BHARATHIAR UNIVERSITY, COIMBATORE-641 046

REGULATIONS FOR M.Sc. PHYSICS DEGREE COURSE (COLLEGES) WITH COMPULSORY DIPLOMA IN NANO SCIENCE
Semester System

(with effect from 2007-2008)

1. Eligibility for Admission to the Course
A candidate who has passed the Degree Examination in **B.Sc. Physics with Mathematics / Mathematics with Computer Applications** as one of the allied subjects or **B.Sc. Physics with Computer Application with Mathematics** as one of the allied subjects.

2. Duration of the Course
This Course of Study shall be based on Semester System. This Course shall consist of four Semesters covering a total of two Academic Years. For this purpose, each Academic Year shall be divided into two Semesters; the first and third Semesters; July to November and the second and the fourth Semesters; December to April. The Practical Examinations shall be conducted at the end of even Semester.

3. Course of Study

The Course of the Degree of Master of Science/Arts/Commerce shall be under the Semester System according to the Syllabus to be prescribed from time to time. This Course consists of Core Subjects and Elective Subjects. There shall be one Paper on applied Skill Oriented, subject preferably in each semester as part of the adjunct Diploma Programme.

4. Requirement to appear for the Examinations
a) A candidate will be permitted to take the University Examination for any Semester, if

i) he/she secures not less than 75% of attendance out of the 90 instructional days during the Semester.

b) A candidate who has secured attendance less than 75% but 65% and above shall be permitted to take the Examination on the recommendation of the Head of the Institution to condone the lack of attendance as well as on the payment of the prescribed fees to the University.

c) A candidate who has secured attendance less than 65% but 55% and above in any Semester, has to compensate the shortage of attendance in the subsequent Semester besides, earning the required percentage of attendance in that Semester and take the Examination of both the Semester papers together at the end of the latter Semester.

d) A candidate who has secured less than 55% of attendance in any Semester will not be permitted to take the regular Examinations and to continue the study in the subsequent Semester. He/she has to re-do the Course by rejoining the Semester in which the attendance is less than 55%.
e) A candidate who has secured less than 65% of attendance in the final Semester has to compensate his / her attendance shortage in a manner to be decided by the Head of the Department concerned after rejoining the Course.

5. Restriction to take the Examinations

a) Any candidate having arrear paper(s) shall have the option to take the Examinations in any arrear paper(s) along with the subsequent regular Semester papers.

b) Candidates who fail in any of the papers shall pass the paper(s) concerned within 5 years from the date of admission to the said Course. If they fail to do so, they shall take the Examination in the revised Text / Syllabus, if any, prescribed for the immediate next batch of candidates. If there is no change in the Text / Syllabus they shall take the Examination in that paper with the Syllabus in vogue, until there is a change in the Text or Syllabus.

In the event of removal of that paper consequent to the change of Regulations and / or Curriculum after a 5 year period, the candidates shall have to take up on equivalent paper in the revised syllabus as suggested by the chairman and fulfill the requirements as per Regulations/Curriculum for the award of the Degree.

6. The Medium of Instruction and Examinations

The medium of instruction and Examinations shall be in English.

7. Submission of Record Notebooks for Practical Examinations

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations. Otherwise the candidates will not be permitted to take the Practical Examinations.

8. The Minimum (Pass) Marks

A candidate shall be declared to have passed in a paper if a student obtains not less than 50% of marks in that paper. A candidate shall be declared to have passed the whole Examination if the student passes in all the papers.

9. Improvement of Marks in the subjects already passed

Candidates desirous of improving the marks secured in their first attempt shall reappear once within the subsequent Semester. The improved marks shall be considered for classification but not for ranking. If there is no improvement there shall not be any change in the original marks already awarded.

10. Classification of successful candidates

A candidate who passes all the Examinations in the first attempt within a period of two years securing 75% and above marks in the aggregated shall be declared to have passed with First Class with Distinction.

Successful candidates passing the P.G. Degree Examinations, securing 60% marks and above shall be declared to have passed the examination in First Class. All other successful candidates shall be declared to have passed the Examination in Second Class.

12. Ranking

A candidate who qualifies for the PG Degree Course passing all the Examinations in the first attempt, within the minimum period prescribed for the Course of Study from the date of admission to the Course and secures 1st or 2nd Class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks.

The improved marks will not be taken into consideration for ranking.

13. Conferment of the Degree

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed Course of Study for a period of not less than four Semesters in an Institution approved of by and affiliated to the University or has been exempted there from in the manner prescribed and has passed the Examinations as have been prescribed.

14. Evening College

The above Regulations shall be applicable for candidates undergoing the respective Courses in the Evening Colleges also.

16. Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

17.Transitory Provision

Candidates who have undergone the Course of Study prior to the Academic Year 2007-2008 will be permitted to take the Examinations under those Regulations for a period of four years i.e. up to and inclusive of the Examination of April 2012 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.

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BHARATHIAR UNIVERSITY, COIMBATORE-46

M.Sc., Physics (Colleges)

SCHEME OF EXAMINATION

(For students admitted from the academic year 2007-2008 onwards)

SEMESTER	TITLE OF PAPER		EXAM DURATION HRS	RECORD MARKS	TOTAL MARKS
FIRST	PAPER I	Classical & Statistical Mechanics	3		100
	PAPER II	Mathematical Physics	3		100
	PAPER III	Quantum Mechanics-I	3		100
	PAPER IV	Advanced Computational Physics	3		100
SECOND	PAPER V	Quantum Mechanics-II	3		100
	PAPER VI	Electromagnetic Theory	3		100
	PAPER VII	Special Electronics-I	3		100
	PRACTICAL I	General Physics	4	15	100
	PRACTICAL II	Electronics	4	15	100
THIRD	PAPER VIII	Optical Physics	3		100
	PAPER IX	Nuclear & Particle Physics	3		100
	PAPER X	Spectroscopy	3		100
	PAPER XI	Elective-I	3		100
FOURTH	PAPER XII	Condensed Matter Physics	3		100
	PAPER XIII	Special Electronics-II	3		100
	PAPER XIV	Elective-II	3		100
	PRACTICAL III	Advanced Experiments	6	15	100
	PRACTICAL IV	Special Electronics	6	15	100

Total 1800

- **Elective Papers-(Any Two- One in the Third Semester and One in the Fourth Semester)**

1. **Plasma Physics**
2. **Thin Film Physics**
3. **Atmospheric Science**
4. **Numerical Methods & Programming**
5. **Solar Energy and its Utilization**
6. **Crystal Growth**
7. **Non Linear Dynamics**

PAPER I – CLASSICAL & STATISTICAL MECHANICS
FIRST SEMESTER

Unit I: Canonical Transformations:
Equations of Canonical Transformations-Lagrange and Poisson's Brackets-Invariance-Equation of Motion in Poisson Bracket Notation.

Hamilton-Jacobi Theory:
H-J Equation for Hamilton's Principle Function-Hamilton's Characteristic Equation-Separation of Variables-Harmonic Oscillator Problem in H-J Method-Action Angle Variables-Kepler Problem in Action Angle Variables.

Unit II: Rigid Body Dynamics:
Generalized coordinates for Rigid Body Motion-Euler Angles-Angular Velocity, Angular Momentum of a rigid body-Moments and Products of Inertia-Principal Axes Transformation-Rotational Kinetic Energy-Moment of Inertia of a Rigid Body-Equation of Motion of a Rigid Body-Euler's Equations

Unit III: Mechanics of Small Oscillations:
Stable and Unstable Equilibrium-Two Coupled Oscillators-Formulation of the Problem-Properties of T,V and ω-Normal Coordinates and Normal Frequencies of Vibration-Systems with few Degrees of Freedom-Parallel Pendula-Double Pendulum-Triple Pendulum(degenerate system)-Linear Triatomic Molecule.

Unit IV: Classical Statistics:
Maxwell Boltzmann Distribution Law(no derivation)- Evaluation of Constants-Maxwell's Law of Distribution of Velocities-Most Probable, Mean, Mean Square and Root Mean Square Speeds- Principle of Equipartition of Energy-Partition Function-Condition for applicability of the M-B Statistics-Non Degenerate and Degenerate Systems-Maxwell Velocity Distribution in a given direction-Total Internal Energy of an Ideal Gas-Molar Heat Capacity of a gas at Constant Volume-Entropy-Helmholtz Free Energy-Pressure and Equation of State of an Ideal Gas-Limitations of M-B statistics.

Unit V: Quantum Statistics:
Bose-Einstein Distribution Law(no derivation)- B-E Energy Distribution for energies in the range E to E+dE-Condition for B-E Distribution to approach M-B Distribution-Bose Temperature- Bose-Einstein Condensation-Planck's Law from B-E Law- Fermi-Dirac Distribution Law(no derivation)- F-D Law for energies in the range E to E+dE-Fermi Energy-Effect of Temperature-Energy Distribution Curve-Free Electrons in a Metal- Comparison of M-B, B-E and F-D Statistics.

Books for Study & Reference:
1. Classical Mechanics- S.L.Gupta, V. Kumar & H.V.Sharma-Pragati Prakashan- Meerut.
2. Classical Mechanics- H. Goldstein-Addison Wesley, London
3. Elements of Statistical Mechanics-Kamal Singh & S.P. Singh- S. Chand & Company, New Delhi.
4. Elements of Statistical Mechanics-Gupta & Kumar- Pragati Prakashan- Meerut
5. Classical Mechanics of Particles & Rigid Bodies-Kiran C.Gupta-Wiley Eastern Ltd.
6. Classical Mechanics-S.N. Gupta
7. Fundamentals of Statistical Mechanics and Thermal Physics-E.Reif-McGraw Hill

PAPER II- MATHEMATICAL PHYSICS
FIRST SEMESTER

Unit I: Special Functions

Legendre's Polynomials and Functions- Differential Equations and Solutions-Rodriguez Formula-Generating Functions-Orthogonality-Relation between Legendre Polynomial and their Derivatives-Recurrence Relations-Bessel's Function-Differential Equation and Solution-Generating Functions-Recurrence Relations

Unit II: Complex Variable Theory

Functions of a Complex Variable-Single and Multivalued Functions-Cauchy-Reimann Differential Equation-Analytical Line Integrals of Complex Function-Cauchy's Integral Theorem and Integral Formula-Derivatives of an Analytic Function-Taylor's Variables-Residue and Cauchy's Residue Theorem-Application to the Equation of Definite Integrals-Conformal Transformations-Invariance of the Laplacian.

Unit III: Linear Space

Definition of Vector Space-Linear Dependence-Linear Independence-Basis-Dimension of a Vector Space-Representation of Vectors and Linear Operators with respect to Basis-Schmidt Orthogonalization Process-Inner Product.

Unit IV: Fourier Series & Laplace Transforms

Fourier Series-Dirichlet's Theorem-Change of Interval-Complex Form-Fourier Series in the Interval$(0, \theta)$-Uses of Fourier Series.-Laplace Transform-Definition-Properties-Translation Property-Inverse Laplace Transform-Properties

Unit V: Group Theory

Definition of Groups-Groups of Transformation-Multiplication Table (C_{4V})-Subgroups and Conjugate Classes-Cyclic Groups-Lagrange's Theorem-Invariant Subgroups-Factor Group-Symmetry Elements-Transformation & Matrix Representation-Point & Space Groups-Reducible & Irreducible Representation of a Group-Schur's Lemmas-Orthogonality Theorem-Character of a Representation & Character Table-C_{2V} & C_{3V} Groups in Molecular Physics-Application for Classification of Elementary Particles

BOOKS FOR STUDY & REFERENCE:

1. Mathematical Physics- Sathya Prakash-Sultan Chand & Sons
2. Mathematical Physics-B.D. Gupta-Vikas Publishing House
3. Mathematical Physics-B.S. Rajput- Pragati Prakashan- Meerut
4. Elements of Group Theory for Physicists-A.W. Joshi-Wiley Eastern
5. Mathematical physics by P.K. Chattopadhayay-New Age International-New Delhi.
6. Mathematical Physics-P.P. Gupta, Yadav & Malik-Kedarnath Ramnath-Meerut
7. Numerical Methods in Science & Engineering-M.K. Venkataraman-National Publishing-Chennai
8. Numerical Methods-A. Singaravelu-Meenakshi Publishing

PAPER III- QUANTUM MECHANICS I
FIRST SEMESTER

Unit I: Equation of Motion & Application of Schroedinger's Equation:

State Vectors-Hilbert Space-Dirac Notation-Dynamical Variables as Operators-Change of Basis-Unitary Transformation-Equation of Motion in Schroedinger Picture, Heisenberg Picture & Dirac Picture-Representation of Operators by Matrices-One Dimensional Linear Harmonic Oscillator in Matrix Mechanics.-Kronig Penny Model

Unit II: Approximate Methods:

Time Independent Perturbation Theory in Non-Degenerate Case-Ground State of Helium Atom-Degenerate Case-Stark Effect in Hydrogen-Variation Method & its Application to Hydrogen Molecule-WKB Approximation.

Unit III: Time Dependent Perturbation Theory:

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation

Unit IV: Angular Momentum

Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components-Ladder Operators-Commutation Relation of J_z with J_+ and J_- - Eigen Values of J^2, J_z -Matrix Representation of J^2, J_z, J_+ and J_- - Addition of Angular Momenta- Clebsch Gordon Coefficients-Properties.

Unit V: Relativistic Wave Equation:

Klein Gordon Equation-Plane Wave Equation-Charge and Current Density-Application to the Study of Hydrogen Like Atom-Dirac Relativistic Equation for a Free Particle-Dirac Matrices-Dirac Equation in Electromagnetic Field-Negative Energy States-Dirac's Equation in a Central Field(Electron Spin)-Spin Orbit Energy.

Books for Study & Reference:

1. Quantum Mechanics-Gupta, Kumar & Sharma
2. Quantum Mechanics-Satyaprakash
3. Quantum Mechanics-L.I. Schiff- McGraw Hill
4. Quantum Mechanics-E. Merzbacher-Wiley and Sons
5. Quantum Mechanics-A. Devanathan-Narosa Publishing-New Delhi
6. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill

PAPER IV-ADVANCED COMPUTATIONAL PHYSICS
FIRST SEMESTER

Unit I: Numerical Methods I

Finding Roots of a Polynomial-Bisection Method-Newton Raphson Method-Solution of Simultaneous Linear Equation by Guass Elimination Method-Solution of Ordinary Differential Equation by Euler, Runge-Kutta Fourth Order Methods-Evaluation of Integrals by means of Simpson's One Third Rule-Girafe's Root Squaring Method for solving Algebraic Equation.

Unit II: Numerical Methods II

Solving Partial Differential Equations- Finite difference method – Explicit and Implicit methods – Stability analysis – Application to diffusion equation – Solving Poisson equation – Introduction to finite volume and finite element methods- Random number generator – Importance sampling – Metropolis algorithm – Monte Carlo simulation

Unit III: Matlab Fundamentals

Introduction-Matlab Features-Desktop Windows: Command, Workspace, Command History, Array Editor and Current Directory -Matlab Help and Demos- Matlab Functions, Characters, Operators and Commands. Basic Arithmetic in Matlab-Basic Operations with Scalars, Vectors and Arrays-Matrices and Matrix Operations-Complex Numbers- Matlab Built-In Functions-Illustrative Examples

Unit IV: Matlab Programming

Control Flow Statements: ***if, else, else if, switch*** Statements-***for, while*** Loop Structures-***break*** Statement-Input/Output Commands-Function m Files-Script m Files-Controlling Output

Unit V: Matlab Graphics:

2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots-Multiple Figures, Graph of a Function- Titles, Labels, Text in a Graph- Line Types, Marker types, Colors-3D Graphics-Curve Plots-Mesh and Surface Plots-Illustrative Examples

Books for Study & Reference

1. Engineering and Scientific Computations Using Matlab- Sergey E. Lyshevski-JohnWiley & Sons
2. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipsman, Jonathan Rosenberg-Cambridge University Press
3. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press-London
4. Matlab Programming-David Kuncicky-Prentice Hall
5. Getting Started With Matlab-Rudra Pratap-Oxford University Press-New Delhi
6. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P. Denier-Springer-Verlag-London
7. Numerical Methods Using Matlab-John Mathews & Kurtis Fink-Prentice Hall-New Jersey
8. Numerical methods in Science and Engineering- M.K. Venkataraman-National Publishing Co. Madras
9. Introductory Methods of Numerical Analysis- S.S. Sastry-Prentice Hall

PAPER V – QUANTUM MECHANICS II
SECOND SEMESTER

Unit I: Scattering Theory

Scattering Amplitude-Expression in terms of Green's Function-Born Approximation and its Validity-Partial Wave Analysis-Phase Shifts-Scattering by Coulomb and Yukawa Potential

Unit II: Application to Atomic Structure

Central Field Approximation-Thomas Fermi Model-Hartree's Self Consistent Model-Hartree Fock Equation-Alkali Atoms-Doublet Separation-Intensities-Complex Atoms-Coupling Schemes

Unit III: Application to Molecular Structure

Hydrogen Molecule Ion-Hydrogen Molecule-Heitler London Method-Covalent Bond-Spin Orbit Interaction as Correction to Central Field Approximation- Hartree Fock Self Consistent Field Method for Molecules-Hybridisation.

Unit IV: Theory of Radiation (Semi Classical Treatment)

Einstein's Coefficients-Spontaneous and Induced Emission of Radiation from Semi Classical Theory-Radiation Field as an Assembly of Oscillators-Interaction with Atoms-Emission and Absorption Rates-Density Matrix and its Applications

Unit V: Quantum Field Theory

Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation-Field Quantization of the Non-Relativistic Schroedinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations-Quantization of Electromagnetic Field Energy and Momentum.

Books for Study & Reference:

1. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill
2. Quantum Mechanics-Gupta, Kumar & Sharma
3. Quantum Mechanics-Satyaprakash
4. Introduction to Quantum Mechanics-A.K. Chandra-Tata McGraw Hill
5. Quantum Mechanics-Merzbacher-John Wiley & Sons
6. Quantum Mechanics-Devanathan-Narosa Publishing-New Delhi
7. Quantum Mechanics-Aruldas
8. Quantum Mechanics-A.K. Ghatak and S. Loganathan-McMillan India
9. Quantum Mechanics-Messiah(North Holland)
10. Quantum Mechanics-L.I. Schiff- McGraw Hill

PAPER VI – ELECTROMAGNETIC THEORY
SECOND SEMESTER

Unit I: Electrostatics
Potential and Field due to an Electric Dipole-Dielectric Polarization-External Field of a Dielectric Medium-Guass' Theorem in a Dielectric-Electric Displacement Vector **D**-Linear Dielectrics-Relations connecting Electric Susceptibility χ_e, Polarization **P**, Displacement **D** and Dielectric Constant-Boundary Conditions of Field Vectors.

Molecular Field-Clausius Mosotti Relation for Non-Polar Molecules-Langevin Debye Formula for Polar Molecules

Electrostatic Energy and Energy Density

Unit II: Magnetostatics
Biot-Savart Law- Statement-Lorentz Force Law and Definition of B-General Proof of Ampere's Circuital Law-Divergence and Curl of B-Magnetic Scalar Potential (derivation of expression only)-Equivalence of Small Current Loop and Magnetic Dipole-Magnetic Vector Potential (derivation of expression only).

Unit III: Field Equations
Equation of Continuity-Displacement Current-Derivation of Maxwell's Equations-Physical Significance-Poynting Vector-Momentum in EM Field-Electro Magnetic Potentials-Maxwell's Equations in terms of EM Potentials-Lorentz Gauge-Coulomb Gauge-Radiation Produced by a Low Velocity Accelerated Charged Particle(Larmor's Formula)-Oscillating Electric Dipole-Radiation due to a Small Current Element-Linear Half Wave Antenna

Unit IV: Interaction of EMW with Matter
Boundary Conditions at Interfaces-Reflection and Refraction-Fresnel's Laws-Brewster's Law & Degree of Polarization-Total Internal Reflection and Critical Angle-Reflection from a Metal Surface-Wave Guides-Rectangular Wave Guide

Scattering and Scattering Parameters-Scattering by a Free Electron (Thomson Scattering)-Scattering by a Bound Electron (Rayleigh Scattering)-Dispersion in Gases-Normal and Anomalous Dispersion in Liquids and Solids.

Unit V: Relativistic Electrodynamics
Four Vectors-Transformation Relation for Charge and Current Densities for Electromagnetic Potentials-Covariant Form of Inhomogeneous Wave Equations-Covariance of Field Equations in terms of Four Vectors-Covariant Form of Electric and Magnetic Field Equations-Covariance of Electromagnetic Field Tensor-Transformation relation for Field Vectors **E** and **B**-Covariant Form of Lorentz Force Law.

Books for Study & Reference

1. Electromagnetic Theory-Chopra & Agarwal-Nath & Co.
2. Electrodynamics-Gupta, Kumar & Singh-Pragati Prakashan-Meerut
3. Electromagnetic Theory & Electrodynamics-Satyaprakash-Kedarnath Ramnath & Co.-Meerut
4. Classical Electrodynamics-J.D. Jackson-Wiley Eastern
5. Principles of Electrodynamics-M. Schwartz-McGraw Hill
6. Introduction to EM Fields & Waves-Carson & Lorrain

PAPER VII- SPECIAL ELECTRONICS I
SECOND SEMESTER

Unit I: Semiconductor Devices
FET as a Voltage Variable Resistor-Common Source Amplifier at High Frequencies-Common Drain Amplifier at High Frequencies-Silicon Controlled Rectifier (SCR)-Characteristics-SCR Power Control-Tunnel Diode

Optoelectronics: Photo Resistor-Photo Diode-Photo Transistor-LED-Photo Voltaic Effect-Solar Cells

Unit II: Operational Amplifier
Frequency Response of an Op-Amp-Parameters of an Op-Amp-Sign Changer-Scale Changer-Adder-Subtractor-Phase Shifter-Differential Amplifier-Integrator-Differentiator-Analog Computer Setup to Solve Linear Simultaneous Equation-Differential Equations in Physics-Logarithmic & Exponential Amplifiers-Active Filters.

Unit III: Digital Circuits & Devices I
Logic Families-Combinational Logic-Function of Combinational Logic-Flip Flops and other Multivibrators-Counters

Unit IV: Digital Circuits & Devices II
Shift Registers-Memories RAM, ROM, PROM, EPROM-Charge Coupled Devices (CCD)

Unit V: Signal Processing & Data Acquisition
Wave Form Generators and Wave Shaping Circuits-Sinusoidal Oscillators-Phase Shift Oscillator-Wein Bridge Oscillator-Crystal Oscillator Multivibrators Comparators-Schmitt Trigger-Square Wave & Triangular Wave Generators-Pulse Generators-IC 555 Timer and its Application-Signal and Signal Processing-Analog Multiplexer and Demultiplexer-Sample and Hold System-D/A Converters-A/D Converters.

Books for Study & Reference:
1. Microelectronics-Millman & Grabel-McGraw Hill
2. Integrated Electronics-Millman & Halkias-Tata McGraw Hill
3. Digital Fundamentals-Floyd-UBS
4. Digital Principles and Applications-Malvino- McGraw Hill
5. Physics of Semiconductor Devices-Wiley Eastern

PRACTICAL I - GENERAL PHYSICS
(Examination at the end of Second Semester)

Any Twelve Experiments

1. Young's Modulus-Elliptical Fringes (Cornu's Method)
2. Young's Modulus-Hyperbolic Fringes (Cornu's Method)
3. Viscosity of a Liquid-Mayer's Oscillating Disc
4. Stefan's Constant
5. Rydberg's Constant-Solar Spectrum
6. Thickness of Wire by Air Wedge and Diffraction
7. Determination of Audio Frequencies-Bridge Method
8. Thermionic Work Function
9. Thermal Conductivity-Forbe's Method
10. Electronic Charge 'e' by Millikan's Oil Drop Method
11. Electronic Specific Charge 'e/m' by Thomson's Method
12. Thermistor-Temperature Coefficient and Band Gap Energy Determination
13. Specific Heat of a Liquid-Ferguson's Method
14. Biprism on Optical Bench-Determination of Wavelength
15. He-Ne Laser –Measurement of Wavelength using Ruler and Thickness of a Wire with Laser
16. Babinet's Compensator
17. LG Plate-Resolving Power
18. Diffraction at a Prism Table-Determination of Wavelength
19. Fabry-Perot Interferometer-Study of Fine Structure
20. Geiger Muller Counter-Determination of Half Life of 'In'
21. Matlab Programming-Roots of a Quadratic Equation & Solution of a System of Linear Equations
22. Matlab Programming -Solution of Ordinary Differential Equations
23. Matlab Programming -Runge-Kutta Method
24. Matlab Programming -Newton-Raphson Method
25. Matlab Programming-Mean, Median & Standard Deviation
26. Matlab Programming-Curve Fitting & Interpolation
27. Matlab Programming-Matrix Summation, Subtraction and Multiplication
28. Matlab Programming-Matrix Inversion and Solution of Simultaneous Equations

PRACTICAL II-ELECTRONICS

(Examination at the end of Second Semester)

Any Fifteen Experiments

1. Regulated and Dual Power Supply Construction
2. Basic Logic Gates-Digital IC's
3. Parameters of Op-Amp
4. Wave Form Generators- Op-Amp
5. Phase-Shift Oscillator- Op-Amp
6. Wein's Bridge Oscillator- Op-Amp
7. Active Filters- Op-Amp
8. Differential Amplifier- Op-Amp
9. Frequency Response of an Op-Amp
10. Sign Changer, Scale Changer, Adder and Subtractor- Op-Amp
11. Analog Computer Setup-Solving Simultaneous Equations
12. UJT Relaxation Oscillator
13. CRO-Differentiating, Integrating, Clipping and Clamping Circuits, Square Wave Testing
14. Source Follower
15. SCR-Characteristics and an Application
16. A.C. Amplifier-Inverting, Non-Inverting, Voltage Follower- Op-Amp
17. Electronic Switch-IC 555
18. Measurement of Hall Coefficient of given Semiconductor-Estimation of Charge Carrier Concentration
19. Shift Register-Digital IC's
20. Schmitt Trigger
21. Matlab Programming-Charging of an Capacitor in an RC Circuit with three Time Constants
22. Matlab Programming- Full Wave Rectifier-Determination of (a) Peak-to-Peak Value of Ripple Voltage, (b) DC Output Voltage (c) Discharge Time of the Capacitor (d) Period of Ripple Voltage
23. Matlab Programming- Plot of Voltage and Current of an RLC Circuit Under Steady State Conditions
24. Matlab Programming- NPN Transistor-Plotting Input & Output Characteristics
25. Matlab Programming-Frequency Response of a Low Pass Op-Amp Filter Circuit
26. Matlab Programming-Diode-Plot of Forward Characteristics & Load Line Plot-Estimation of Operating Point

PAPER VIII-OPTICAL PHYSICS
THIRD SEMESTER

Unit I:

Electrical Constant-Plane Harmonic Waves-Phase Velocity-Group Velocity-Doppler Effect-Relativistic Correction to the Doppler Formula-Linear Partial Polarization-Scattering & Polarization-Circular & Elliptical Polarization-Matrix Representation-Orthogonal Polarization-Eigen Vectors & Jones Matrices-Reflection and Refraction at a Plane Boundary-Amplitudes of Reflected and Refracted Waves-Brewster's Angle.

Unit II: Coherence and Interference

Theory of Partial Coherence-Coherence Time and Coherence Length-Spectral Resolution of a Finite Wave Train-Coherence and Line Width-Spatial Coherence-Extended Sources-Measurement of Stellar Diameter-Hanbury Brown Twiss Intensity Interferometry-Fabry Perot Interferometer-Theory of Multi Layer Films.

Unit III: Optics of Solids

General Wave Equation-Propagation of Light in Conducting Media-Reflection and Refraction at the Boundary of an Absorbing Medium-Propagation of Light in Crystals-Double Refraction at a Boundary-Optical Activity-Faraday Rotation in Solids-Magneto Optic and Electro Optic Effects.

Unit IV: Optical Fibres

Propagation of Light in an Optical Fibre-Acceptance Angle-Numerical Aperture-Step and Graded Index Fibres-Fibre Fabrication Techniques-Optical Fibre as a Cylindrical Wave Guide-Wave Guide Equations-Wave Equations in Step Index Fibres-Flow of Power in SI Fibres-Fibre Losses and Dispersion-Applications.

Unit V: Lasers

Characteristics of Laser Light-Atomic Basis for Laser Action-Laser Pumping-Creating a Population Inversion-Laser Resonator-Single Mode Operation-Q Switching-Mode Locking-Helium-Neon Laser-Argon Ion Laser-Carbon dioxide Laser-Solid State Lasers-Semiconductor Laser-Applications.

Books for Study & Reference

1. Introduction to Modern Optics-G.R. Fowles, Holt, Rincharf – Winstron Inc-N.Y.
2. Principles of Optics-Born and Wolf-Pergamon Press
3. Fibre Optics technology & Applications-Stewart D. Personick-Khanna Publishers-Delhi
4. Introduction to Lasers & their Applications-D.C.O. Shea, W. Rusell Callen and W.T. Rhodes-Addison Wesley
5. Contemporary Optics-Nassbaum & Philips-Prentice Hall
6. Statistical Optics-J.W. Goodman-John Wiley
7. Optical Physics-S.G. Lipson, H. Lipson, D.S. Tannhanser-Cambridge University Press
8. Modern Interferometers-Wolf-London

PAPER X-SPECTROSCOPY
THIRD SEMESTER

Unit I: Atomic & Microwave Spectroscopy
Spectra of Alkali Metal Vapours-Normal Zeeman Effect-Anomalous Zeeman Effect-Magnetic Moment of Atom and the G Factor-Lande's 'g' Formula-Paschen Back Effect-Hyperfine Structure of Spectral Lines.

Microwave Spectroscopy-Experimental Method-Theory of Microwave Spectra of Linear, Symmetric Top Molecules-Hyperfine Structure-Quadrupole Moment-Inversion Spectrum of Ammonia.

Unit II: Infrared & Raman Spectroscopy
IR Spectroscopy: Practical Aspects-Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules-Applications-Basic Principles of FTIR Spectroscopy.

Raman Spectroscopy: Classical and Quantum Theory of Raman Effect-Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules-Applications-Laser Raman Spectroscopy.

Unit III: Electronic Spectra: Fluorescence & Phosphorescence Spectroscopy
Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules-Deslandre's Table-Intensity Distribution-Franck Condon Principle-Rotational Structure of Electronic Bands-Resonance and Normal Fluorescence-Intensities of Transitions-Phosphorescence Population of Triplet State and Intensity-Experimental Methods-Applications of Fluorescence and Phosphorescence.

Unit IV: NMR & NQR Spectroscopy
NMR Spectroscopy: Quantum Mechanical and Classical Description-Bloch Equation-Relaxation Processes-Experimental Technique-Principle and Working of High Resolution NMR Spectrometer-Chemical Shift

NQR Spectroscopy: Fundamental Requirements-General Principle-Experimental Detection of NQR Frequencies-Interpretation and Chemical Explanation of NQR Spectroscopy

Unit V: ESR & Mossabauer Spectroscopy
ESR Spectroscopy: Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure

Mossabauer Spectroscopy: Mossabauer Effect-Recoilless Emission and Absorption-Mossabauer Spectrum-Experimental Methods-Hyperfine Interaction-Chemical Isomer Shift-Magnetic Hyperfine and Electric Quadrupole Interaction

Books for Study & Reference:

1. Spectroscopy: Volumes I, II and III-B.P. Straugham & S. Walker
2. Fundamental of molecular spectroscopy – C.B.Banwell
3. Introduction to molecular spectroscopy - G.M.Barrow.
4. Atomic Physics - J.B.Rajam, S.Chand Publications.

PAPER IX- NUCLEAR & PARTICLE PHYSICS
THIRD SEMESTER

Unit I: Nuclear Structure
Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Bainbridge and Jordan, Neir, Mass Spectrometer-Theories of Nuclear Composition (proton-electron, proton-neutron)- Bound States of Two Nucleons-Spin States-Pauli's Exclusion Principle-Concept of Hidden Variables-Tensor Force-Static Force-Exchange Force.

Unit II: Radioactivity
Alpha Decay: Properties of α Particles-Gamow's Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles.

Beta Decay: Properties of β Particles-General Features of β Ray Spectrum-Pauli's Hypothesis-Fermi's Theory of β Decay-Forms of Interactions and Selection Rules-Fermi and Gamow Teller Transitions.

Gamma Decay: Absorption of γ Rays by Matter-Interaction of γ Rays with Matter-Measurement of γ Ray Energies-DuMond Bent Crystal Spectrometer Method-Internal Conversion.

Unit III: Nuclear Models
Liquid Drop Model: Bohr Wheeler Theory of Fission-Condition for Spontaneous Fission-Activation Energy-Seaborg's Expression.

Shell Model: Explanation of Magic Numbers-Prediction of Shell Model-Prediction of Nuclear Spin and Parity-Nuclear Statistics-Magnetic Moment of Nuclei-Schmidt Lines-Nuclear Isomerism.

Collective Model: Explanation of Quadrupole Moments-Prediction of Sign of Electric Quadrupole Moments.

Unit IV: Nuclear Reactions
Kinds of Reactions and Conversion Laws-Energy of Nuclear Reaction-Iso Spin-Continuum Theory of Nuclear Reaction-Resonance-Breit and Wigner Dispersion Formula-Stages of a Nuclear Reaction-Statistical Theory of Nuclear Reaction-Kinematics of Stopping and Pickup Reaction-Surface Reaction.

Unit V: Particle Physics
Leptons-Hadrons-Mesons-Hyperons-Pions-Meson Resonances-Strange Mesons and Baryons-Gell-Mann Okuba Mass formula for Baryons-CP Violation in Neutral Kaons (K^0) Decay- Symmetry and Conversion Laws-Quark Model-Reaction and Decays-Quark Structure of Hadrons.

Books for Study & Reference:

1. Concepts of Nuclear Physics-Bernard L. Cohen-Tata McGraw Hill- New Delhi
2. Introductory Nuclear Physics-Kenneth S. Krane-John Wiley & Sons
3. Nuclear Physics- D.C. Sharma-K.Nath & Co-Meerut
4. Nuclear and Particle Physics-Pandya and Yadav
5. Nuclear Physics-J.C. Tayal-Umesh Prakashan-Gujarat
6. Physics of Nucleus and Particles-Volume I & II-B. Nermeir & Sheldon
7. The Investigations of Physics World-G.Torld di Froncia-Cambridge University Press
8. Auto Nuclear-Evan-McGraw Hill

PAPER XII-CONDENSED MATTER PHYSICS
FOURTH SEMESTER

Unit I: Crystal Structure & Diffraction

Lattice Constant and Density-Reciprocal Lattice Concept-Graphical Construction-Vector Development of Reciprocal Lattice-Properties-Reciprocal Lattice to BCC, FCC Lattices-Bragg Condition in terms of Reciprocal Lattice-Rotary Crystal Method of X-Ray Diffraction-Neutron Diffraction-Principle-Advantage-Experiment

Unit II: Crystal Defects & Dislocations

Defects: Classification-Point Defects-Schottky Defect-Frenkel Defect-Colour Centers-F Centre-Other Colour Centers-Production of Colour Centers by X-Rays and Irradiation.
Dislocations: Slip and Plastic Deformation-Shear Strength of Single Crystals-Edge Dislocation-Screw Dislocation-Stress Field around an Edge Dislocation

Unit III: Lattice Vibrations, Semiconductors & Dielectrics

Vibrations of One Dimensional Diatomic Linear Lattice-Acoustic and Optical Branches-Phonon State-Semiconductors-Conductivity of Semiconductors-Model for Intrinsic and Impurity Semiconductors-Hall Effect-Dielectrics-Ferro Electric Crystals-Ferro Electric Domains

Unit IV: Metals & Superconductors

Heat Capacity of Electron Gas-Experimental Electrical Resistivity of Metals-Superconductivity-Electron Phonon Interaction-Cooper Pairs-BCS Theory-Energy Gap and its Temperature Dependence-London Equation-Josephson Effect & Applications-High Temperature Superconductivity.

Unit V: Magnetism

Langevin Theory of Paramagnetism-Quantum Theory of Paramagnetism-Curie Law-Ferromagnetism-Weiss Molecular Field Theory-Domain Theory-Anti Ferromagnetism-Neel Theory-Ferrimagnetism-Ferrites-Spin Waves-Experimental Techniques to Study Magnetic Properties.

Books for Study & Reference:

1. Introduction to Solid State Physics-C. Kittel-Wiley Eastern-New Delhi
2. Solid State Physics-B.S. Saxena, R.C. Gupta & P.N. Saxena-Pragati Prakashan- Meerut
3. Solid State Physics-A.J. Dekker-Macmillan India
4. Solid State Physics-S.L. Kahani & C. Hemaranjani-Sultan Chand & Sons
5. Solid State Physics-H.E. Hall-John Wiley & Sons
6. An Introduction to Solid State Physics & Its Applications-R.J. Elliot & A.P. Gibson-ELBS & Macmillan
7. Principles of Solid State-H.V. Keer-Wiley Eastern
8. Physics of Solids-C.A. Wert & R.M. Thomson-McGraw Hill
9. Fundamentals of Solid State Physics-J.R. Christmann- John Wiley & Sons

PAPER XIII- SPECIAL ELECTRONICS II
FOURTH SEMESTER

Unit I: Antennas & Wave Propagation

Terms and Definition-Effect of Ground on Antennas-Grounded λ/4 Antenna-Ungrounded λ/2 Antenna-Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas-Wideband and Special Purpose Antennas-Sky Wave Propagation-Ionosphere-Ecles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation.

Unit II: Microwaves

Microwave Generation-Multicavity Klystron-Reflex Klystron-Magnetron-Travelling Wave Tubes (TWT) and other Microwave Tubes-Microwave Transistors-MASER-Tunnel Diode-Gunn Diode.

Unit III: Radar and Television

Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems-Radar Antennas-Duplexers-Radar Receivers and Indicators-Pulsed Systems-Other Radar Systems-Black & White TV Transmission and Reception-Colour TV Transmission and Reception.

Unit IV: Communication Electronics

Analog and Digital Signals – Modulation – Types of Modulation- Amplitude modulation theory – Frequency spectrum of the AM wave – Representation of AM – Power relations in the AM wave – Generation of AM – Basic requirements- Description of frequency and phase modulation – Mathematical representation of FM – Frequency spectrum of the FM wave- Effects of noise on carrier – pre emphasis and de emphasis -other forms of interference- intersystem comparisons- comparison of wide band and narrow band FM – Generation of FM– Pulse Modulation Techniques

Unit V: Internetworking Technology:

Computer Networks – Overview– Types of Networks – Network Topologies – Network Protocols – Network Architecture– ISDN,LAN,WAN, MAN- Wireless Transmission Bridges, TCP/IP Routing-Congestion and Flow Control-Tunneling-Internet Work Routings-IP Addressing-Network Security- Internet Connectivity (Dial Up, Dedicated Lines, Broad Band, DSL, Radio, VSAT, etc.)-Internet Security-Multimedia-Technique of Data Compression-Voice-Radio-Mobile Computing

Books for Study & Reference:

1. Electronic Communication System-George Kennedy & Davis -Tata McGraw Hill
2. Principles of Communication Systems-Taub Schilling-TMH
3. Communication Systems-Simon Haykin-John Wiley & Sons
4. Electronics & Radio Engineering-F.E.Terman- McGraw Hill
5. Communication Systems-Carlson- McGraw Hill
6. Fundamentals of Information Technology-Alexis Leon &Mathews Leon-UBS Publishers
7. Digital Logic and Computer Design-S. Morrismano-Prentice Hall of India
8. Computer networks -W. Stailing- Prentice Hall of India
9. Computer networks : S. Keshav-Addison Wesley

PRACTICAL III- ADVANCED PRACTICALS

(Examination at the end of Fourth Semester)

Any Twelve Experiments

1. AlO Band
2. CN Band]
3. Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Barium
4. Michelson Interferometer- λ, $d\lambda$ and Thickness of Mica Sheet
5. Susceptibility-Guoy and Quincke's Method
6. Compressibility of a Liquid-Ultrasonic Method
7. Hall Effect
8. e/m-Zeeman Effect
9. e/m-Magnetron Method
10. B-H Curve-Anchor Ring
11. B-H Curve-Solenoid
12. Double Slit-Wavelength Determination
13. G.M Counter-Characteristics
14. Kelvin's Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance.
15. Study of Faraday's Effect using He-Ne Laser
16. Photo Cell-Determination of Planck's Constant
17. Study of Fluorescent Spectrum of DCN Dye and Determination of Quantum Yield of Fluorescence Maxima and Full Width Maxima using Monochromator.
18. Matlab Programming-Radioactive Decay
19. Matlab Programming-Numerical Integration
20. Matlab Programming-Double Integration
21. Matlab Programming-Solution of Ordinary Differential Equations
22. Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles
23. Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations
24. Matlab Programming-Computer Simulation of Kronig-Penney Model
25. Matlab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator
26. Matlab Programming-Simulation of Wave Functions for a Particle in Critical Box
27. Matlab Programming-Solution of Diffusion Equation

PRACTICAL IV-SPECIAL ELECTRONICS

(Examination at the end of Fourth Semester)

Any Ten Experiments

1. Op-Amp: Simultaneous Addition & Subtraction
2. Op-Amp: Instrumentation Amplifier-Temperature Measurement
3. Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law
4. Op-Amp: V to I & I to V Converter
5. Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Peak Value, Clipper, Clamper
6. Op-Amp: Log and Antilog Amplifier
7. Op-Amp: Analog Computation-Second Order Differential Equation
8. Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker
9. IC 555 Timer Application-Monostable, Linear & Astable
10. A/D Converters-Any One Method
11. D/A Converters-Binary Weighted & Ladder Methods
12. IC Counters with Feedback
13. Microprocessor: LED Interfacing
14. Microprocessor: Stepper Motor Interfacing
15. Microprocessor: Traffic Control Simulation
16. Microprocessor: ADC Interface-Wave Form Generation
17. Microprocessor: Hex Keyboard Interfacing
18. Microprocessor: Musical Tone Generator Interface

ELECTIVE PAPER: PLASMA PHYSICS

Unit I: Introduction

Introduction to Plasma State-Elementary Concepts & Definitions of Temperature and other Plasma Parameters-Occurrence and Importance of Plasma for Various Applications-Production of Plasma in the Laboratory- Physics of Glow Discharge-Electron Emission-Ionization-Breakdown of Gases-Paschen's Laws & the Different Regimes of E/p in a Discharge

Unit II: Plasma Diagnostics

Probes-Energy Analyzers-Magnetic Probes & Optical Diagnostics-Preliminary Concepts-Single Particle Orbital Theory: Drifts of Charged Particles under the effect of different Combinations of Electric & Magnetic Fields-Crossed E & M Fields-Homogenous E & M Fields-Time varying E & M Fields-Particle Motion in Large Amplitude Waves

Unit III: Fluid Description of Plasmas

Distribution Functions and Liouville's Equation-Macroscopic Parameters of Plasma-Two and One Fluid Equations for Plasma-MHD Approximations Commonly used in One Fluid Equations and Simple One Fluid & MHD Equations-Waves in Fluid Plasmas: Dielectric Constant of Field Free Plasma-Plasma Oscillations-Space Charge Waves of Warm Plasma-Dielectric Constant of a Cold Magnetized Plasma-Ion Acoustic Waves-Alfen Waves- Magnetosonic Waves

Unit IV: Stability of Fluid Plasma

Equilibrium of Plasma-Plasma Inequalities-Stability Analysis-Two Stream Instability-Instability of Alfven Waves-Plasma Supported against Gravity by Magnetic Field-Energy Principle.
Kinetic Description of Plasma: Microscopic Equations for Many Body Systems-Statistical Equations for Many Body System-Vlasov Equation and its Properties-Drift Kinetic Equation and its Properties.

Unit V:

Waves in Vlasov Plasma-Vlasov Equation and its Linearization- Solution of Linearized Vlasov Equation-Theories of Langmuir Waves- Landau Damping-Ion Acoustic Waves-drift Waves in Magnetized Plasmas-Non-Linear Plasma Theories-Non-Linear Electrostatic Waves, Solutions, Shocks, Non-Linear Landau Damping-Thermonuclear Fusion-Status, Problems & Technological Requirements- Application of Cold Low Pressure and Thermal Plasmas

Books for Study & Reference:

1. Introduction to Plasma Physics-F.F. Chen
2. Principles of Plasma Physics-Krvail & Trivelpiece
3. Introduction to Plasma Theory-D.R. Nicholson
4. The Plasma State-J.L. Shohet
5. Introduction to Plasma Physics-M. Uman
6. Principles of Plasma Diagnostics-I.H. Hutchinson
7. Plasma Diagnostic Techniques-R.H. Huddlestone & S.L. Leonard

ELECTIVE PAPER: THIN FILM PHYSICS

Unit I: Preparation of Thin Film

Nature of Thin Film-Deposition Technology-Distribution of Deposit-Resistance Heating-Thermal Evaporation-Flash Evaporation

Unit II:

Electron Beam Method-Cathodic Sputtering-Glow Discharge Sputtering-Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition

Unit III: Film Thickness & Its Control

Mass Methods-Optical Method-Photometry-Ellipsometry-Interferometry-Other Methods-Substrate Cleaning-Microscopic Defect and Dislocation-Edge Dislocation-Screw Dislocation-Boundary Defect-Stress Effect-Removal of Defect-Defect and Energy State

Unit IV: Thin Film Analysis

Electron Diffraction Technique- High Energy Electron Diffraction-Low Energy Electron Diffraction-Electron Microscopy- Scanning Electron Microscopy-X Ray Photoelectron Spectroscopy-Mass Spectroscopy- Thermodynamics of Nucleation-Nucleation Theories- Film Growth-Incorporation of Defects, Impurities etc.,. in Film-Deposition Parameters and Grain Size

Unit V:

Epitaxy-Thin Film Structure-Substrate Effect-Epitaxial Deposit-Twinning and Multitwinning-Phase Transition-Dissociations-Film Thickness Effect-Crystal Growth Process

Books for Study & Reference:

1. Thin Film Fundamentals-A. Goswami-New Age International-New Delhi
2. Thin Film Phenomena-K.L. Chopra
3. Handbook of Thin Film Technology-L.T. Meissel & R. Glang-McGraw Hill

ELECTIVE PAPER: ATMOSPHERIC SCIENCE

Unit-I: Physical & Dynamic Meteorology

Physical Meteorology: Structure of Earth's Atmosphere and Composition-Law of Thermodynamics of the Atmosphere- Adiabatic Process-Potential Temperature-Clausius-Clapyeron Equation-Laws of Black Body Radiation-Solar and Terrestrial Radiation-Albedo-Green House Effect-Heat Balance of Earth Atmosphere System.
Dynamic Meteorology: Fundamental Forces-Structure of Static Atmosphere-Momentum, Continuity and Energy Equations-Thermodynamics of the Dry Atmosphere-Elementary Applications of the Basic Equations-Circulation Theorem-Vorticity-Potential Vorticity and Potential Vorticity Equations.

Unit-II: Climate & Monsoon Dynamics

Climate Classification-Polar, Artic, Antarctic, Temperate & Tropical Climates

Wind, Temperature & Pressure Distribution over India in the Lower, Middle and Upper Atmosphere during Pre- Post- and Mid-Monsoon Season-Energy Cycle of Monsoon-Dynamics of Monsoon Depression and Easterly Waves-Intra Seasonal and Interannual Variability of Monsoon-Quasi-Bi Weekly and 30-60 Day Oscillations-Walker Circulation, Southern Oscillations & El Nino-Dynamical Mechanism for their Existence.

Unit-III: Atmospheric Pollution:

Role of Meteorology in Atmospheric Pollution-Atmospheric Boundary Layer-Air Stability-Local Wind Structure-Ekman Spiral-Turbulence & Boundary Layer Scaling-Residence Time and Reaction Rates of Pollutants-Sulphur Compounds-Carbon Compounds-Organic Compounds-Aerosols- Toxic Gases and Radio Active Particles-Trace Gases

Unit-IV Radar Meteorology:

Basic Meteorology-Radar Principles and Technology-Radar Signal Processing & Display-Weather Radar-Observation of Precipitating Systems-Estimation of Precipitation-Radar Observation of Tropical Storms & Cyclones-Use of Weather Radar in Aviation-Clear Air Radars-Observation of a Clear Air Phenomena

Books for Study & Reference:

1. The Atmosphere-Frederick K. Lutgens and Edward J. Tarbuk
2. Dynamic Meteorology-J.R. Holton-Academic Press- NY
3. The Physics of Monsoons-R.N. Keshvamurthy & M. Shankar Rao-Allied Publishers
4. Principles of Air Pollution Meteorology-Tom Lyons & Prillscott-CBS Publishers & Distributors
5. Radar Meteorology-Henry Saugageot.

ELECTIVE PAPER: NUMERICAL METHODS & PROGRAMMING

Unit I: Numerical Methods

Methods for Determination of Zeroes of Linear and Non-linear Algebraic Equations and Transcendental Equations-Convergence of Solutions-Solutions of Simultaneous Linear Equations-Gaussian Elimination-Pivoting-Interactive Method-Matrix Inversion

Unit II:

Eigenvalues and Eigenvectors of Matrices-Power and Jacobi Method-Finite Differences-Interpolation with Equally Spaced and Unevenly Spaced Points-Curve Fitting-Polynomial Least Squares & Cubic Spline Fitting-Numerical Differentiation & Integration-Newton-Cotes Formulae-Error Estimates-Guass Method

Unit III:

Random Variate-Monte Carlo Evaluation of Integrals- Methods of Importance Sampling-Random Walk and Metropolis Method—Numerical Solution of Ordinary Differential Equations-Euler and Runge Kutta Methods-Predictor and Corrector Methods-Elementary Ideas of Solutions of Partial Differential Equations

Unit IV: FORTRAN Programming

Digital Computer Principles-Compilers-Interpreters-Operating Systems-Fortran Programming-Flow Charts-Integer and Floating Point Arithmetic-Expressions

Unit V:

Built-In Functions-Executable and Non-Executable Statements-Assignment, Control and Input/Output Elements-Subroutines & Functions-Operation with Files

Books for Study & Reference

1. Introductory Methods of Numerical Analysis-S.S. Sastry-Prentice Hall
2. Numerical Analysis-Raja Raman
3. Fortran Programming-Raja Raman
4. Numerical Recipes-Vetterming, Teukosuky, Press & Flannery

ELECTIVE PAPER: SOLAR ENERGY & ITS UTILIZATION

Unit I: Solar Radiation

Basics of Heat Transfer-Conduction, Convection, Radiation, Reflectance, Transmittance and Absorptance-Transmittance Absorptance Product-Green House Effect

Solar Radiation Outside the Earth's Atmosphere-At Earth's Surface-Instruments for Measuring Solar Radiation and Sunshine- Solar Radiation Data-Solar Radiation Geometry-Empirical Equations for measuring the Availability of Solar Radiation-Average Daily Diffusing Radiation- Solar Radiation Artilted Surfaces

Unit II: Liquid Flat Plate Collectors

Performance Analysis-Transmissivity & Cover System-Overall Loss Coefficient & Heat Transfer Correlations-Collector Efficiency Factor-Collector Heat Removal Filter

Unit III: Effects of Various Parameters on Performance

Selective Surfaces-Number of Covers-Spacing-Collector Flit-Fluid Inlet Temperature-Incident Solar Flux-Dust on the Top Cover-Other Types of Liquid Flat Plate Collectors: Variations on the Conventional Type-Evacuated Collectors-Some Novel Designs-Honey Comb Collector-Double Exposure Flat Plate Collector-Thermal Trap Collector-Packed Bed Collector

Unit IV: Solar Air Heaters

Introduction-Performance & Analysis of a Conventional Air Heater-Other Types of Air Heaters-Flow between Cover & Absorber Plate- Conventional Air Heater with Fins-Overlapped Glass Plate Solar Air Heater-Matrix Air Heater-Honey Comb Porous Bed Air Heater-Testing Procedures

Unit V: Concentrating Collectors

General Characteristics-Definitions-Types-Flat Plate Collectors with Plane Reflectors-Cylindrical Parabolic Reflector-Compound Receiver Collector-Thermal Energy Storage: Introduction-Sensible Heat Storage-Liquids-Solids-Analysis of a Liquid Storage Tank-Thermal Stratification-Analysis of Packed Bed Storage-Latent Heat Storage-Thermo chemical Storage-Solar Pond: Concept, Description and Operational Problems

Books for Study & Reference:

1. Solar Energy-Principles of Thermal Collection & Storage-S.P. Shukatme-Tata McGraw Hill
2. Solar Energy-M.P.Agarwal-S. Chand & Company
3. Non-Conventional Sources of Energy-H.C. Jain-Sterling Publishers
4. Solar Heating & Cooling-Jan F. Kreider & Frank Keith-Hemisphere Publishing Corporation.-USA
5. Energy Technology Handbook-Douglas & .Considine- McGraw Hill
6. Solar Energy Utilization-G.D. Rai-Khanna Publishers
7. Non-Conventional Energy Sources-G.D. Rai- Khanna Publishers

ELECTIVE PAPER: CRYSTAL GROWTH

Unit I: Introduction

Significance of Single Crystal- Crystal Growth Techniques-Chemical Physics of Crystal Growth- Crystal Growth Phenomena-Nucleation-Gibb's Thomson Equation-For Vapour-For Solution-Spherical Nucleus-Heterogeneous Nucleation-Cap Shaped Nucleus-Disc Shaped Nucleus

Unit II: Kinetics of Crystal Growth

Singular & Rough Faces-Models on Surface Roughness-Joss Stranshi Volmer (JSV) Theory-Burton Cabrera & Frank (BCF) Theory- BCF Theory of Solution Growth-Periodic Bond Chain Theory-Miller Krumbhaar Model

Unit III: Growth from Melt

Bridgman & Related Techniques-Crystal Pulling Techniques-Connection in Melts-Modeling & Simulation of Bulk Crystal Growth Considering Melt Dynamics-Melt Growth of Oxide Crystals for SAW, Piezo Electric and Non-Linear Optical Applications-Liquid Encapsulated & Czochralshi Technique-Zone Melting Technique-Skull Melting Process-Heat Exchange Method

Unit IV: Solution Growth

Low Temperature Solution Growth- Crystal Growth System-Growth of KDP & ADP-Non-Linear Phenomena in KDP Family Crystals-Solubility of KDP & ADP-Seed Preparation, Mounting & Seasoning-High Temperature Solution Growth-Practical Aspects-Growth of Potassium Titanyl Phosphate

Unit V: Other Growth Techniques

Vapour Growth: Physical Vapour Deposition-Chemical Vapour Deposition-Chemical Vapour Transport-Stationary Temperature Profile-Oscillating Temperature Profile
Hydrothermal Growth: Design Aspect of Autoclave-Electro Crystallization-Narnst Relation-Electrochemical Reaction
Gel Growth: Various Types of Gel-Structure of Gel- Growth of Crystals in Gels-Experimental Procedure

Books for Study & Reference

1. Crystal Growth-P. Santhanaraghavan & P. Ramasamy
2. Crystal Growth Processes-J.C. Brice-John Wiley & Sons-New York
3. The Growth of Crystals from Liquid- J.C. Brice-North Holland Publishing Company
4. Crystal Growth-H.C. Buckley-Chapman & Hall-London
5. Crystal Growth-C.D. Branda-Pergamon Press-Oxford

ELECTIVE PAPER: NON LINEAR DYNAMICS

Unit I: Introduction to Nonlinear Dynamics

Nonlinearity and its Relevance–Superposition Principle and its Validity–Linear and Nonlinear Oscillators and Circuits–Riccati and Elliptic Function Equations–Nonlinear Ordinary Differential Equations: Phase Trajectories–Classification of Singular Points of Second Order Ordinary Differential Equations–Limit Cycles–Perturbation Methods for Periodic Solutions.

Unit II: Regular and Chaotic Motions

Nonlinear Dissipative Systems–Regular Motions–Elementary Theory of Bifurcations–Chaos–Logistic map–Doubling route to chaos–Beyond chaos–Duffing Oscillator and its Analog Simulation–Nonlinear Conservative Systems

Unit III: Solitons–An Introduction

Linear and Nonlinear Waves–The Discovery of Solitary Waves–Numerical Experiments of Fermi, Pasta and Ulam, - and of Kruskal and Zabusky–Solitons–Lax Operators–Inverse Scattering and Kortweg –de Vries Equation

Unit IV: Solitary Wave Solutions and Solitons in Biological Systems

Derivation of Single and Multi Soliton Solutions–Conservation Laws–Complete Integrability–Other Soliton Equations–Applications
Basic Equations for Collective Excitations–Solitons in Alpha Helix Proteins–Solitons in the Presence of External Perturbations

Unit V: Soliton and Proton Motion in Molecular Systems with Hydrogen Bonds

Theoretical Study of Proton Conductivity: Basic Equations–Proton Motion without an Account of Interaction between Sub lattices–Proton Motion Taking into Account the Interaction between Sub lattice Displacements–Proton Pumps

Books for Study & Reference:

1. Chaos in Nonlinear Oscillators-M. Lakshmanan and K. Murali-World Scientific-Singapore
2. Nonlinear Dynamics, Integrability, Chaos and Spatio-temporal Patterns-Springer Verlag-Advanced Text in Physics-M. Lakshmanan and S. Rajasekar
3. Lecture notes on “Nonlinear Dynamics- M. Lakshmanan- Bharathidasan University
4. Solitons: An Introduction- P. G. Drazin and R. S. Johnson- Cambridge
5. Solitons in Molecular systems- A. S. Davydov- D. Reidal Publishing Company, Holland
6. Nonlinear waves and Solitons M. Toda-KTK Scientific Publishers, Tokyo
7. Nonlinear systems-P. G. Drazin-Cambridge University Press
8. Nonlinear phenomena in Physics and Biology-A. C. Scott-Plenum Press-New York