantum Mechanics, Concept and Applications, N Zettili

MPYC-202(STATISTICALMACHINES-I) MARKS-100

UNIT-I (Max Mark:30)

Classical Statistical Mechanics:

Classical probabilities: Binomial distribution of probanilitie, varaiance,mean value; Poisson's distribution, fluctuation, variance, mean value;Gaussian distribution, variance, mean value and applications.Basic principles and application of classical statistical mechanics,Liouville'stheorem,micro canonical ensemble, Review of thermodynamics , equipartition theorem , classical ideal gas , Gibb's paradox.Canonical ensemble and energy fluctuation , grand canonical ensemble and density fluctuation , Equivalence of Canonical and grand canonical ensemble.(**14 classes**)

UNIT-II(Max Mark:40)

Quantum Statistical Mechanics:

The density matrix, ensembles in quantum mechanics, Ideal gas in microcanonical and grand canonical ensemble ; equation of state for ideal Fermi gas, Theory of white dwarf stars. Ideal Bose gas, photons and planck's law, statistics of photon and phonon gas, Bose-Einstein

condensation. Distribution function for Fermi-Dirac system, Equation of states for ideal Fermi gas, The theory of White Dwarf star; Landau Diamagnetism; The quantised Hall effect, Pauli Paramgnetism, The De Haas-Van Alphen Effect.

Ising model: Definition of Ising model, One dimensional Ising model, application to Ferromagnetism.(**20 classes**)

UNIT-III(Max Mark:30)

Phase Transition: Thermodynamics description of Phase Transitions, Phase Transitions of second kind,Landau theory of phase transition beyond mean field, Gaussian fluctuation and Ginzberg criteria,Discontinuity of specific heat , change in symmetry in Phase a transition of second kind. (**10 classes**)

Books:

1. Statistical physics - K. Huang
2. Statistical Physics- B B Laud
3. Statistical physics - R.K. Pathria
4. Statistical physics - F. Mohling
5. Elementary Statistical physics - C.Kittel
6. Statistical physics - Landau and Lifsitz
7. Physics Transitions & Critical Phonomena – H.E. Stanly
8. Fundamental of statistical & Thermal physics- F. Rei

MPYC-203(BASIC CONDENSED MATTER PHYSICS) MARKS-100

Unit-I

Crystal of inert gases ,ionic crystals, covalent crystals, Metallic bonding ,Hydrogen bonded

crystals, Phonons and lattice vibrations Vibrations of monoatomic and diatomic lattices,dispersion,optics & acoustic modes, quantum of lattice vibrations and phonon momentum, Inelastic scat-

tering of neutron and photons by phonons. Thermal properties of insulators Lattice heat capacity, debye & Einstein model, Anharmonic Crystal interactions, Thermal conductivity & thermal expansion.(12)

Unit-II

Free electron Fermi gas: Density of state in one dimention,effect of temperature on Fermi-Dirac distribution ,Free electron gas in three dimentions, heat capacity of electron gas, electrical and thermal conductivity of metals.

Band theory: Electrons in periodic potential,Blochs theorem,Kronig Penney model,origin of band gap,Intrinsic & extrinsic semiconductors,band gap,law of mass action,intrinsic carrier concentration,mobility in the intrinsic region,pn junction rectification.(13)

Unit-III

Superconductivity:

Experimental survey,Meisners effect,Type-I & Type-II superconductors,Thermodynamics of superconductors,Londons theory,Josephsons effect,Basic concepts of cooper pairing in BCS theory,Ginz-Landau Theory ,flux quantization ,applications of superconductors. Magnetism Exchange interaction, diamagnetism, paramagnetism, ferromagnetism & antiferromagnetism, Langevins theory of diamagnetism, Curie-weiss law, Heisenburg model, Mean field Theory, Domain theory

of ferromagnetism & hysteresis loop, Ferrimagnetic materials.(15)

BOOKS:

1. Introduction to solid state physics C. Kittel
2. Solid state physics Ashcroft and Mermin 3. Principles of Condensed Matter physics P.M. Chaikin and T.C. Lubensky
3. Solid state physics A.J. Dekker
4. Solid state physics O.E. Animaler
5. Quantum Theory Solid State J.Callaway
6. Solid state physics C.G. Kuper
7. Solid state physics David W. Snoke (LPE Publication)
8. Solid state physics Dan Wei (Cengauge Learning)

MPYC-204(MATHEMATICAL METHOD-II)-MARKS-100

Unit-I

Tensor analysis and differential geometry:

Cartesian tensor in three space,Curves in three space and Frenet Formula, General Tensor analysis,Covarient derivative and Christofoel symbol.(10)

Unit-II

Special functions:

Solution of Bessel, Laguerre, hypergeometric and con uent Hyper geometric Equation by generating function method and their properties.(15)

Unit-III

Functions of complex variable, Ordinary differential equations , differential operations and Sturm Liouville theory, Partial differential equations, Greens function, Solution of inhomogeneous partial differential equation by Green function method.(15)

BOOKS:

1. Mathematical methods of physics J. Mathews & R.L. Walker. 2. Mathematical methods of physics Arfken and Weber.
2. Mathematical methods for physicists Dennery & Krzywicki.
3. Mathematical methods of physics H. K. Das
4. Mathematical methods of physics Dr. Rama verma (S. Chand) 6.Mathematical methods of physics Satyaprakash (S. Chand)
5. Mathematical methods of physics Binoy Bhattacharya. (NCBA Publication) Introduction to Tensor calculus - Goreux S. J.
6. Mathematical methods of physics Dettman J.W.

MYC-205(NUCLEAR AND PARTICLE PHYSICS) MARKS-100

Unit-I

General nuclear properties: Radius, mass, binding energy, nucleon separation energy, angular momentum, parity, electromagnetic moments, excited states.

Two Nucleon Problem:

Central and noncentral forces, deuteron and its magnetic moment and quadrupole moment; Force dependent on isospin, exchange force, charge independence and charge symmetry of nuclear force, mirror nuclei. Nuclear models:

Liquid drop model, fission, magic numbers, shell model, analysis of shell model predic-tions,beta stability line,collective rotations & vibrations, Nuclear Structure: Form factor and charge distribution of the nucleus, Hofstadter form factor.(15)

Unit-II

Nuclear reaction:

Energetics of nuclear reaction, conservation laws, classification of nuclear reaction ,radio active decay,radio active decay law ,production and decay of radioactivity, radioactive dating ,alpha decay:Gamow theory and branching ratios, beta decay: energetic angular momentum and parity selection rules, compound nucleus theory, resonance scattering, Breit- Wigner formula, Fermi's theory of beta decay, Selection rules for allowed transition, parity violation.(10)

Unit-III

Particle Physics:

The Standard model of particle physics, particle classification, fermions and bosons, lepton avors, quark Flavors, electromagnetic, weak and strong processes, Spin and parity determi-nation, Isospin,strangeness, hypercharge, and baryon number, lepton number, Gell-Mann-Nishijima Scheme, Quarks in hadrons: Meson and baryon octet, Elementary ideas of SU(3) symmetry, charmonium, charmed mesons and B mesons, Quark spin and colour(15)

BOOKS:

1. Nuclear physics,Satyaprakash.
2. Nuclear and Particle Physics, Mital,Verma,Gupta.

3. Nuclear Physics, Dr.S.N.GHOSAL. 4. Atomic and Nuclear physics, Shatendra Sharma.

Practicals/Sessionals:

MPYF-256 (COMPUTATIONAL METHODS IN PHYSICS) MARKS-100.

Introduction to computer hardware and software , introduction to storage in computer memory,stored program concepts,storage media computer operating system,LINUX ,Com-mands;

Programing with fortran:
Programme solving on computers-algorithem and flow charts in FORTAN 77 data types, Exercises for acquaintance:

1.To nd the largest or smallest of a given set of numbers
2.To generate and print rst hundred prime numbers
3.Sum of an AP series,GP series,Sine series ,Cosine series
4.Factorial of a number
5.Transpose of a square matrix
6.Matrix multiplication and addition 7.Evaluation of log and exponentials
8.Solution of quadratic equation
9.Division of two complex numbers
10.To nd the sum of the digits of a number

NUMERICAL METHODS

1. Interpolation by Lagrange methods
2. Numerical solution of simple algebraic equation by Newton-Raphson Methods
3. Least square t using rational functions
4. Numerical integration: Trapizoidal methods,Simsons method,Romberg method,Gauss quadra-ture method.
5. Eigen values and eigen vectors of a matrix
6. Solution of linear homogenius equations
7. Trace of a matrix
8. Matrix invertion
9. Solution of ordinary differential equation by Runge-Kutta Method
10. Introduction to Monte carlo techniques

MPYC-251 (GENERAL PHYSICS LAB) MARKS-100

1. Coeffcient of linear expansion of solid by zues method
2. Dielectric constant of solid (wax) by Lecher Wire
3. Verification of Richardsons $T^{3/2}$ law
4. RF characteristics of coil
5. Calibration of an oscilloscope
6. Stefans constant measurement.
7. Youngs modulus of glass by Cornus method.
8. Determination of magnetic susceptibility of a paramagnetic solution using Quincke’s tube method.
9. Determination of magnetic susceptibility of a paramagnetic solution using Gouys method.
10. Measurement of dielectric constant by plate capacitor.

THIRD SEMESTER

MPYC-301 (ADVANCED QUANTUM MECHANICS & FIELD THEORY) Marks-100

Unit-I

Relativistic Quantum Mechanics:

Klein-Gordon equation and its drawbacks,need for Dirac equation, Properties of Dirac matrices, Non-relativistic reduction of Dirac equation, magnetic moment, Darwins term, Spin-Orbit coupling, Poincare transformation, Lorentz group, Covariant form of Dirac equation, Bilinear covariants, Gordon decomposition.(12)

Unit-II

Free particle solution of Dirac equation, Projection operators for energy and spin, Physi-cal interpretation of free particle solution, Zitterbewegung, Hole theory, Charge conjugation, space reflection and time reversal symmetries of Dirac equation. Continuous systems and fields. Transition from discrete to continuous systems, Lagrangian and Hamiltonian Formulations, Noether's theorem.(13)

Unit-III

Quantization of free fields:

Second quantization, Equal Time Commutators, Normal Ordering, covariant quantization of electromagnetic field, Quantization of scalar, e.m, and Dirac fields, Propagators for scalar, spinor and vector fields(15)

BOOKS:

1. Advanced Quantum Mechanics - J.J. Sakurai
2. Relativistic Quantum Mechanics - J.D. Bjorken and S.D. Drell Relativistic Quantum Fields - J.D. Bjorken and S.D. Drell Quantum Field Theory - F. Mandl and G. Shaw
3. Reference books:
4. Quantum Field Theory - C. Itzykson and J. Zuber Quantum Field Theory - M. E. Peskin and D. V. Schroeder Quantum Field Theory - L. H .Ryder
5. Quantum Field Theory - S. Weinberg

MPYC-302 (BASIC ELECTRONICS) Marks-100

Unit-I

Amplifiers:

Frequency response of linear amplifiers, amplifier pass band, R.C.L.C. and transformer coupled amplifiers, Frequency response, gain band-width product, Feedback amplifiers, e ffects of negative feedback, Boot-strapping the FET, Multistage feedback, stability in ampli fiers, noise in amplifiers.

Operational amplifiers:

The differential amplifiers, integral amplifier, rejection of common mode signals. The op-erational amplifier input and output impedances, application of operational amplifiers, unit gala buer, summing, integrating and differentiating amplifiers, comparators and logarithmic amplifiers.(12)

Unit-II

Oscillator Circuits:

Feedback criteria for oscillation, phase shift, Wien bridge oscillator, crystal controlled oscil-lator, klystron oscillator, Principle of multivibrator.(10)

Unit-III

Digital Circuits:

Logic fundamentals, Boolean theorem, Logic gates RTL, DTL and TTL gates, CMS switches RS ip- op, JK ip- ops.

Radio Communication:

Ionospheric propation, Antennas of different types, super heterodyne, receiver (Block dia-gram).
Various types of optical fibers and optical communications.(15)

Books :

1.Electronic Fundamental and application J.D. Ryder 2.Int. Digital Electronics Heap and Martin
3.Integrated Electronics Millman and Halkias
4.Foundation of Electronics Chattopadhyay, Rakshit, Saha and Purkalt

MPYC-303 (CLASSICAL ELECTRODYNAMICS-I) Marks-100

Unit-I(34 marks)

Coulomb's law and electrostatics, Laplace and Poisson's equations and its solutions, unique-ness theorem, boundary value problems, method of images,dielectrics and steady currents, and magnetostatics,time varying fields, Lorentz force, Poynting theorem, gauge transformation and gauge invariance, electromagnetic potential, wave propagation in conductors and dielectrics, Lorentz theory of dispersion and complex refractive index.(15)

Unit-II(33 marks)

Maxwell's Equations:

Maxwells equations in free space; Magnetic charge; Maxwells equations inside matter; Dis-placement current; Vector and scalars potentials; Wave equation for potentials; Lorentz and Coulomb gauge conditions; Wave equation for Electric and Magentic fields in absence of sources.(12)

Unit-III(33 marks)

Covariant Formulation of Maxwells Equation:

Lorentz transformation; Scalars, vectors and Tensors; Maxwells equations and equations of continuity in terms of A and J ; Electromagnetic field tensor and its dual; Covariant form of Maxwells equations; Lagrangian for a charged particle in presence of external electromagnetic eld and Maxwells equation as Euler-Lagrange equations.(13)

MPYE-304 (SEMINAR) Marks-100

Each student has to give a seminar on any advanced topic from its core electives of 45minutes presentation before the faculty members who shall give marks out of 100 on the following criteria:

Criteria	marks allotted
1. Introduction	10
2. Theory/experimental deduction/desciption	60
3. Result	20
4. Conclusions	10

CORE ELECTIVE-I
CORE ELECTIVE- A PARTICLE PHYSICS-I

Unit-I

Lorentz Group:

Continuous and discrete transformations, Group structure, Proper and improper Lorentz Transformations, SL(2,C) representations, Poincare group.

Interacting fields:

Interaction picture, Covariant perturbation theory, S-matrix, Wicks theorem, Feynman dia-grams.(12)

Unit-II

QED:

Feynman rules, Example of actual calculations: Rutherford, Bhabha, Moeller, Compton, $e^+e^- \rightarrow \mu^+ \mu^-$. Decay and scattering kinematics. Mandelstam variables and use of crossing symmetry.

Higher order corrections:

One-loop diagrams. Basic idea of regularization and renormalization. Degree of divergence. Calculation of self-energy of scalar in Φ^4-theory using cut-of or dimensional regularization. Elementary discussions on running couplings and renormalization group.(13)

Unit-III

Gauge theories:

Gauge invariance in QED, non-abelian gauge theories, QCD (introduction), Spontaneous sym-metry breaking, Higgs mechanism.

Electroweak Theory:

Gauge boson and fermion masses, Neutral current, Experimental tests. Calculation of FB asymmetry in $e^+e^- \rightarrow \mu^+ \mu^-$ and decay widths of W and Z (only at tree-level). Higgs physics.(13)

BOOKS:

1. M. Peskin and F. Schroeder: Quantum Field Theory
2. J.D. Bjorken and S.D. Drell: Relativistic Quantum Fields
3. D. Bailin and A. Love: Introduction to Gauge Field Theory
4. A. Lahiri and P.B. Pal: A First Book of Quantum Field Theory
5. F. Mandl and G. Shaw: Quantum Field Theory
6. P. Ramond: Field Theory: A Modern Primer
7. C. Itzykson and J.B. Zuber: Quantum Field Theory

CORE ELECTIVE-B CONDENSED MATTER PHYSICS-I:

Unit-1

Crystallography:-

Crystal lattice, crystal structure, symmetry elements in crystal, proper rotation axis,plane of symmetry, inversion center, screw axis, glide plane, types of bravais lattices, crystal structure: simple cubic, body centre cubic face centred cubic, HCP structure, Diamond structure,Zinc blende structure, Fluorite structure ,perovskite structure,,Weigner –Seitz cell, Miller indices, Liquid crystals, quasi crystals, carbon clusters, carbon nano tubes.

Concepts of point group; Point groups and Bravais lattices; Crystal symmetry space groups; Symmetry and degeneracy crystal eld splitting; Kramers degeneracy; Quasicrystals: general idea, approximate translational and rotational symmetry of two-dimensional Penrose tiling, Frank-Casper phase in metallic glass.(15)

Unit-II

X-ray diffraction and reciprocal lattices

Choice of x ray ,electron and Neutron for crystal structure determination, Bragg diffraction,Reciprocal lattices,The bragg's condition and ewald construction, Brillouin zones,Brillouin zones of SC,BCC,FCC lattices, Atomic scattering factor,Geometrical Structure factor,Laue method,Rotating crystal method, powder method,Electron diffraction, Geometrical nature of electron diffraction patterns,Indexing of electron diffraction spot pattern,electron microscope ,transmission electron microscopy,scanning electron microscopy,Debye Scherrer Technique,-Analysis of the powder photograph,The determination of lattice type and space group,crystal structure determination

Fermi surface:-

Square lattice,Fermi surface,Fermi surface and Brillouin Zone,Fermi surface of three dim lattices,characteristics of Fermi surface,Closed orbit and open orbits,De Hass Van Alphen Effect,ShubinKov-De Hass Effect(12)

Unit-III

Laser Physics:

Basic elements of a laser; Threshold condition; Four-level laser system,Three level laser, CW operation of laser; Critical pumping rate; Population inversion and photon number in the cavity around threshold; Output coupling of laser power. Optical resonators; Cavity modes; Mode selection; Pulsed operation of laser: Q-switching and Mode locking; Experimental technique of Q-switching and mode locking Different laser systems: Ruby,He-Ne , CO_2 , Dye and Semiconductor diode laser; applications.

Dielectrics and ferroelectrics:

Macroscopic Dielectric constants,polar and nonpolar molecules,molecular polarizability, electronic, ionic and dipolar polarizability,depolarization field,Clausius-Mossotti equation, Classical theory of electronic polarizability,Frequency dependence of different polarizability,Ferroelectricity, Classification,ferroelectric domain, application, structure of $BaTiO_3$,Antiferroelectricity,Piezoelectricity,Ionic polarization-application to long wavelength optical modes of ionic crystal,Application to a plasma,,metal plasma,Plasmon excitation,Polarons,Debye equations.(13)

Books:

1. D. Pines: Elementary Excitations in Solids S. Raimes: Many Electron Theory
2. O. Madelung: Introduction to Solid State Theory
3. N.H. March and M. Parrinello: Collective E ects in Solids and Liquids
4. H. Ibach and H. Luth: Solid State Physics: An Introduction to Theory and Experiments J.M. Ziman: Principles of the Theory of Solids
5. C. Kittel: Quantum Theory of Solids

MPYE-353/MPYE-352 (CORE ELECTIVE-I(PRACTICAL)) Marks-100

Core Elective-II ,Particle Physics-I

1. Study of surface barrier detector.
2. Determination of value for DPPH using ESR.
3. Study of counter technique.
4. Study of single channel analyzer.
5. Study of photo detector and photo multiplier.

CORE ELECTIVE-I CONDENSED MATTER PHYSICS-I

1. Determination of magnetoresistance of bismuth
2. Study of Laues spot of mica sheet using X-ray di raction technique.
3. Study of the dispersion relation for the monoatomic and lattices using the given electrical transmission line.
4. Find the Youngs modulus for the given metal using composite piezoelectric oscillator technique.
5. Determination of magnetic susceptibility by Guoy-balance.
6. Velocity of ultrasonic waves in a given medium at different temperatures.
7. Measurement of Lande's g factor of DPPII by ESR at Microwave frequency.
8. Study of thermoluminescence of F-centre in alkali halide crystals.
9. Study of phase transition using feed back amplifier circuit.

MPYC-351(BASIC ELECTRONICS LAB.) MARKS-100

1. Setting of a transistor ampli fier and determination of the ampli fication factor at various
2. Frequency response of transister ampli er with the without feedback
3. Characterstics of Harteley oscillator
4. Determination of di erent parameters of transistor
5. Study of multivibrator Astable
6. Study of multivibrator Bistable
7. Study of multivibrator Monostable
8. VSWR in a microwave transmission line
9. Study of squarewave response of R.C. Network
10. Modulation of detection
11. Lock-in-ampli er
12. Design of operational amplier circuit

FOURTH SEMESTER

MPYC-401 (STATISTICAL MECHANICS-II) Marks-100

UNIT-I
Distribution function for Fermi-Dirac system, Equation of states for ideal Fermi gas,, The theory of White Dwarf star, Landau Diamagnetism,(10)

UNIT-II
The quantised Hall effect, Pauli Paramgnetism, The De Haas-Van Alphen Effect.

Ising model:
Definition of Ising model, One dimensional Ising model. Application to Ferromagnetism(12)

UNIT-III
Phase Transition:
Thermodynamics description of Phase Transitions , Phase Transitions of second kind , Landau theory of phase transition beyond mean field,Gaussian fluctuation and Ginzberg crite-ria,Discontinuity of specific heat , change in symmetry in Phase a transition of second kind.(15)
Books:

1. Statistical physics - K. Huang
2. Statistical physics - R.K. Pathria
3. Statistical physics - F. Mohling
4. Elementary Statistical physics - C.Kittel
5. Statistical physics - Landau and Lifsitz
6. Physics Transitions & Critical Phonomena H.E. Stanly
7. Thermal Physics C. Kittel
8. Fundamental of statistical & Thermal physics- F. Reif

MPYC-402 (CLASSICAL ELECTRODYNAMICS-II) Marks-100

Unit-I
Plane Waves in Non-Conducting Media:
Plane waves in non-conducting media;velocity of wave propagation and energy flow;linear,circular and elliptic polarization; Reflection and refraction of electromagnetic waves at a plane inter-face between dielectrics; normal and oblique incidence;total internal reflection and polarization by reflection; waves in dispersive media,Kramer-Kronig relation.
Plane Waves in Conduction Media:
Plane waves in conduction media; Reflection and transmission at a conducting surface; Cylindrical cavities and wave guides; Modes in rectangular wave guide and resonant cavities.(15)

Unit-II
Diffraction:
Kirchoff 's formulation of diffraction by a circular aperature.
Green's Function Solution for Retarded Potential:Green's function solution of potential form of Maxwell's equations, Retarded and advanced Green's Functions.(12)
Unit-III
Multipole Radiation:Potential,Fields and radiation due to an oscillating electric dipole; radiation due to a centre -fed linear antenna; angular distribution of power radiated; Rayleigh Scattering. Magnetic dipole and Electric Quadrupole radiation.
Radiation by Point Charge:Lienard-Weichert potential,Field due to a point charge, Angular distribution of radiation and total power radiated by an accelerated charge, Larmor's formula, Thomson's scattering.(13)

Books:

1. Classical Electrodynamics - J. D. Jackson
2. Classical Theory of Fields - L.Landau Lifsitz
3. Introduction to Electrodynamics - D.J.Gri ths.
4. Principles of Optics-M.Born and E. Wolf

MPYC-403 (ATOMIC AND MOLECULAR PHYSICS) Marks-100

Unit-I(34 marks)

One Electron Atom:

Introduction: Quantum States; Atomic orbital; Parity of the wave function; Angular and radial distribution functions.

Hyper ne structure:

Review of Fine structure and relativistic correction, Lamb shift. Hyper ne interaction and isotope shift; Hyper fine splitting of spectral lines; selection rules.

Many electron atom:

Independent particle model; He atom as an example of central field approximation; Central field approximation for many electron atom; Slater determinant; L-S and j-j coupling; Equiva-lent and nonequivalent electrons; Energy levels and spectra; Spectroscopic terms; Hunds rule; Lande interval rule; Alkali spectra.(13)

Unit-II(33 marks)

Molecular Electronic States:

Concept of molecular potential, Separation of electronic and nuclear wavefunctions, Born-Oppenheimer approximation, Electronic states of diatomic molecules, Electronic angular mo-menta, Approximation methods for the calculation of electronic Wave function, The LCAO approach, States for hydrogen molecular ion, Coulomb, Exchange and Overlap integral, Sym-metries of electronic wavefunctions; Shapes of molecular orbital; and bond; Term symbol for simple molecules.

Rotation and Vibration of Molecules:

Solution of nuclear equation; Molecular rotation: Non-rigid rotator, Centrifugal distortion, Symmetric top molecules, Molecular vibrations: Harmonic oscillator and the anharmonic oscillator approximation, Morse potential.(12)

Unit-III(33 marks)

Spectra of Diatomic Molecules:

Transition matrix elements, Vibration-rotation spectra: Pure vibrational transitions, Pure ro-tational transitions, Vibration-rotation transitions, Electronic transitions: Structure, Franck-Condon principle, Rotational structure of electronic transitions, Fortrat diagram, Dissocia-tion energy of molecules, Continuous spectra, Raman transitions and Raman spectra.

Vibration of Polyatomic Molecules:

Application of Group Theory Molecular symmetry; Matrix representation of the symmetry elements of a point group; Reducible and irreducible representations; Character tables for C 2v and C 3v point groups; Normal coordinates and normal modes; Application of group theory to molecular vibration.

Laser Physics:

Basic elements of a laser; Threshold condition; Four-level laser system, CW operation of laser; Crit- ical pumping rate; Population inversion and photon number in the cavity around threshold; Output coupling of laser power. Optical resonators; Cavity modes; Mode selec-tion; Pulsed operation of laser: Q-switching and Mode locking; Experimental technique of Q-switching and mode locking Different laser systems: Ruby, CO_2 , Dye and Semiconductor diode lase.(15)

BOOKS:

B.H. Bransden and C.J. Joachain: Physics of Atoms and Molecules

- C. Cohen-Tannoudji, B. Dier, and F. Laloe: Quantum Mechanics vol. 1 and 2
- R. Shankar: Principles of Quantum Mechanics
- C.B. Banwell: Fundamentals of Molecular Spectroscopy
- G.M. Barrow: Molecular Spectroscopy
- K. Thyagarajan and A.K. Ghatak: Lasers, Theory and Applications
- O. Svelto: Principles of Lasers
- B.H. Eyring, J. Walter and G.E. Kimball: Quantum Chemistry
- W. Demtroder: Molecular Physics
- H. Herzberg: Spectra of Diatomic Molecules
- J.D. Graybeal: Molecular Spectroscopy
- M.C. Gupta: Atomic and Molecular Spectroscopy
- B.B. Laud: Lasers and Non-linear Optics
- Johnson: Spectrophysics

(CORE ELECTIVE-II(THEORY)) MARKS-100

CORE ELECTIVE-A PARTICLE PHYSICS-II

Unit-I(34 marks)
Symmetry:
Different types of symmetries and conservation laws. Noethers theorem.

Symmetry groups and Quark model:
SU(2) and SU(3): root and weight diagrams, Composite representation, Youngs tableaux, quark model, colour, heavy quarks and their hadrons.

Hadron structure:
Elastic e-p scattering, electromagnetic form factors, electron-hadron Deep Inelastic Scatter-ing, structure functions, scaling, sum rules, neutrino production.(12)
Unit-II
Strong interactions:
QCD, asymptotic freedom, gluons and jets in e^+e → hadrons, Scaling violation.
Low energy weak interactions:
Fermi theory, calculation of decay widths of muon and π^+.
Neutrino physics:
Theory of two- flavour oscillation. Solar and atmospheric neutrino anomalies. Neutrino ex-periments. The Indian Neutrino Observatory.(13)
Unit-III
Flavour physics:
Quark mixing, absence of tree-level FCNC in the Standard Model, the CKM matrix, oscillation in K and B systems, CP violation.
HEP experiments:
Relative merits and demerits of e^+e^- and hadronic colliders, LEP, LHC, B-factories.(15)

Books

1. F. Halzen and A.D. Martin: Quarks and Leptons
2. J. Donoghue, E. Golowich and B. Holstein: Dynamics of the Standard Model
3. T.-P. Cheng and L.-F. Li: Gauge Theories in Particle Physics
4. E. Leader and E. Predazzi: An Introduction to Gauge Theories and Modern Particle Physics
5. F.E. Close: An Introduction to Quarks and Partons

CORE ELECTIVE-B
CONDENSED MATTER PHYSICS-II

Unit-I

Lattice dynamics:

Classical theory of lattice vibrations in 3-dimensions under harmonic approximation; Dispersion relation: acoustical and optical, transverse and longitudinal modes; Lattice vibrations in a monatomic simple cubic lattice; Frequency distribution function; Normal coordinates and phonons; Occupation number representation of the lattice Hamiltonian; Thermodynamics of phonons; The long wavelength limits of the acoustical and optical branches; Neutron diffraction by lattice vibrations; Debye-Waller factor; Atomic displacement and melting point; Phonon-phonon interaction Hamiltonian in occupation number representation; Thermal conductivity in insulators.

Spin-spin interaction: Magnons :

Absence of magnetism in classical statistics; Origin of the exchange interaction; Direct ex-change, super 10exchange, indirect exchange and itinerant exchange; Spin-waves in Ferro-magnets magnons, sponta-neous magnetization, thermodynamics of magnons; Spin-waves in lattices with a basis ferri- and antiferromagnetism; Measurement of magnon spectrum; Ordered magnetism of valence and conduction electrons, Stoners criterion for metallic Ferro-magnet.(15)

Unit-II

The basic Hamiltonian in a solid: electronic and ionic parts, the adiabatic approximation; Single- particle approximation of the many-electron system single product and determinant wave functions, matrix elements of one and two-particle operators; The Hartree-Fock (H-F) theory: the H-F equation, exchange interaction and exchange hole, Koopmans theorem; The occupation number representation: the many electron Hamiltonian in occupation number representation; the H-F ground state energy.

The interacting free-electron gas: Quasi electrons and Plasmon:

The H-F approximation of the free electron gas: exchange hole, single-particle energy levels, the ground state energy; Perturbation: theoretical calculation of the ground state energy; Correlation energy difficulty with the second-order perturbation theoretic calculation, Wigners result at high density, low-density limit and Wigner interpolation formula; Cohesive energy in metals; Screening and Plasmons; Experimental observation of plasmons

Unit-III

Super fluidity:

Basic Phenomenology; Transition and Bose-Einstein condensation; Two fluid model; Roton spectrum and specific heat calculation, Critical velocity.

Disordered systems:

Disorder in condensed matter substitutional, positional and topographical disorder; Short-and long-range order; Atomic correlation function and structural descriptions of glasses and liquids; Anderson model; mobility edge; Minimum Metallic Conductivity, Qualitative application of the idea to amorphous semiconductors and hopping conduction

Optical properties of solids:

The dielectric function: the dielectric function for a harmonic oscillator, dielctric losses of electrons, Kramers-Kronig relations; Interaction of phonons and electrons with photons; In-terband transition direct and indirect transition; Absorption in insulators; Polaritons; One-phonon absorption; Optical properties of metals, skin effect and anomalous skin effect.(13)

Selected topics:

Mott transition, Hubbard Model, Kondo effect.

Books:

1. M. Tinkham: Group Theory and Quantum Mechanics
2. M. Sachs: Solid State Theory
3. A.O.E. Animalu: Intermediate Quantum Theory of Crystalline Solids
4. N.W. Ashcroft and N.D. Mermin: Solid State Physics
5. J.M. Ziman: Principles of the Theory of Solids
6. C. Kittel: Introduction to Solid State Physics

MPYE-404(DISSERTATION/PROJECT) Marks-100

Project evaluation guidelines :

Every student will have to complete one project each in Semester IV with four credits (100 marks) each. Students can take one long project (especially for SSP/SSE/Material Sc/Nanotechnology/Nuclear etc). However for the project students have to submit disser-tation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester IV and actual experimental work, results and analysis with four credits each. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipments etc. Maximum three students can do a joint project. Each one of them will submit a separate

project report with details/part only he/she has done. However he/she can in brief (in a page one or two) mention in Introduction section what other group members have done. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project. In case a student takes training in a research institute/training of handling sophisticate equipment, he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.
Each project will be of 100 marks by internal evaluation.

The project report should be le bound/spiral bound/hard bound and should have fol-lowing format

Title Page/Cover page

Certificate endorsed by Project Supervisor and Head of Department

Declaration

Abstract of the project

Table of Contents

List of Figures

List of Tables

Chapters of Content:

Introduction and Objectives of the project Experimental/Theoretical Methodology/Circuit/Model etc. details Results and Discussion if any
Conclusions
References

Evaluation by Internal examiner will be based on following criteria

Criteria	Maximum Marks
Literature Survey	10
Objectives/Plan of the project	10
Experimental/Theoretical methodology/Working condition of project or model	20
Significance and originality of the study/Society application and Inclusion of recent References	10
Depth of knowledge in the subject / Results and Discussions	20
Presentation	30
Total marks	100

MPYE-453/MPYE-452 (CORE ELECTIVE-II(PRACTICAL)) Marks-100

CORE ELECTIVE-A PARTICLE PHYSICS-II

1. Calibration of the x-ray spectrometer and determination of x-ray energy of unknown sources.
2. Determination of resolving poser of x-ray spectrometers.
3. Study of b spectrum.
4. Determination of absorption co-efficient of Aluminum using G.M Counter.
5. X-test and operating point determination using G-N tube.
6. Characteristics of G.M. counter.

CORE ELECTIVE-B CONDENSED MATTER PHYSICS-II

1. Design of astable multivibrator using transistor
2. Study of frequency modulation.
3. Characterization of Solar cell
4. Synthesis of thin films samples by thermal evaporation method and determination of its resistance.
5. Determination of precise lattice parameter and grain size of crystalline materials by X-Ray powder diffractometer.
6. Study of energy gap of Germanium by four-probe method.
7. Callibration of magnetic FIeld using Hall apparatus.
8. Determination of Hall Voltage and Hall coeffcients.
9. Measurement of Hall angle and mobility.
10. Determination of ferroelectric transition point(Curie temperature) of the given sample.
11. Determination of magnetoresistance of bismuth.
12. Study of Laues spot of mica sheet using X-ray diffraction technique.

13. Study of the dispersion relation for the monoatomic and lattices using the given electrical transmission line.
14. Find the Youngs modulus for the given metal using composite piezoelectric oscillator technique.
15. Determination of magnetic susceptibility by Guoy-balance.
16. Velocity of ultrasonic waves in a given medium at different temperatures.
17. Measurement of Lande's g factor of DPPII by ESR at Microwave frequency.
18. Study of thermoluminescence of F-centre in alkali halide crystals.
19. Study of phase transition using feedback amplifier circuit.

MPYC-451(MODERN PHYSICS LAB.) Marks-100

1. Michelson Interferometer
2. Fabry-Perot Interferometers
3. Measurement of Rydberg constant
4. Babinets compensator
5. Constant deviation spectroscope
6. e/m measurement by Braun tube
7. e/m measurement by Magnetron Valve Method
8. e/m measurement by Thomson Method
9. Magnetic field measurement by search coil
10. Michelson Interferometer
11. Fabry-Perot Interferometers
12. Measurement of Rydberg constant
13. Babinets compensator
14. Constant deviation spectroscope
15. e/m measurement by Braun tube
16. e/m measurement by Magnetron Valve Method
17. e/m measurement by Thomson Method
18. Magnetic field measurement by search coil
19. Ferroelectric transmission point by Dielectric Constant Measurement Rectification by junction Diode using various filters
20. Characteristics of a Transistor
21. Dielectric constant of solid (wax) by Lecher Wire
22. Verification of Richardson's T 3/2 low