Minutes of the meeting of Board of studies

of

Physics

An online meeting of the Board Of Studies in Physics was organised on 08th May 2022 at 5:45 p.m. which lasted at 6:45 p.m.. it was convened by Dr Amit Kumar Srivastava, the convenor. The meeting was attended by each and every member on the Board including members nominated as subject experts. The quorum was complete.

The agenda of the meeting was to discuss and finalise the syllabus of M.Sc. classes in the light of National Education Policy -2020. Considering the convenience a draft of the syllabus was posted to the members concerned prior to the meeting was to held. during the course of the meeting, every aspect were thoroughly discussed and opinions to improve the syllabus were forwarded. A number of valuable, constructive suggestions came out were made to improve and update the syllabus which are as under:

- that a Master dissertation should be pre-planned and topic allotted to the students be research-oriented. the topics of the dissertation compulsorily allotted in the IIIrd semester and be completed by IVth semester and it should be of eight credits.
- that tutorial classes be introduced simultaneously with lecture also.
- Apart from computer language the students be made aware of knowledge of software e.g. Metlab, comsol, Silvako and their practical use and applications.
- That the Computer software course should be included as a part of syllabus of the Mathematical Physics-II.
- that the division of credits between the lectures and tutorials in the proportionate the ratio of 3+1 i.e. of 4 credits
- also got the suggestion that instead of computer language it should be numerical methods in computer programming
- that Industrial Training be a made part of syllabus. Two months training with different research labs and institutions be a part of syllabus.
- That the nomenclature be changed, it should Numerical methods in Computer Programming instead of present topic _ Computer language.
- That the provision of practical be incorporated in IV th semester.
- that a correlation should be there in research project and master dissertation
- That the Nuclear Physics-II be exchanged with a special paper.

The deliberations of the meeting are proved to be beneficial to the students

The suggestion and input obtained during the course of discussions were given full weightage and were appreciated

Submitted for necessary action

Dr. Amit Kumar Srivastava
Convenor of Physics
C.S.J.M. University, Kanpur

External Members of BOS

Prof. K.N. Uttam
Allahabad University,
Prayagraj

Prof. D.K. Dwivedi
M.M.M. University,
Gorakhpur

Prof. Rajeev Manohar
University of Lucknow
Lucknow

Dr. Akhilesh Tiwari
IIIT Prayagraj
Prayagraj

Internal Members of BOS:

Dr. Pragya Agarwal
D.B.S. College
Kanpur

Dr. Pawan Srivastava
D.S.N. College,
Unnao

Dr. Arun Kumar
K.K. P.G. College,
Etawah

Invited Members of BOS:

Dr. R.K. Dwivedi
Director, C.D.C.,
C.S.J.M University,
Kanur

Dr. P.S. Dobal
V.S.S.D. College,
Kanpur

Dr. A.K. Agnihotri
B.N.D. College,
Kanpur

CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

STRUCTURE OF SYLLABUS FOR THE

PROGRAM: M.Sc. , SUBJECT: PHYSICS

Syllabus Developed by		
Name of BoS Convenor / BoS Member	**Designation**	**College/University**
DR. AMIT K SRIVASTAVA	Convenor	D.A.V. COLLEGE, CIVIL LINES, KANPUR

SEMESTER / YEAR	COURSE CODE	TYPE	COURSE TITLE	CREDITS	CIA	ESE	MAX. MARKS
I[ST] YEAR / I[ST] SEM	B010701T	CORE	MATHMATICAL PHYSICS-I	4	25	75	100
	B010702T	CORE	CLASSICAL MECHANICS	4	25	75	100
	B010703T	CORE	ELECTROMAGNETIC THEORY	4	25	75	100
	B010704T	CORE	QUANTUM MECHANICS-I	4	25	75	100
	B010705P	PRACTICAL	GENERAL LAB	4	25	75	100
I[ST] YEAR / II[ND] SEM	B010801T	CORE	MATHMATICAL PHYSICS-II	4	25	75	100
	B010802T	CORE	SOLID STATE PHYSICS	4	25	75	100
	B010803T	CORE	STATISTICAL MECHANICS	4	25	75	100
	B010804T	CORE	ELECTRONICS	4	25	75	100
	B010805P	PRACTICAL	GENERAL LAB	4	25	75	100
	B010806R	PROJECT	RESEARCH PROJECT -INDUSTRIAL TRAINING/INTERNSHIP/SURVEY WORK ETC	8	25	75	100
II[ND] YEAR / III[RD] SEM	B010901T	CORE	CLASSICAL ELECTRODYNAMICS AND PLASMA PHYSICS	4	25	75	100
	B010902T	CORE	QUANTUM MECHANICS-II	4	25	75	100
	B010903T	CORE	NUCLEAR PHYSICS-I	4	25	75	100
	B010904T	ELECTIVE	ELECTRONICS-I	4	25	75	100
	B010905T		CONDENSED MATTER PHYSICS-I				
	B010906P	PRACTICAL	PRACTICAL-SPECIALIZATION BASED	4	25	75	100
II[ND] YEAR / IV[TH] SEM	B011001T	CORE	ATOMIC AND MOLECULAR PHYSICS	4	25	75	100
	B011002T	CORE	NUCLEAR PHYSICS-II	4	25	75	100
	B011003T	ELECTIVE	ELECTRONICS-II	4	25	75	100
	B011004T		CONDENSED MATTER PHYSICS-II	4	25	75	100
	B011005T	ELECTIVE	PHYSICS OF LIQUID CRYSTALS				
	B011006T		LASER PHYSICS AND APPLICATIONS				
	B011007T		PHYSICS OF NANOMATERIALS				
	B011008T		ELEMENTS OF ATMOSPHERIC AND SPACE SCIENCE				
	B011009P	PRACTICAL	PRACTICAL-SPECIALIZATION BASED	4	25	75	100
	B011010R	PROJECT	RESEARCH PROJECT	8	25	75	100

06/10/22

CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

STRUCTURE OF SYLLABUS FOR THE

PROGRAM: M.Sc. , SUBJECT: PHYSICS

Syllabus Developed by		
Name of BoS Convenor / BoS Member	**Designation**	**College/University**
DR. AMIT K SRIVASTAVA	Convenor	D.A.V. COLLEGE, CIVIL LINES, KANPUR

SEMESTER / YEAR	COURSE CODE	TYPE	COURSE TITLE	CREDITS	CIA	ESE	MAX. MARKS
IST YEAR / IST SEM	B010701T	CORE	MATHMATICAL PHYSICS-I	4	25	75	100
	B010702T	CORE	CLASSICAL MECHANICS	4	25	75	100
	B010703T	CORE	ELECTROMAGNETIC THEORY	4	25	75	100
	B010704T	CORE	QUANTUM MECHANICS-I	4	25	75	100
	B010705P	PRACTICAL	GENERAL LAB	4	25	75	100
IST YEAR / IIND SEM	B010801T	CORE	MATHMATICAL PHYSICS-II	4	25	75	100
	B010802T	CORE	SOLID STATE PHYSICS	4	25	75	100
	B010803T	CORE	STATISTICAL MECHANICS	4	25	75	100
	B010804T	CORE	ELECTRONICS	4	25	75	100
	B010805P	PRACTICAL	GENERAL LAB	4	25	75	100
	B010806R	PROJECT	RESEARCH PROJECT -INDUSTRIAL TRAINING/INTERNSHIP/SURVEY WORK ETC	8	25	75	100
IIND YEAR / IIIRD SEM	B010901T	CORE	CLASSICAL ELECTRODYNAMICS AND PLASMA PHYSICS	4	25	75	100
	B010902T	CORE	QUANTUM MECHANICS-II	4	25	75	100
	B010903T	CORE	NUCLEAR PHYSICS-I	4	25	75	100
	B010904T	ELECTIVE	ELECTRONICS-I	4	25	75	100
	B010905T		CONDENSED MATTER PHYSICS-I				
	B010906P	PRACTICAL	PRACTICAL-SPECIALIZATION BASED	4	25	75	100
IIND YEAR / IVTH SEM	B011001T	CORE	ATOMIC AND MOLECULAR PHYSICS	4	25	75	100
	B011002T	CORE	NUCLEAR PHYSICS-II	4	25	75	100
	B011003T	ELECTIVE	ELECTRONICS-II	4	25	75	100
	B011004T		CONDENSED MATTER PHYSICS-II	4	25	75	100
	B011005T	ELECTIVE	PHYSICS OF LIQUID CRYSTALS				
	B011006T		LASER PHYSICS AND APPLICATIONS				
	B011007T		PHYSICS OF NANOMATERIALS				
	B011008T		ELEMENTS OF ATMOSPHERIC AND SPACE SCIENCE				
	B011009P	PRACTICAL	PRACTICAL-SPECIALIZATION BASED	4	25	75	100
	B011010R	PROJECT	RESEARCH PROJECT	8	25	75	100

NOTE:

1. *A MINOR ELECTIVE FROM OTHER FACULTY SHALL BE CHOSEN IN 1^{ST} YEAR (EITHER Ist / IInd SEMESTER) AS PER AVAILABILITY.
2. In both years of PG program, there will be a Research Project or equivalently a research-oriented Dissertation as per guidelines issued earlier and will be of 4 credit (4 hr/week), in each semester. The student shall submit a report/dissertation for evaluation at the end of the year, which will be therefore of 8 credits and 100 marks
3. Research project can be done in form of Internship/Survey/Field work/Research project/ Industrial training, and a report/dissertation shall be submitted that shall be evaluated via seminar/presentation and viva voce.
4. The student straight away will be awarded 25 marks if he publishes a research paper on the topic of Research Project or Dissertation.

M.Sc. (PHYSICS) SEMESTER- I (B010701T)

MATHEMATICAL PHYSICS- I

Total Lectures 45 (4 Credits)

UNIT- I Complex Analysis (10 Lectures)
Continuity and differentiability of complex functions, Analytic (regular) functions, The Cauchy-Riemann equations, Entire function, Branch cuts and branch points, Line integral in complex plane, Cauchy's integral formula, Taylor's and Laurent's expansions, Liouville's theorem, singularities, Zeroes and poles Residue theorem and contour integration of simple functions, Jordan's lemma, Problems on the above topics.

UNIT- II Linear Differential Equation and special function (13 Lectures)
Ordinary point and singularities of a linear differential equation Power series, solution of second order differential equations (Hyper- geometric, Bessel, Legendre, Laguerre and Hermite equations Orthonormality, Rodrigue's formula and other properties of Legendre, Associated Legendre, Bessel Hermite and Laguerre polynomials, its applications in Physics.

UNIT- III (10 Lectures)
Linear Vector Space: A brief review of linear vector spaces, Inner product, norm, Schwarz inequality, linear operators, Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors, adjoint of a linear operator, Hermitian or self-adjoint operators and their properties, unitary operators, ortho-normal basis –discrete and continuous.

Unit IV Probability statistics and Elementary Tensor Analysis (12 Lectures)
Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem, Hypothesis Testing and Data Analysis in Statistics.

Coordinate transformations, Contravariant and covariant vectors, Contravariant, covariant and mixed tensors, symmetric and skew symmetric tensors, fundamental operations with tensors, metric tensor, conjugate tensors, and associated tensors, Examples of tensors in physics.

Reference Books:

1. Advanced Engineering Mathematics: Erwin Kreyszig
2. Applied Mathematics for Engineer & Physicists: Louis A. Pipes & Lawrence R Harvill
3. Mathematical Methods for Physicists: G. Arfken
4. Mathematical Physics: V. Balakrishnan
5. Mathematical Physics: B.D. Gupta
6. Mathematical Physics: B.S. Rajput
7. Mathematical Physics: H.K. Das & Rama Verma

20 May 2022

M.Sc. (PHYSICS) SEMESTER- I

CLASSICAL MECHANICS (B010702T)

Total Lectures 45 (4 Credits)

UNIT- I (8 Lectures)

Review of Newtonian mechanics, Mechanics of a system of particles, Constraints, Classification of Constraints, Generalized Co- ordinates, Virtual displacement and principle of virtual work, D'Alembert Principle, Lagrange's Equations, Generalized momenta, Cyclic Co-ordinates, Conservation Laws.

UNIT- II (12 Lectures)

Central forces, definition and characteristics, Two body problems, General analysis of orbits, Keplar's laws and equation, closure and stability of circular orbits Calculus of variation- Euler- Lagrange Equation, Application of Variational Principle, Shortest distance problem, brachistrochrone, Geodesics of a Sphere, Variation under constraints- Lagrange's multipliers, Hamilton's principle, Lagrange's equations from Hamilton's principle, Problems based on Lagrange's equations, Principle of least action.

UNIT- III (12 Lectures)

Hamilton's equations and Problems based on it, Canonical Transformation, Generating function, Conditions for canonical transformation and problems, Poisson Brackets and their properties, Invariance of Poisson Bracket under canonical transformation. Symmetry invariance and Noether's theorem.

UNIT- IV (13 Lectures)

Hamilton-Jacobi Equations, Hamilton's principal and characteristic function, Inertia Tensor and Moment of Inertia, Euler's Equation of motion, Torque free motion of a rigid body, Motion of heavy symmetrical Top, Theory of small oscillations, normal modes.

Reference Books:

1. Classical Mechanics: Herbert Goldstein, Addison-Wesley.
2. Introduction to Classical Mechanics: David Morin, Cambridge University Press
3. Mathematical methods of Classical Mechanics: V.I. Arnold, Springer
4. Classical Mechanics: G. Aruldhas, PHI learning Private Ltd.
5. Classical Mechanics: Systems of Particles and Hamiltonian Dynamics: Walter Greiner, Springer.

20 May 2022

M.Sc. (PHYSICS) SEMESTER- I

ELECTROMAGNETIC THEORY (B010703T)

Total Lectures 45 (4 Credits)

UNIT- I (10 Lectures)

Maxwell's Equations in vacuum and matter, Maxwell's correction to Ampere's law for non-steady currents and concept of Displacement current, Boundary conditions for electromagnetic fields, Poynting's theorem, Conservation of energy and momentum for a system of charged particles and electromagnetic field.

UNIT- II (10 Lectures)

Vector and scalar potentials, Maxwell's Equations in terms of Electromagnetic Potentials, Electromagnetic wave equation, Non-uniqueness of Electromagnetic Potentials and Concept of Gauge. Gauge Transformations: Coulomb and Lorenz Gauge, Transformation Properties of Electromagnetic Fields and Sources under Rotation, Spatial Inversion and Time-Reversal.

UNIT- III (15 Lectures)

Propagation of Electromagnetic Plane Waves in Vacuum, Non-conducting Medium, Conducting Medium and Plasma, Reflection, Refraction and Polarization of Electromagnetic Waves, Fresnel Formulae, Total internal reflection and critical angle, Frequency Dispersion Characteristics of Dielectrics and Conductors; Normal and Anomalous Dispersion, Kramer Kronig Relations.

UNIT- IV (10 Lectures)

Basic concept of waveguide, Propagation of Electromagnetic Waves in Rectangular Waveguides, TE and TM Modes, Cut off frequency, Energy Flow and Attenuation. Modal Analysis of guided modes in a cylindrical waveguide, Cavity resonator, Radiation due to electric and magnetic dipoles.

Reference Books:

1. Introduction to Electrodynamics: David J. Griffiths (Prentice-Hall of India, New Delhi).
2. Classical Electrodynamics: John David Jackson (Wiley India).
3. Theory and Problems of Electromagnetics: Joseph A. Edminster (Tata Mc Graw Hill).
4. Electricity and Magnetism: E.M. Purcell (Berkeley Physics Course , Vol II, Mc Graw- Hill).
5. Foundations of Electromagnetic Theory: J. R. Reitz, F. J. Milford and R. W. Christy (Pearson).

20 May 2022

M. Sc. (PHYSICS) SEMESTER- I

QUANTUM MECHANICS- I (B010704T)

Total Lectures 45 (4 Credits)

Unit I (17 lectures)

Abstract formulation of Quantum Mechanics: Mathematical properties of linear vector spaces. Dirac's bra and ket notation. Hermitian operators, eigenvalues and eigenvectors. Orthonormality, completeness, closure. Postulates of quantum mechanics. Matrix representation of operators. Position and momentum representations – connection with wave mechanics. Commuting operators. Generalised uncertainty principle. Change of basis and unitary transformation. Expectation values. Ehrenfest theorem.

Unit II (17 lectures)

Quantum Dynamics: Schrodinger picture, Heisenberg picture, Heisenberg equation of motion, classical limit, Solution of simple harmonic oscillator problem by the operator method, general view of symmetries and conservation laws, Symmetries in Quantum Mechanics : hydrogen-like atoms and spherical harmonics. Spatial translation – continuous and discrete, time translation. parity, time reversal, Density matrices - properties, pure and mixed density matrices, expectation value of an observable, time-evolution, reduced density matrix.

Unit III (11 lectures)

Angular Momentum: Commutation relations of angular momentum operators. Eigenvalues, eigenvectors. Ladder operators and their matrix representations. Spin angular momentum and Pauli matrices. Identical particles: Many-particle systems, Exchange degeneracy, symmetric and anti-symmetric wavefuncttions. Pauli exclusion principle. Addition of angular momenta. Clebsch-Gordan coefficients. Wigner - Eckart theorem.

Reference Books:

1. Quantum Mechanics: B.H. Bransden & C.J. Joachain (Pearson, 2000)
2. Quantum Mechanics: Concepts and Applications: Nouredine Zettili (Wiley, 2016)
3. Introduction to Quantum Mechanics: David J Griffiths (Pearson,2015)
4. Quantum Mechanics -Theory and Applications: Ajoy Ghatak (Trinity, 2015)
5. Principles of Quantum Mechanics: R. Shankar (3rd Ed., Springer, 2008)
6. Modern Quantum Mechanics: J.J. Sakurai (Addison-Wesley, 1993)
7. Quantum Mechanics: Eugen Merzbacher (3rd Ed., Wiley, 1997)

20 May, 2022

M.Sc. (PHYSICS) SEMESTER- II

MATHEMATICAL PHYSICS- II (B010801T)

Total Lectures 45 (4 Credits)

UNIT- I PDE (10 Lectures)
Partial differential equations, Lagrange's linear equation, Method of multipliers Solutions of Laplace, Poisson, Diffusion and wave equations in Cartesian, spherical and cylindrical co-ordinates Physical applications of the above topics.

UNIT- II Green's Function, Fourier and Laplace transform (12 Lectures)
Inhomogeneous equations, Green's function for a free particle, Fourier series, Dirichlet's conditions, Even and odd functions, Parseval's identity for Fourier series Fourier integral, Dirac Delta Function, Properties and applications, Fourier and Laplace Transforms. Physical applications of the above topics.

UNIT- III Group Theory: (13 Lectures)
Groups, subgroups, cosets, invariant subgroups, factor groups, homomorphism and isomorphism, Representations: reducible and irreducible, unitary representations, Schur's lemma and orthogonality theorems, characters of representation, direct product of representations, Continuous groups with special reference to SO(3), SU(2),SU(3).

UNIT- IV Numerical Analysis (10 Lectures)
Methods of numerical analysis: Finite difference with equal and unequal intervals, Interpolation formulae, Errors and accuracy tests in numerical analysis, the iterative algorithms for solving equations and finding roots Discrete Fourier Transform, Fast Fourier Transform with its advantages in sciences integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods.

Reference Books:

1. Advanced Engineering Mathematics: Erwin Kreyszig
2. Applied Mathematics for Engineer & Physicists: Louis A. Pipes & Lawrence R Harvill
3. Mathematical Methods for Physicists: G. Arfken
4. Mathematical Physics: V. Balakrishnan
5. Mathematical Physics: B.D. Gupta
6. Mathematical Physics: B.S. Rajput
7. Elementary Ideas of Group Theory: A.W. Joshi
8. A Friendly Introduction to Group Theory: David Nash
9. Group Theory: W.R. Scott
10. Introductory methods of Numerical Analysis: S.S. Sastry
11. An Introduction to Numerical methods and analysis: Jmes F. Eppeson

20 May 2022

M. Sc. (PHYSICS) SEMESTER- II

Solid State Physics **(B010802T)**

Total Lectures 45 (4 Credits)

Unit I (6 Lectures)

Crystallography: Crystal structure, symmetry elements in crystals, proper rotation axis, plane of symmetry, inversion centre, screw axis, Glide plane, Type of Bravais lattices, closed packed structures, diamond structure, Zinc blend structure, Weigner-Seitz cell, Miller indices.

Unit II (8 Lectures)

X-rays diffraction and Reciprocal Lattice: Choice of x-ray, electron and neutron for crystal structure determination, Bragg's diffraction, Reciprocal lattice, The Braggs condition and Ewald construction, Brillouin zones of SCC, BCC and FCC lattices, Atomic Scattering factor, Geometrical structure factor, Laue method, Rotating crystal method, Powder method.

Unit III (6 Lectures)

Metals: Drude theory, DC conductivity, magneto-resistance, thermal conductivity, thermoelectric effects, Fermi-Dirac distribution, thermal properties of an electron gas, Wiedemann- Franz law, critique of free-electron model.

Unit IV (5 Lectures)

Lattice Dynamics: Failure of the static lattice model, adiabatic and harmonic approximation, vibrations of linear monoatomic lattice, one-dimensional lattice with basis, models of three dimensional lattices, quantization of lattice vibrations, Einstein and Debye theories of specific heat, phonon density of states.

Unit V (10 Lectures)

Band theory of Solids:

Electron in a periodic lattice, Bloch theorem, Band theory, Effective mass, Nearly free electron approximation, tight binding approximation, Fermi surfaces, Cyclotron resonance.

Unit VI (10 Lectures)

Semi-conductors: Semiconductors: General properties and band structure, carrier statistics, impurities, intrinsic and extrinsic semiconductors, drift and diffusion currents, mobility, Hall effect.

Superconductivity: Concept of superconductivity, Meissner effect, Type I and type II superconductors, Energy gap, Isotope Effect, London equations, Penetration depth, Coherence length, Super-conductivity ground state.

References:

1. Charles Kittel: Solid State Physics
2. Caikin and Lubensky: Principles of Condensed Matter Physics
3. Aschroft and Mcrmin: Solid state physics
4. Azaroff: Introduction to Solids
5. Verma and Srivastava: Crystallograpby for Solid state Physics
6. S. O. Pillai: Solid state Physics
7. M.A. Wahab: Solid State Physics

20 May 2022

M.Sc. (PHYSICS) SEMESTER- II

STATISTICAL MECHANICS (B010803T)

Total Lectures 45 (4 Credits)

Unit I (8 Lectures)
Foundation of Statistical Physics: Phase space, microstates and macrostates; Liouville's equation, Postulates of statistical mechanics, Review of probability concepts; Random walk problem in one dimension-binomial distribution, Specification of state of system, Concept of statistical equilibrium, Fundamental postulates of equal a priory probability.

Unit II (15 Lectures)
Ensembles: Micro-canonical, Canonical and grand canonical ensembles and their comparative study, Partition function, Calculation of statistical quantities in terms of partition function (connection to thermodynamics), Entropy of mixing of gases (Ising partition function), Gibbs paradox and its resolution; Derivation of equation of state of classical ideal gas using partition function.

Unit III (12 Lectures)
Quantum statistics: Ideal quantum gas, Indistinguishability, Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics, Photon statistics, Ideal Bose gas, Bose- Einstein condensation, Ideal Fermi gas, Correlation function.

Unit IV (10 Lectures)
Interacting systems and phase transitions: Interacting spin systems. The Ising model, Exact solution of Ising model in 1-dimension, mean-field solution in higher dimensions, Paramagnetic and ferromagnetic phases. Critical exponents. Order parameter, Landau theory.

Reference Books:

1. Statistical Physics of Particles, Mehran Kardar (Cambridge University Press, 2007).
2. Statistical Mechanics, Kerson Huang (2ndEdition, Wiley-India, 2008).
3. Statistical Mechanics, R.K. Patharia (Butterworth-Heinemann, 1996).
4. Statistical Mechanics: An Advanced course with problems and solutions, Ryogo Kubo (North- Holland, 1965).

20 May 2022

M.Sc. (PHYSICS) SEMESTER- II

ELECTRONICS (B010804T)

Total Lectures 45 (4 Credits)

Unit I (10 Lectures)

Operational Amplifier: Differential Amplifier, circuit configurations, dual input., balanced output differential amplifier. DC analysis, AC analysis, inverting and non-inverting inputs, CMRR, constant current bias level translator. Block diagram of a typical Op-Amp analysis. Open loop configuration. inverting and non— inverting amplifiers. Op-Amp with negative feedback, voltage series feedback, effect of feedback on closed loop gain input persistance output resistance bandwidth and output offset voltage, voltage follower. Practical Op-Amp input offset voltage, input bias current, input offset current, total output offset voltage, CMRR frequency response.

Unit II (13 Lectures)

Adder, Subtractor, Summing amplifier, Integrator and differentiator, Logarithmic and anti logarithmic amplifier, Oscillators principles, oscillator types, frequency Stability, response, Phase shift, Wein bridge, LC tunable oscillators, Square wave and Triangular wave generators, VCO, Comparators, Schmitt trigger, V/F and F/V converter, A/D and *D/A* converters, Sample and hold circuit, multivibrators.

Unit III (12 Lectures)

Optoelectronic devices: Radiative and non-Radiative transition, photon absorption and emission in semiconductors, Electron- Hole pair generation rate, Light emitting diode (LED} construction, working principle, generation of light and external quantum efficiency, high frequency limit, effect of surface and indirect recombination current in LED. Photodiodes, Phototransistors, Solar Cell- open circuit voltage, short circuit current, Fill factor.

Unit IV (10 Lectures)

Fiber Optics: Structure and Classification, Single & Multimode, Step & Graded Index, light propagation through optical fiber, acceptance angle and numerical aperture, fiber fabrication techniques, Transmission characteristics of optical fiber, Attenuation pulse broadening mechanism, intermodal dispersion, material dispersion. Fiber Loss.

Text and Reference books:

1. Op-Amp & Linear Integrated Circuits, Ramakanth A. Gayakwad , Printice Hall of India.
2. Electronic Devices and Circuit Theory, Robert Boylested and Louis Nashdsky, Printice-Hill Inc.
3. Optoelectronics: Theory and Practice, Alien Chappal, McGraw Hill Book Co., NY.
4. Ghatak and K. Thyagrajan Optical Electronics
5. M. S. Tyagi: Introduction to semiconductor devices
6. S. M. Sze: Physics and Technology of Semiconductor Devices
7. Ajoy Ghatak and K. Thyagarajan: Introduction to Fiber Optics.

20 May 2022

M.Sc. (PHYSICS) SEMESTER- III

CLASSICAL ELECTRODYNAMICS & PLASMA PHYSICS (B010901T)

Total Lectures 45 (4 Credits)

UNIT- I (10 Lectures)
Homogeneous and inhomogeneous (Poincare) Lorentz groups, Pseudo-Euclidean spacetime, Spacetime rotations, rapidity, Proper, improper, orthochronous, antichronous Lorentz groups, Light cone and Matrix representation of Lorentz transformations, Spacelike, time like and light like Four-vectors, orthogonality, Four-tensors, four- velocity, four-momentum, four-acceleration, Minkowski force.

UNIT- II (15 Lectures)
Covariant form of continuity equation, 2-Form electromagnetic field-strength tensor, dual field-strength tensor, Covariant formulation of Maxwell's field equations with gauge invariance, Lorentz force equation in covariant form, Transformation of electromagnetic fields as tensor components, Proca Lagrangian with Photon mass, Canonical approach to electrodynamics, Lagrangian and Hamiltonian formulation for a relativistic charged particle in external electromagnetic field, Canonical and Symmetric Stress Tensors, Solution of the wave equation in covariant form.

UNIT- III (10 Lectures)
Retarded and advanced potentials, Lienard-Wiechert potentials for a moving point charge, Fields produced by a charge in uniform and accelerated motion, Radiation from an accelerated charge, Radiated power, Larmor's formula and its relativistic generalization, Thomson scattering of radiation, Thomson cross section.

UNIT- IV (10 Lectures)
Elementary concepts of plasma, derivation of moment equations from Boltzmann's equation. Plasma oscillation, Debye shielding, plasma confinement, magneto plasma. Fundamental equations, hydromagnetic waves: magnetosonic waves, Alfven waves, wave propagation parallel and perpendicular to magnetic field.

Reference Books:

1. Classical Electrodynamics: John David Jackson (Wiley India).
2. Introduction to Electrodynamics: David J. Griffiths (Prentice-Hall of India, New Delhi).
3. An Introduction to Relativity: J. V. Narlikar (Cambridge Univ Press).
4. Introducing Einstein's Relativity: Ray D'Inverno (Clarendon Press, Oxford)
5. Electromagnetic Field Theory for Engineers and Physicists: G. Lehner (Spinger).
6. Modern Electrodynamics: A. Zangwill (Cambridge University Press)

20 May 2022

M.Sc. (PHYSICS) SEMESTER- III

QUANTUM MECHANICS- II (B010902T)

Total Lectures 45(4 Credits)

UNIT- I (10 Lectures)
Approximation Methods for Stationary Systems: Time-independent perturbation theory - (a)non-degenerate and (b) degenerate, Variational Method; WKB method and its applications.

Unit II (12 Lectures)
Time Dependent Perturbation theory, Transition to a continuum of final states-Fermi Golden Rule, Applications, Semi-Classical theory of radiation.

UNIT- III (13 Lectures)
Scattering: Non-relativistic scattering theory, differential and total scattering cross section, Born approximation method with examples of scattering by Coulomb, Gaussian, Square well and Yukawa potentials. Partial wave analysis, optical theorem, phase shift, example of scattering by square well potential.

UNIT- IV (10 Lectures)
Relativistic QM: Klein-Gordon equation, Dirac equation. Properties of Dirac matrices, Plane wave solution of Dirac equation, spin and magnetic moment of the electron, non-relativistic reduction to Dirac equation.

Reference Books:

1. Principles of Quantum Mechanics: R Shanker
2. Quantum Mechanics by B.H. Bransden & C.J. Joachain (Pearson Education, 2000)
3. Quantum Mechanics (vol 1): Tannoudji
4. Modern Quantum Mechanics by J.J. Sakurai (Addison-Wessley, 1993)
5. Quantum Mechanics: Concepts and Applications, Nouredine Zettili (Wiley 2nd edition 2009)
6. Quantum Mechanics: E Merzbacher
7. Introduction to Quantum Mechanics: Griffiths
8. Quantum Mechanics: Schiff
9. Quantum Mechanics :Liboff
10. Quantum Mechanics Theory and Applications: Ghatak and Loknathan
11. Relativistic Quantum Fields, Vol.II, J.D. Bjorken and S.D. Drell (McGraw-Hill, 1978)
12. Relativistic Quantum Fields, Vol.I, J.D. Bjorken and S.D. Drell (McGraw-Hill, 1964)

20 May 2022

M. Sc. (PHYSICS) SEMESTER- III

NUCLEAR PHYSICS- I (B010903T)

Total Lectures 45 (4 Credits)

UNIT- I (10 Lectures)
Basic facts about nuclei, Mass and binding energy, Semi-empirical mass formula, Nuclear size determination using mu-mesic X-rays and scattering of fast electrons, Nuclear spin and magnetic moment of nuclei, Molecular beam resonance method, Nuclear induction method, Electric quadrupole moment.

UNIT- II (10 Lectures)
Alpha decay, Alpha spectra, Selection rules, Geiger-Nuttall relation, Theory of alpha decay, Beta-spectra, Fermi's theory of beta decay, Sergeant's law, Kurie Plot, Allowed and forbidden transitions, Fermi and Gamow Teller Transition, Extraction of Fermi constant, Parity violation in beta-decay, Detection of neutrino.

UNIT- III (10 Lectures)
Gamma emission, Multi-polarity of gamma rays, Selection rules, Theoretical prediction Transition probability, estimation of transition probability for single particle (Weisskopf unit), Internal conversion, Angular correlation, Nuclear isomerism, Mossbauer Effect and its applications.

UNIT- IV (15 Lectures)
Nuclear reactions, Conservation laws, The Q-equation and deduction of nuclear energy, Compound nucleus, Bohr hypothesis, Resonance phenomenon, Breit-Wigner single level formula, Optical model, Simple discussion of direct reactions. Nuclear fission, Bohr-Wheeler theory of nuclear fission, Controlled chain reaction, Nuclear reactors, Nuclear Fusion.

Reference Books:

1. Nuclear Physics: Krane K.S., Wiley India Pvt. Ltd., (2008).
2. Nuclear physics principles and applications: Lilley J.S., John Wiley & sons Ltd.,
3. The Atomic Nucleus: Evans R. D. Tata McGraw Hill, 1955.
4. Atomic and Nuclear Physic: S N. Ghoshal, Vol. II.,2000.
5. Nuclear Physics: R. R. Roy and B. P. Nigam, Wiley-Eastern Ltd. 1983.
6. Introduction to Nuclear Physics: Wong, PHI.
7. Introduction to Nuclear and Particle Physics: A Das and T Ferbel.

20 May 2022

M.Sc. (PHYSICS) SEMESTER- III

ELECTRONICS I (B010904T)

Total Lectures 45 (4 Credits)

Unit I (12 lectures)
Communication: EM wave propagation- transmission lines, line equation, coaxial cable, Propagation of ground wave, space wave and Sky wave, Characteristic impedance, reflection coefficient, Standing wave ratio and measurement of impedance in various media, Introduction to Fiber optics and wireless communication.

Unit II (7 lectures)
Antennas : Linear dipole antennas, Antenna array techniques, Systems and characterization antenna matching and basic antenna types, Radar-principle, operation and application

Unit III (6 lectures)
Noise: Signal to noise ratio (SNR) and enhancement of SNR in instrumentation and communication. Noise reduction in electronic circuits. Principles of phase locking and lock-in amplifier, Sample and hold circuits.

UNIT IV (10 lectures)
Microprocessor: Introduction to microcomputers, memory, input/output interfacing devices. 8085 microprocessor, Architecture, Microprocessor initiated operations, Internal data operation, Externally initiated operations, instruction set and addressing modes, 8085 programming, Writing simple programs of addition, subtraction, multiplication and division of two numbers.

Unit V (10 lectures)
Microwave Devices & Communication: Klystrons, Magnetrons and Travelling Wave Tubes, Velocity modulation, Basic principles of two cavity Klystrons and Reflex Klystrons, principles of operation ofMagnetrons. Helix Travelling Wave Tubes, Wave Modes.

Advantages and disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnelzone problem. ground reflection, Fading sources, detectors, components, antennas used in microwave communication systems.

Recommended Books:

1. Digital Principles and Applications, A. P. Malvino and D. P. Leach, Tata McGraw Hill. Digital Integrated Electronics, Taub and Schilling, McGraw Hill Co.
2. Principles of Communication Systems, Taub and Schilling, McGraw Hill Co. Communication Systems, Simon Haykin, John Wiley & Sons, Inc.
3. Microprocessor Architecture, Programming and Application with 8085, Ramesh S. Gaonkar, Willey-Eastern Ltd.
4. Electronic Communications, Dennis Roddy & John Coolen, Pearson Education.
5. Electronic Communication System, George Kennedy & Bernard Davis, McGraw Hill Pub.
6. Computer Networks. Andrew S. Tanenbaum, Prentice Hall Inc.

20 May 2022

M. Sc. (PHYSICS) SEMESTER- III

Condensed Matter Physics-I (B010905T)

Total Lectures 45 (4 Credits)

Unit I (9 Lecture)

Transport Properties of Solids: Boltzmann transport equation, resistivity of metals and semiconductors, Fermi surfaces –determination, Landau levels, de Hass van Alphen effect, Quantum Hall effect- Integral quantum Hall effect and Magnetoresistance.

Unit II (9 Lecture)

Dielectric Properties of Solids: Dielectrics and ferroelectrics, macroscopic electric field, local field at an atom, dielectric constant and polarizability, ferroelectricity, antiferroelectricity, piezoelectric crystals, ferroelasticity, electrostriction.

Unit III (8 Lecture)

Optical properties: Optical constants and their physical significance, Reflectivity in metals, plasmonic properties of metals, determination of band gap in semiconductors: direct and indirect band gap, defect mediated optical transitions, excitons, photoluminescence, Electroluminescence

Unit IV (10 Lecture)

Magnetism: Types of magnetic materials, Quantum theory of paramagnetism, Hund's rule, Ferromagnetism, antiferromagnetism: molecular field, Curie temperature. Domain theory, Magnetic Anisotropy, Magnetic interactions, Heitler-London method, exchange and superexchange, magnetic moments and crystal-field effects, spin-wave excitations and thermodynamics, antiferromagnetism, Magnetostriction.

Unit V (9 Lecture)

Superconductivity: Phenomenological theories of superconductivity, BCS theory, two fluid and Pippard's theory, London equations Flux quantization, BCS ground state and energy gap, Cooper pairs, coherence, vortex states Ginzburg-Landau theory, Josephson effect, SQUID, introduction to high-temperature superconductors.

Reference:

1. Solid State Physics, N. W. Ashcroft and N.D. Mermin(Ist Ed., Cengage Learning, 2003)
2. Elementary Excitations in Solids, D. Pines (CRC press, 1999)
3. The Wave Mechanics of Electrons in Metals, S. Raimes (North-Holland, 1970)
4. Lecture Notes on Electron Correlation & Magnetism, P. Fazekas (World Scientific, 1999)
5. Introduction to Superconductivity,M. Tinkham (Dover Publications Inc., 2004)
6. Condensed Matter Physics,M. Marder(2nd Ed., John Wiley & Sons, 2010)
7. Principles of Condensed Matter Physics,P.M. Chaikin and T.C. Lubensky (Cambridge University Press, 1995)
8. Crystal Structure Analysis by Buerger
9. Elementary Solid State Physics by M. Ali Omar
10.Physics of Quasi Crystals by Steinhard and Oustlan
12.Quantum theory of Solids by Callaway
13.Theoretical Solid State Physics by Huang

20 May 2022

M.Sc. (PHYSICS) SEMESTER- IV

ATOMIC AND MOLECULAR PHYSICS (B011001T)

Total Lectures 45 (4 Credits)

UNIT- I (10 lectures)
Introduction to Quantum theory, Spin-Orbit interaction energy, Doublet separation, Spectroscopic Description of Atomic Electronic States – Term Symbols, Intensity rules for fine structure doublet, Fine structure of Hydrogen lines. Optical spectra of alkali metals, Non-penetrating and penetrating orbits, Rydberg-Schruster law, Runge's Law, The Ritz Combination Principle, Optical spectra of alkaline earth elements, Singlet and triplet terms.

UNIT- II (10 lectures)
Coupling scheme for two electron systems – non-equivalent and equivalent electron cases, Hund's rule, Lande's interval rule. Normal and Anomalous Zeeman Effect, Paschen-Back effect of one electron system, Stark effect, Hyperfine structure, Isotope effect in atomic spectra, distinction between Isotope effect and hyperfine structure, Lamb Rutherford Shift.

UNIT- III (10 lectures)
Microwave Spectroscopy – Rotational spectra, Diatomic and polyatomic molecules, Infrared Spectroscopy – Vibrating diatomic molecule, the diatomic vibrating rotator, Rotation- Vibration spectra of diatomic molecules, Raman Spectroscopy- Pure rotational Raman spectra, Vibrational Raman spectra, Structural determination from Raman Spectroscopy, Selection rules, P.Q and R branches, Isotopic shift.

UNIT- IV (15 lectures)
Electronic Spectra of Diatomic molecules -Breakdown of Born Oppenheimer Approximation, Intensity of Vibrational -Electronic Spectra-The Franck Condon Principle, Dissociation energy and Dissociation Products, Rotational Fine Structure of Electronic-Vibration transitions,
Coherence-spatial and temporal, He-Ne gas laser, ruby laser, Raman spectroscopy, uses of lasers in Raman spectroscopy, Principle of Electron Spin Resonance (E.S.R), Nuclear Magnetic Resonance (N.M.R) and their applications.

Reference Books:

1. Introduction to Atomic Spectra: H.E. White (McGraw Hill, 1934)
2. Atomic Spectra and Atomic Structure, G. Herzberg (Dover Publications, 2003)
3. Molecular Spectra and Molecular Structure, G. Herzberg (Van Nostrand, 1950)
4. Atoms, Molecules and Photons, W. Demtroder (Springer, 2006)
5. Fundamentals of Molecular Spectroscopy, C. N. Banwell (McGraw Hill, 1983)
6. Basic atomic & Molecular Spectroscopy, J. M. Hollas (Royal Society of Chemistry, 2002)
7. Principles of Lasers, O. Svelto (5th Ed., Springer, 2010)
8. Laser Spectroscopy, W. Demtroder (3rd Ed., Springer, 2003)
9. Molecular Quantum Mechanics, P Atkins & R. Friedman (Oxford Univ. Press, 2005)
10. Quantum Chemistry, I. N. Levine (7th Ed., Pearson, 2016)
11. Physics of Atoms and Molecules, B. H. Bransden and C. J. Jochain (2nd Ed., Pearson Education, 2003)
12. Molecular Spectroscopy by G.M. Barrow

20 May 2022

M. Sc. (PHYSICS) SEMESTER- IV

NUCLEAR PHYSICS- II (B011002T)

Total Lectures 45 (4 Credits)

UNIT- I (12 lectures)
Nuclear two-body problem, Simple theory of deuteron, Spin dependence and non-central feature of nuclear forces, Partial wave analysis, Low energy n-p scattering, Low energy p-p scattering, Existence of two nucleon bound system, Scattering length and effective range theory, Charge symmetry and charge independence of nuclear forces, Meson theory of nuclear forces.

UNIT- II (10 lectures)
liquid drop model, Magic numbers and evidence of shell structure, Extreme single particle shell model, Predictions of spin, parity and electromagnetic moments, Nilsson Model (Qualitative), Collective model, Rotational and Vibrational Hamiltonian, Energy levels and band structure due to single particle; Vibrational and rotational behaviour of different nuclei.

UNIT- III (10 lectures)
Classification of elementary particles Exact conservation laws, Approximate conservation laws: Isospin and Isospin wave functions for pion-nucleon system, strangeness, parity, time reversal and charge conjugation, CP violation.

UNIT- IV (13 lectures)
Eight fold way, Quarks, Quark-Quark interaction, SU(3) quark model, Gellmann-Nishijima formula, Magnetic dipole moment of baryons, Masses of hadrons. Basic ideas about the standard model. Mass generation.
(10 Lectures)

Reference Books:

1. Nuclear and Particle Physics: W. Burcham and M. Jobes.
2. Quarks and Leptons: Halzen and Martin, Jon Willey and Sons
3. Unitary symmetry and Elementary Particles: D.B.Lichtenberg.
4. Symmetry Principles in particle Physics: Emmerson.
5. Introduction to High Energy Physics: Donald H. Perkins, University of Oxford.
6. Nuclear Physics: S. N. Ghoshal, First edition, S. Chand Publication.
7. Nuclear & Particle Physics: An Introduction: B. Martin (Willey, 2006)
8. Introduction to Elementary Particles: D. Griffiths (Academic Press, 2nd Ed. 2008)

20 May 2022

M. Sc. (PHYSICS) SEMESTER- IV
Electronics II (B011003T)

Total Lectures 45 (4 Credits)

UNIT I (10 lectures)

Analog Communication Electronics: Amplitude modulation, generation of AM waves. demodulation of AM waves, DSBSC modulation, generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB Waves, Vestigial sideband modulation.

Unit II (10 lectures)

Frequency modulation, Frequency spectrum for sinusoidal FM. Non-sinusoidal modulation, Phase modulation, equivalence between PM & FM. Varactor diode modulators, Reactance modulator, FM transmitter, Armstrong indirect method, FM detectors, Foster-Seeley discriminator, Ratio detector,

UNIT III (10 lectures)
Digital Communication:

Sampling theorem, sampling of Low Pass and Band - pass signals, Pulse Modulation-PAM, PWM, PPM, Ideal sampling, Natural sampling, Flat-top sampling, Quantization of signals; Quantization, PCM, Differential PCM, Delta Modulation, Adaptive Delta modulation, CVSD, Line encoding; unipolar, polar, bipolar, Manchester encoding.

Unit IV (15 lectures)

Digital Modulation Techniques: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK) - Binary (BPSK), Differential (DPSK), Quadrature (QPSK) & M-ARY Quadrature Amplitude Shift Keying (QASK), QAM, Frcquency Shift Keying (FSK), Minimum Shift keying (MSK).

Recommended Books:

1. Advance Electronics Communications Systems, Wayne Tomasi, Pill, Edn.
2. Electronic Communication System, George Kennedy & Bernard Davis, McGraw HillPub.
3. Modern Digital and Analog Communication systems- B P Lathi, Oxford Univ Press
4. Electronic Communication system- R Blake, Cengage india edition
5. Communication System Engineering- Proakis and Salehi, PHI Learning
6. Advance Electronics Communications Systems, Wayne Tomasi, Pill, Edn.

20 May, 2022

M. Sc. (PHYSICS) SEMESTER- IV

Condensed Matter Physics II (B011004T)

Unit I (8 lectures)

Imperfections in Crystal: Point imperfections, Vacancies, Interstitial, Schottky and Frenkel defect. Colour centres, Dislocation of elastic and plastic deformation of solids, Slip planes, Critical resolved shear stress, Elastic energy, Frank and Reid source, Stacking faults, Grain boundaries, Tilt boundaries, and Twin boundaries, Whiskers, Observations of dislocation and other defects.

Unit II (12 lectures)

Exotic Solids: Glass formation, types of glasses and glass transition, radial distribution function and amorphous semiconductors, electronic structure of amorphous solids, localized and extended states, mobility edges, Density of states and their determination, transport in extended and localized states, Optical properties of amorphous semiconductors. Structure of polymers, polymerization mechanism, characterization techniques, optical, electrical, thermal and dielectric properties of polymers, Liquid Crystals, Quasi Crystals.

Unit III (10 lectures)

Nano structural materials: Introduction, Methods of synthesis and experimental characterization techniques, Quantum size effect and its applications, C60, C80 and C240, Fullerene, Graphene, Single wall and multi wall carbon nanotubes, their formation, characterization and applications, Introduction to photonic crystal.

Unit IV (15 lectures)

Thin films and surfaces: Study of surface topography by multiple beam interferometry, Determination of film thickness (Fizeau and FECO method), Elementary concepts of surface crystallography, SEM, TEM and STM, AFM, Thin film preparation methods, Boltzman transport equation for different scattering expression for electrical conductivity, Elementary ideas of surface states in semiconductors, localized vbrational states, Elementary idea of Excitons.

Text and Referances

1. Introduction to Dislocations by D. Hull
2. Introduction to Solid State Theory by Madelung
3. Quantum theory of solid State by Callaway
4. Theoretical Solid State Physics by Huang
5. Quantum theory of solids by Kittle
6. Physics of Thin Films by K.L. Chopra
7. Multiple beam interferometry by Tolansky
8. Transmission Electron Microscopy by Thomas
9. Solid State Physics by C. Kittel

20 May, 2022

Optional paper

Titles of open Elective Paper

Total Lectures 45 (5 Credits)

- **Physics of Liquid Crystals**
- **Laser Physics and applications**
- **Physics of nanomaterials**
- **Elements of Atmospheric and space Science**

(Any one of the elective paper is to be opted in the final Semester)

20 May, 2022

M. Sc. (PHYSICS) SEMESTER- IV

Physics of Liquid Crystals (B011005T)

Total Lectures 45 (4 Credits)

Unit I (10 Lecture)

Classification of Liquid Crystals: Historical Outlook, Classification of Liquid Crystals, Polymorphism in LC, Optical Textures, Thermotropic Liquid Crystals, Calamitic Liquid Crystals: Nematic (N} Phases, Smectic phases (SmA and SmC), Chiral Nematic (N°) Phase/Cholesteric Phase. A review of Discotic Liquid Crystals and Bent-Core Liquid Crystals, Polymer Liquid Crystals, Lyotropic Liquid Crystals.

Unit II (12 Lecture)

Theory of Liquid Crystal and Phase Transitions: Nature of Phase Transition and critical phenomenon in liquid crystals, hard particle model. Maier-- Saupe Theory and Van der Waals theories for isotropic-nematic and nematic-Smectic A transitions; Landau theory: essential ingredients, application to isotropic-nematic, nematic-smectic A/C transitions and other smectics.

Unit III (13 Lecture)

Nematic Liquid Crystals: Elastic Continuum Theory, Dielectric Constant and Refractive Indices, Flows and hydrodynamics, Alignment of Liquid Crystals (Planar and homeotropic), Field induced director reorientation, Threshold Voltage for Switching. Estimation of Elastic Constants (Splay Twist and bend coefficients), Birefringence and Order Parameter.

Unit IV (10 Lecture)

Application of Liquid Crystals: Display Applications: Principle, design and working of LC displays, Nematic Liquid Crystals Switches, 7-segment display. Non -Display Applications: Temperature Sensor, Spatial Light Modulators, Optical Shutters, Tunable Pbotonic Crystals, Biomedical Applications.

References:

1. Liquid Ctystals, S. Cbandrashekhar, Cambridge University Press, Second Edition, 1992. Liquid Crystals, lam-Oloon Khoo, Willey, Second Edition, 2007.
2. Introduction to Liquid Crystals, PJ Collings and M. Hird, Taylor Francis, Bristol, PA 1997. PG D Gennes and J. Prost J. The physics of Liquid Crystals, Clarendon Press, Oxford, 1993.
3. Liquid Crystal Devices: Physics and Applicatioos, VG Chigrinov Artech House, Boston, London, 1999.

20 May 2022

M. Sc. (PHYSICS) SEMESTER- IV

Laser Physics and applications (B011006T)

Total Lectures 45 (4 Credits)

Unit I (15 Lectures)
Basic Principles: Laser rate equation for three level and four level systems, Dynamics of Laser Process: switching, Mode locking, mode pulling, lamb dip, hole burning, Energy levels and radiating properties of molecules, liquids and solids

Unit II (12 Lectures)
Laser amplifier, Laser resonators, Techniques of laser excitation,Different laser systems, Ruby laser, He-Ne laser, Nd: YAG laser, CO_2 laser, Semiconductor diode laser, Dye lasers, Excimer lasers.

Unit III (10 Lectures)
Applications of Laser: Material processing; Laser Communication, Holography, Military applications, Medical applications, Laser hazards and Laser safety, Infrared optical devices, Laser cooling,Trapping.

Unit IV (10 Lectures)
Optical Fiber Communication: Optical Fiber structure, Wave guiding and Fabrication of Fiber, Types of Fiber and solution of Maxwell's equation inside Fiber, Signal degradation and attenuation in Optical Fibers,

Reference books:

1. Lasers by A. E. Siegmann. University science books
2. Laser Physics by P. W. Milonni and J. H. Eberly
3. Laser Spectroscopy by W. Demtroder
4. Principles of Laser by O. Swelto
5. Lasers, Theory and Applications by K. Thyagarajan and A. K. Ghatak

20 May 2022

M. Sc. (PHYSICS) SEMESTER- IV

Physics of Nano materials (B011007T)

Total Lectures 45 (4 Credits)

Unit I (7 Lecture)

Physics of the Solid State: Crystal structures, Band and free electron theory of solids, Idea of band structure, Density of state in bands, Diffusive transport, scattering mechanisms, Surfaces, Interfaces and Layered Systems.

Unit II (15 Lecture)

Quantum Nature of Nano world: Introduction of Nanomaterials, Characteristic or Critical lengths in mesoscopic systems e.g. mean free path, scattering length, coherence length etc; Idea of quantum well, Quantum wire & and Quantum dots; One and Two dimensional electron systems: general properties, Quantum confinements, Variation of density of states and band gap with dimensionality, Optical properties of semiconductor and metal nanomaterials, Surface Plasmon Resonance in Metal Nanoparticles. Carbon Nanostructures (Fullerenes, Carbon Nanotubes and Graphene) and their Renewable Energy Applications.

Unit III (10 Lecture)

Nano fabrication: Synthesis of nanomaterial (0, 1& 2 Dimensional) by Top down and Bottom-up Approaches; Ball Milling. Lithography, etching. epitaxial growth, physical and chemical vapour deposition (PVD & CVD) methods, Microwave, Hydrothermal and Solvo-thermal synthesis methods, Chemical synthesis of nanomaterial etc.

Unit IV (13 Lecture)

Characterization of Nano materials: Structure (X-Ray and electron Diffraction}; Determination of Particle size, Crystallography, atomic and surface structures, Microscopy (Scanning and Transmission electron microscopy, atomic force microscopy, Scanning tunnelling microscopy); Spectroscopy (X-ray Photoelectron Spectroscopy, Infrared and Raman Spectroscopy).

Text and Reference Books:

1. Introduction of Nanotechnology by Charles P Poole Jr and F J Owens Wiley India
2. Nanotechnoology for Microelectronics and optoelectronics by JMM Duart, RJM Palma and FA Rueda Elsevier
3. Introduction to Solids by Kittel
4. Physics of semiconductor nanostructure by KP *Jain*, Narosa
5. Physics of low dimensional semiconductors by John H. Davies
6. Nano particles and nanostructured films: Preparation, Characterisation and Application, Ed. J. H. Fendler, John Wiley

20 May, 2022

M.Sc. (PHYSICS) SEMESTER- IV

ELEMENTS OF ATMOSPHERIC AND SPACE SCIENCE (B011008T)

Total Lectures 45 (4 Credits)

UNIT- I (10 Lectures)
Lower atmosphere: Composition, constituents, dynamics; diurnal and seasonal variations of Temperature, Pressure and Humidity; Ozone hole and its impact on climate.

UNIT- II (12 Lectures)
Ionosphere and magnetosphere: structure and formation, Density profile of upper atmosphere. Storm – substorm phenomena.

UNIT- III (10 Lectures)
Structure of the Sun: Solar interior, solar atmosphere, photosphere, chromosphere, corona; Sunspots and their properties, solar rotation, Babcock model of sunspot formation.

UNIT- IV (13 Lectures)
Solar cycle and solar activity: Solar Wind, Solar Flares, Coronal Mass Ejections (CMEs); heliosphere and solar magnetic field. Space Weather: causes and consequences.

Reference Books:

1. Meteorology: Understanding the Atmosphere: Steven A. Ackerman and John A. Knox
2. An introduction to Meteorology: S. Petterssen, McGraw-Hill Book Company, USA
3. Element of Space Physics: R.P. Singhal, Prentice Hall of India, New Delhi
4. Astrophysics of the Sun: Harold Zirin, Cambridge University Press, Cambridge, U.K.
5. Guide to the Sun: Kenneth J. H. Philips, Cambridge University Press, U.K.

20 May 2022

M. Sc. Physics I (B010705P) & II sem (B010805P) Practicals Suggested List

1. Study of a Regulated power supply
2. Measurement of inductance and capacitance and study of LCR series and parall el resonance circuits
3. I-V characteristics of Silicon controlled rectifier
4. I-V characteristics of Unijunction transistor
5. MOSFET characteristics.
6. Verification of network theorems.
7. Study of low pass. high pass and band pass filters
8. Measurement of inductance and capacitance using AC bridges
9. Measurement of Stephan's constant of radiation
10. Study of transistorized multivibrators
11. Measurement of wavelength of He-Ne laser using a steel scale
12. Measurement of intensity distrbution in a single slit diffraction pattern produced by He-Ne laser.
13. Thickness of mica sheet using a biprism
14. Thickness of quartz plate using constant deviation spectrometer
15. Resolving power of prism
16. Babinet C ompensator
17. Young's Modulus and Poisson's ratio of glass by Comu's fringes
18. Michelson interferometer
19. Febri-Perot Interferometer
20. Verification of Fresnel's formula
21. Study of absorption spectrum of iodine
22. Velocity of ultrasonic waves in liquids

20 May, 2022

MSc Physics- Semester III &IV Practicals List:

Condensed Matter Physics:

1. Determination of lattice parameter and indexing of powder photographs.
2. Study of dispersion curves of monoatomic lattice using given transmission lines
3. Measurement of resistivity of semiconductor by four probe method and determination of bandgap
4. Measurement of Hall coefficient of given semiconductor to estimate charge carrier Concentration.
5. Measurement of thermal and electrical conductivity of copper and determination of Lorentz number.
6. Measurement of thermal conductivity of poor conductor (Perspex)
7. Measurement of thermal diffusivity of brass
8. Verification of Curie-Weiss law for ferroelectric material
9. B-H curve of a ferromagnetic material
10. Measurement of thermal relaxation time of a serial light bulb and verification of Debye relaxation formula.
11. Measurement of polarizability of nonpolar liquid and dipole moment of polar liquid.
12. Determination of Lande's g factor of DPPH using Electron Spin Resonance spectrometer
13. Determination of magnetic susceptibility of paramagnetic substance by Quincke's method
14. Measurement of dislocation density of a crystal by etching
15. Determination of magneto resistance of bismuth
16. Dielectric constant of solid (wax) by Lecher wire.

Electronics:

1. To study OP-AMP characteristics
2. To study OP-AMP applications
3. To study transistorized differential amplifier.
4. To study OP-AMP as a Comparator and Schmitt Trigger.
5. To study the operation of V/F & *F/V* converter.
6. To study Wien Bridge, Phase-Shift and Colpitt Oscillators.
7. To study Astable, Mono-stable and Bi-stable multivibrators.
8. To study the operation of PLL and VCO.

20 May 2022

9. To study BCD to 7 segment Decoder, BCD to Excess-3 code, Binary to Gray and Gray to Binary conversion.
10. To study 4 Bit R-2R ladder DAC and 4 Bit Counter type ADC.
11. To study 4 Bit Synchronous and Ripple Counter.
12. To study losses in an Optical Fibre.
13. To measure Numerical Aperture (NA) of an optical fibre.
14. Addition, Subtraction, Multiplication and Division using 8085 microprocessor.
15. Signal Sampling and Generation in PAM.
16. Study of amplitude modulation
17. Study of frequency modulation
18. Study of amplitude demodulation
19. Study of Frequency demodulation
20. Study of Gunn diode
21. Experiments based on microwaves
22. Study of Electronic devices.

20 May 2022

MSc Physics IIIrd and IVth SEMESTER
Research Projects/ Dissertation

The Master Dissertation/ Research project is intended to give an essence of research work for excellence in specific areas. It will be based on preliminary research oriented topics both in theory and experiment. The dissertation(s) in both theory and experimental stream are expected to give a flavour of how research leads to new findings. The teachers who will act as supervisors for the master dissertation, will float Research project/dissertation topics and any one of them will be allotted to the student. At the completion of the project/dissertation at year end, the student will submit the report in the form of Dissertation which will be examined by the Examiners appointed through University.

The examination shall consist of

1. Presentation and
2. Comprehensive Viva-voce.

20 May 2022