Raja Mahendra Pratap Singh State University, Aligarh
(Established by the State Legislature Act XX of 1956)

Board of Studies-Physics

Date: 02.07.2022

Minutes of Meeting

Meeting of Board of Studies of Physics held today on 02.07.2022 at D S College, Aligarh. Following members were present:

1. Dr. Anil Kumar Pachauri — Convenor
2. Dr. Manju Giri — Member
3. Dr. Keshav Deo Verma — Member
4. Dr. Mukesh Kumar — Member
5. Dr. Ateet Srivastava — Member
6. Dr. Ravindra Nath Chakraborty — Member
7. Dr. Jay Prakash Gupta — Member

All members discussed and recommended the syllabus of ~~M.Sc.~~ (Physics) VII, VIII, IX & X semester from session 2022-2023.

(Convenor)

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INTRODUCTION OF PG PHYSICS COURSE	
DEGREE IN BACHELOR (RESEARCH) OF SCIENCE	
FOURTH YEAR	1 Minor Paper (From Other Faculty) of minimum 4 Credits **in Semester VII** **SEMESTER VII** 4 Theory Papers (Compulsory) of 4 Credits each. 1 Practical Paper (Compulsory) of 4 Credits. 1 Research Project of 4 Credits. **SEMESTER VIII** 3Theory Papers (Compulsory) of 4 Credits each. 1 Theory Paper (Optional Paper) of 4 Credits. 1 Practical Paper (Compulsory) of 4 Credits. 1 Research Project of 4 Credits.
DEGREE IN MASTER OF SCIENCE	
FIFTH YEAR	**SEMESTER IX** 2 Theory Papers (Compulsory) of 4 Credits each. 2 Theory Paper (Optional Specialization Paper) of 4 Credits 1 Practical Paper (Specialization Lab.) of 4 Credits. 1 Research Project of 4 Credits. **SEMESTER X** 2 Theory Papers (Compulsory) of 4 Credits each. 2 Theory Paper (Optional Specialization Paper) of 4 Credits 1 Practical Paper (Specialization Lab.) of 4 Credits. 1 Research Project of 4 Credits.

DEGREE IN BACHELOR (RESEARCH) OF SCIENCE						
Year	**Sem.**	**Code**	**Nature**	**Paper Title**	**Theory/ Practical**	**Credits**
FOURTH YEAR	VII	RB010701T	Compulsory	Mathematical Physics	Theory	4
		RB010702T	Compulsory	Classical Mechanics	Theory	4
		RB010703T	Compulsory	Atomic and X-Ray Sepctroscopy	Theory	4
		RB010704T	Compulsory	Electrodynamics	Theory	4
		RB010705P	Compulsory	Lab	Practical	4
		RB010706R	Compulsory	Physics Dissertation – 1	Project	4
				Minor paper — Other faculty — Theory - 4		
	VIII	RB010801T	Compulsory	Advanced Mathematical Physics	Theory	4
		RB010802T	Compulsory	Statistical Physics	Theory	4
		RB010803T	Compulsory	Molecular and Laser Sepctroscopy	Theory	4
		RB010804T	Optional	**Optional Paper – I** Select any **One** from the following list	Theory	4
			1	Plasma Physics		
			2	Nano Physics		
		RB010805P	Compulsory	Lab	Practical	4
		RB010806R	Compulsory	Physics Disseration – 2	Project	4

SEMESTER-WISE TITLES OF THE PAPERS IN PG PHYSICS COURSE						
Year	**Sem.**	**Code**	**Nature**	**Paper Title**	**Theory/ Practical**	**Credits**
FIFTH YEAR	IX	RB010901T	Compulsory	Quantum Physics	Theory	4
		RB010902T	Compulsory	Nuclear Physics – 1	Theory	4
			Optional	**Optional Specialization Paper 1 & 2**	Theory	4
			Optional	Select any **Set** (of two papers) from the following list	Theory	4
		RB010903T RB010904T	Set 1	1. (a) : Electronics – 1 1. (b) : Electronics – 2		
		RB010903T RB010904T	Set 2	2. (a) : Condensed Matter Physics – 1 2 (b) : Condensed Matter Physics – 2		
		RB010905P	Compulsory	Specialization Lab	Practical	4
		RB010906R	Compulsory	Physics Dissertation	Project	4
	X	RB011001T	Compulsory	Advanced Quantum Physics	Theory	4
		RB011002T	Compulsory	Nuclear Physics – 2	Theory	4
			Optional	**Optional Specialization Paper 1 & 2**	Theory	4
			Optional	Select any **Set** (of two papers) from the following list	Theory	4
		RB011003T RB011004T	Set 1	1. (a) : Electronics – 3 1. (b) : Electronics – 4		
		RB011003T RB011004T	Set 2	2. (a) : Condensed Matter Physics – 3 2 (b) : Condensed Matter Physics – 4		
		RB011005P	Compulsory	Specialization Lab	Practical	4
		RB011006R	Compulsory	Physics Dissertation	Project	4

M.Sc. Physics – Paper 1st
Semester VII – Mathematical Physics

UNIT 1 **Total Lectures:- 45**

Vector, Vector Space, Gamma and Beta Funtion :

Component of Vector, Product of two and three vector, Gradient of scalar field, Divergence and curl of a vector field, Linear independence, Bases, Dimensionality, Inner product definitions, relating between Gamma and Beta Functions, Evaluation of definite integral

Lectures:- 11

UNIT 2

Matrices :

Definition, Matric algebra, The Complex conjugate and the transpose of a product of matrix, square matrices, Singular and non singular matrices, The inverse of a matrix, Trace of a matrix, Transformation matrices, Diagonalization matrices, Eigen ~~Valws~~ Value and Eigen vectors, Caylly – Homilton theorem.

Lectures:- 12

UNIT 3

Differential Equation and Special Function :

Solution of Secord order linear differential equation with variable coefficients solution by series expansion, Legendre, Bessel and Hermits equations, Physical applications, Generating functions, Recurrence relations.

Lectures:- 12

UNIT 4

Complex variable :

Function of complex variable, Cauchy – Riemann conditions for analytic function, Cauchy's integral theorem, Laurent's series, Residues, Cauchy residue theorem, Evaluation of definite integrals.

Lectures:- 10

Text and Reference Books :

1. Applied Mathematics for Engineers and Physicists by Pipes & Harvill
2. Mathematical Physics by B.S. Rajput
3. Mathematical Physics by B.D. Gupta

M.Sc. Physics – Paper 2nd
Semester VII – Classical Mechanics

Total Lectures:- 45

UNIT 1

Mechanics of a system of Particles, Constraints and their classification, Degrees of freedom, Generalised coordinates, Principle of Virtual work, D' Alembert's principle and Lagranges equation, Generalised Potential, Lagrangian for a charge particle moving in an electromagnetic field (Gyroscopic force), Guage Invariance of the Lagrangian, Applications of Lagrangian formulation.

Lectures:- 12

UNIT 2

Generalised momentum, Cyclic coordinates, Hamiltonian function H and conservation of energy (Jacobis Integral), Hamiltons equations, Examples on Hamiltonian dynamics, Hamilton's principle, Derivation of Hamilton's principle from D. Alembert principle, Derivation of Lagranges equation from Hamiltons principle, Principle of least action and other forms of principle.

Lectures:- 12

UNIT 3

Reduction of two particles, conservation theorem (First Integral of motion), Motion in a central force field, The Virial theorem, The inverse square law offeree (Kepler's problem), General description of scattering cross section, impact parameter, scattering angle, Rutherford Scattering .

of force

Lectures:- 10

UNIT 4

Canonical Transformation, Generating functions, Conditions for canonical transformation, Examples of canonical transformations, Poisson's brackets and their properties, Equations of motion in terms of Poisson's brackets, Poisson's brackets of angular momentum, Invariance Poisson's brackets, Lagrange brackets, Relation between Lagrange and Poisson bracket, Liouville's theorem.

Lectures:- 11

Reference Books :

Classical Mechanics by H. Goldstein, C. Poole and J. Safko
Classical Mechanics by N. C. Rana and P.S. Joag
Classical Mechanics by J. C. Upadhyaya

M.Sc. Physics – Paper 3rd
Semester VII – Atomic and X-Ray Spectroscopy

Total Lectures:- 45

UNIT 1 – Elements Spectroscopy :

Vector atom model, Quantum states of electrons in an atom, Selection rules, Spectroscopic terms, Spectra of one electron system, Intensity rules, Qualitative idea of spin, Quantum defects, Penetrating and non-penetrating orbits, Spin-Orbit interaction and fine structure. Spectra of Alkali elements.

Lectures:- 12

UNIT 2 – Spectra of Multi-electron Atoms :

Pauli's exclusion principle, Magnetic moment of an atom and Lande's g-factor, Coupling schemes, L-S coupling, j-j coupling, Spectroscopic terms for equivalent and non-equivalent electron atoms, Singlet and triplet states, Spectra of Alkaline earths.

Lectures:- 10

UNIT 3 – Effects on Atomic Spectra :

Isotopic effect, Hyperfine structure of atomic spectra, Electric and magnetic effects on spectral lines, Normal and Anomalous Zeeman effects, Paschen-back effect, Stark effect, Classical and Quantum mechanical explanations.

Lectures:- 11

UNIT 4 – X-Ray Spectra :

Continuous and characteristic X-ray spectra, Kossel's explanation of characteristic X-ray spectra, Shorter wavelength limit, Moselay Law, Emission and Absorption X-ray spectra, Fine structure of absorption edges, Fine structure in emission X-ray spectra, Comparison between X-ray and Optical spectra.

Lectures:- 12

Text and Reference Books :

1. Elements of Spectroscopy by S.L. Gupta & V. Kumar.
2. Atomic & Molecular Spectra by Raj Kumar
3. Introduction of Atomic Spectra by H.E. White
4. Atomic Physics by C.J. Foot

M.Sc. Physics – Paper 4
Semester VII – Electrodynamics

Unit 1
Relativistic Electrodynamics : **Total Lectures:- 45**

Transformation of differential operators, Invariance of D'Alembertian operator, Four vectors, proper time and velocity, relativistic dynamics, Minkowski force, Geometrical Interpretation of Lorentz Transformations of Space and Time, Lorentz transformations of Space and Time in Four-vector Form, Transformation of Charge and Current Densities, Transformation of Electromagnetic Potentials, Lorentz Transformation of Electric and Magnetic Fields, Invariance (or covariance) of Maxwell's Field Equations in terms of Four Vectors, Electromagnetic Field Tensor, Maxwell's Equations in Covariance Four Tensor Form.

Lectures:- 12

Unit 2
Electrodynamics of a moving charge and radiating systems :

Solution of inhomogeneous wave equation by Fourier analysis, Lienard-Wiechert potentials, the electromagnetic fields from Lienard-Wiechert potentials of a moving point charge, the electromagnetic fields produced by a charge in uniform and accelerated motion, reaction force of radiation, radiated power, angular distribution of radiation due to accelerated charge, Bremsstrahlung and synchrotron radiation.

Lectures:- 10

Unit 3
Maxwell's Equations and Electromagnetic Waves :

Equation of continuity, Maxwell's postulate, physical interpretation of Maxwell's postulate, Maxwell's equations and their empirical basis, derivation of Maxwell's equations, physical significance of Maxwell's equations, Electromagnetic energy and pointing theorem, Poynting vector, the wave equation, plane electromagnetic waves in free space, plane electromagnetic waves in isotropic and anisotropic non-conducting medium, plane electromagnetic waves in conducting medium.

Poynting

Lectures:- 11

Unit 4
Applications of Electromagnetic Waves :

Boundary conditions at the surface of discontinuity, reflection and refraction of electromagnetic waves at the interface of non-conducting media, Fresnel's equations (Dynamic properties of reflection and refraction, experimental verification of Fresnel's equations, Normal and Anomalous dispersion, dispersion in gases, experimental demonstration of anomalous dispersion in gases, dispersion in solids and liquids, scattering and scattering parameters, theory of scattering of electromagnetic waves, polarisation of scattered light, coherence and incoherence of scattered light.

Lectures:- 12

Text and Reference Books :

1. Classical Electrodynamics, J D Jackson, John Wiley
2. Electrodynamics, D J Griffith, Prentice Hall of India, New Delhi

3. Classical Electricity and Magnetism, Panofsky and Phillips, Addison Wesley.

List of Experiments for Semester VII

1. Y of glass plate by Cornu's method.
2. Viscosity of fluid by rotation Viscometer.
3. ' λ ' By prism and to find thinkness of micasheet.
4. Verification of Freshnel's law of Reflection
5. Verify Hartmanns formula using Prism Spectrometer.
6. Study of Zeeman's effect.
7. To analyse elliptically polarized light by Babinet compensator.
8. Assembly of Power Supply.

M.Sc. Physics – Paper 1st

Semester VIII – Advanced Mathematical Physics

Total Lectures:- 45

UNIT 1

Definition of Group, Group table, Sub Group, Lagrange's theorem, Classes, Complexes, Conjugate subgroup, Cayley theorem, Group representation Unitarity theorem, Schur's lemma theorem, Equivalence theorem, Unitary group, Point group.

Lectures:- 10

UNIT 2

Integral Transforms, Laplace transform, First and second shifting theorems, Inverse LT by partial functions, LT of derivative and integral of a function, Fourier series, FS orbitrary period, Half-wave expansion, Partial sums, Fourier integral and transforms, FT of delta function.

Lectures:- 11

UNIT 3

Methods for determination of zeroes of linear and nonlinear algebraic eqations and transcendental equations, converagence of solutions, Solution of simultaneous linear equations, Gaussian elimination, pivoting, iterative method, matrix inversion, Eigenvalues and eigenvectors of matrices, Power& Jacobi Method, Finite differences, interpolation with equally spaced and unevenly spaced points, Curve fitting, Polynomial least squares and cubic spline fitting.

Lectures:- 12

UNIT 4

Numerical differentiation and intergration, Newton-Cotes formula, error estimates, Gauss method, Random variate, Monte carlo evaluation of integrals, Methods of importance sampling, Random walk and Metropolis method, Numerical Solution of ordinary differential equations, Taylor's method, Euler & Runge Kutta Methods, Elementary ideas of solutions of partial differential equations.

Lectures:- 12

Text and Reference Books :

4. Applied Mathematics for Engineers and Physicists by Pipes & Harvill
5. Mathematical Physics by B.S. Rajput
6. Mathematical Physics by B.D. Gupta

M.Sc. Physics – Paper 2nd
Semester VIII – Statistical Physics

UNIT 1 **Total Lectures:- 45**

Calculation of statistical quantities, Energy and density fluctuations, Entropy of an ideal gas using microcanonical Ensemble, Glbb's paradox, Sackur- Tetrode equation.

Lectures:- 10

UNIT 2

Postulates of quantum statistical mechanics, Density matrix, Statistics of indistinguishable particles, Maxwell-Boltzmann, Fermi- Dirac and Bose- Einstein Statistics, properties of ideal Bose and Fermi gases, Bose- Einstein condensation.

Lectures:- 12

UNIT 3

Cluster expansion for a classical gas, Virial equation of state, Ising model, mean-field theories of the ising model in three, two and one dimensions, Exact solutions in one-dimension. Landau theory of phase transition, critical indices, scale transformation and dimensional analysis.

Lectures:- 12

UNIT 4

Correlation of space-time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory, fluctuation dissipation theorem, The Fokker-Plank equation.

Lectures:- 11

Text and Reference Books

1. Statistical and Thermal Physics by F. Reif
2. ~~Reif~~ Statistical Mechanics by K. Huang
3. Statistical Mechanics by R. K. Pathria
4. Statistical Mechanics by R. Kubo
5. Statistical Physics by Landau and Lifshitz
6. Statistical Mechanics and properties of matter, theory and application by E.S.R. Gopal

M.Sc. Physics – Paper 3rd
Semester VIII – Molecular and Laser Spectroscopy

UNIT 1 – Microwave or Far Infra-Red Spectroscopy : Total Lectures:- 45

Electronic, vibrational and rotational states of a molecule, Linear symmetric top, asymmetric top and spherical top molecules, Rotational spectra of a diatomic molecules as a rigid rotator and as a non-rigid rotator, Intensity of rotational lines, Stark modulated microwave spectrometer (Qualitative only), Determination of intra-nuclear distances (examples of CO and HCl).

Lectures:- 12

UNIT 2 – Near Infra-Red Spectroscopy :

Salient features of vibrational spectra, Diatomic molecule as harmonic oscillator, Concept of zero-point energy, Diatomic molecule as An-harmonic oscillator, Salient features of vibrational-rotational spectra, fine structure of infra-red bands, R-branch and P-branch.

Lectures:- 11

UNIT 3 – Raman Spectroscopy :

Raman effect and its salient features, Raman's experimental arrangement, Classical and Quantum theory of Raman effect, Stokes lines and Anti-stokes lines, Pure rotational Raman spectra, Vibrational Raman spectra, Mechanism of Fluorescent and Phosphorescent emission. **Lectures:- 12**

UNIT 4 – Laser Spectroscopy :

Spontaneous and stimulated emission, Laser principle, Properties of Laser beam, Einstein's coefficients, Laser action, Injection Laser threshold current, Semiconductor Laser, Argon Laser, Liquid Laser, Dye Laser and Free electron Laser.

Lectures:- 10

Text and Reference Books :

1. Elements of Spectroscopy by S.L. Gupta & V. Kumar
2. Atomic & Molecular Spectra by Raj Kumar
3. Molecular Spectroscopy by J.M. Brown
4. Fundamentals of Molecular Spectroscopy by C.B. Banwell

M.Sc. Physics – Paper 4
Semester VIII – Plasma Physics

Unit 1 **Total Lectures:- 45**

Motion of Charged particle in Electromagnetic Field :

Motion of charged particle in uniform electric and magnetic field, non-uniform field, time varying electric and magnetic field, diffusion of ions and electrons across magnetic field, Adiabatic invariants: first, second and third adiabatic -invariants.

Lectures:- 10

Unit 2

Plasma Oscillations and Waves :

Derivation of Moment Equations from Boltzmann equation, Debye Shielding, Plasma parameters, Plasma confinement. **Hydro- dynamical Description of Plasma:** Fundamental equations. **Hydro-magnetic waves:** Magneto-sonic and Alfven waves.

Lectures:- 11

Unit 3

Wave Phenomenon in Magneto-plasma :

Polarisation, phase velocity, group velocity, propagation of electromagnetic wave through Plasma (ionosphere) in the presence of magnetic field:Appleton-Hartee formula , Cut offs and Resonances for Electromagnetic wave propagating parallel and perpendicular to the magnetic field.

Lectures:- 12

Unit 4

Plasma Diagnostic Techniques :

Single probe method, Double probe method, Use of probe technique for measurement of plasma parameters in magnetic field, Microwave method, Spectroscopic method, Laser as a tool for plasma diagnostics, X-ray diagnostics of plasma, Acoustic method.

Lectures:- 12

Text and Reference Books :

1. Introduction to Plasma Physics: Francis F. Chen
2. Plasma Physics: S.N. Sen

M.Sc. Physics – Paper 4
Semester VIII – Nano Physics

Unit 1 **Total Lectures:- 45**

Introduction to Nanostructure Materials :

Nano-science and nanotechnology, size dependence of properties, Moore's law, surface energy and Melting point depression of nanoparticles, Free electron theory (qualitative idea) and its features, idea of band structure, insulators, semiconductors, energy band gaps of semiconductors, effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, variation of density of states with energy and size of crystal.

Lectures:- 12

Unit 2

Quantum Size Effect :

Quantum confinement, Nano-materials structures, Quantum well, Quantum wire and Quantum dot, Fabrication techniques.

Lectures:- 10

Unit 3

Characterization techniques of Nano-materials :

Determination of particle size, XRD (Scherrer's formula), increase in width of XRD peaks of nanoparticles, shift in absorption spectra peak of nanoparticles, shift in photoluminescence peaks, Electron microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM), Scanning Tunnelling Electron Microscopy (STEM) and Atomic Force Microscopy (AFM).

Lectures:- 12

Unit 4

Synthesis of Nano-materials :

Key issues in the synthesis of Nano-materials, Different approaches of synthesis, Top down and Bottom up approaches, Co-precipitation technique, Solid- state reaction technique, Cluster beam evaporation, Ball Milling, Chemical vapour deposition, capping agents.

Lectures:- 11

Text and Reference Books :

1. Nanostructures and Nano-materials, Synthesis, Properties & Applications by Guozhong Cao, Imperial College Press.
2. Introduction to Nanotechnology by Charles P. Poole, Jr. Frank J. Owens, John Wiley & Sons Inc. Publication.
3. Quantum Wells, Wires and Dots by Paul Harrison, John Wiley Sons Ltd.
4. Quantum Dot Heterostructures by D. Bimberg, M. Grundman, N.N. Lendenstov.
5. Introduction to Nanoscience and Nanotechnology by Hornyak G. L., Tibbals H. F., Dutta J., Moore J. J., CRC Press.

List of Experimental for Semester VIII

1. Michelson's interferometer 'λ' and Δ λ , thickness of mica sheet.
2. B H Curve
3. Determination of Hall ~~constants~~ coefficient of metals.
4. Plank's constant
5. To determine absolute capacity by B G
6. Synthesis of nano particales by chemical route. .
7. Study of Passi filter.
8. Study of Active filter.

M.Sc. Physics – Paper 1st
Semester IX – Quantum Physics

Total Lectures:- 45

UNIT 1

Linear operators, Null operator, Identity operator, Singular and Non-singular operator, Eigen functions and Eigen values orthogonal eigen functions, The operator formalism in quantum mechanics, Momentum operator, Hamiltonian operator, commutation in operators, Hermitian operator, Properties of Hermitian operator, Parity operator, Postulates of quantum mechanics, coordinate and momentum representation, superposition of eigen states, continuous spectrum, Equation of motion, Ehrenfest's theorem, simultaneous measurements and commuting operators, Schwartz inequality, Heisenberg uncertainty relation derived from operator, commutator algebra.

Lectures:- 12

UNIT 2

Angular momentum operator, Commutation relation for Lx, Ly and Lz, Ladder operators, Completeness of eigen functions, Dirac-delta function, bra and ket notation, Matrix representation of an operator, Unitary transformation, The Schrodinger equation for spherically symmetric potentials, Degeneracy, Hydrogen atom, Radial equation, Eigen value, Radial Probability.

Lectures:- 11

UNIT 3

Stationary perturbation theory, Non-degenerate case, First order perturbation, second order perturbation, Perturbation of an oscillator, Helium atom, Degenerate case, Removal of degeneracy in first and second order, First order Stark effect in hydrogen, Weak field Zeeman effect, The variational method, Expectation value of the energy, Ground state of Helium, Exchange degeneracy, Heitler-London theory of hydrogen molecule, W K B method and its applications.

Lectures:- 12

UNIT 4

Scattering cross-section, Relation between angles, energies, etc. in laboratory and centre of mass system of co-ordinates, Normalisation of incoming wave, Differential scattering cross-section, Partial waves and phase shifts, Born approximation and its validity condition, Study of scattering from a square well potential.

Lectures:- 10

Text and Reference Books :

1. Quantum Mechanics by Satya Prakash & C.K. Singh
2. Advance Quantum Mechanics by B.S. Rajput
3. Quantum Mechanics by L.I. Schiff

M.Sc. Physics – Paper 2nd
Semester IX – Nuclear Physics 1

Total Lectures:- 45

Unit-I

Theories of nuclear composition: Proton- electron theory, Proton-neutron theory; Nuclear shape and size: charge distribution, mass distribution; Nuclear Instability; Importance of binding energy; Nuclear density; Spin angular momentum; Nuclear spin (total angular momentum); Parity; Nuclear dipole and electric quadrupole moments; Isobaric spin concept.

Lectures:- 12

Unit-II

Properties and simple theory of deuteron in ground state; Magnetic dipole and quadrupole moments of deuteron; Scattering cross section; Neutron-proton scattering at low energy; S-wave effective range theory; Proton- proton scattering at low energy; Properties of nuclear forces (Spin dependence, Saturation properties, tensor component, charge symmetry and charge dependence); Exchange force model.

Lectures:- 12

Unit-III

Experimental evidences of Shell structure in nuclei; Extreme single particle shell model; Spin orbit interaction and prediction of magic numbers; Prediction of angular momentum, parity, magnetic moment and electric quadrupole moment; The limitations of the model.

Lectures:- 11

Unit-IV

Types of reactions and conservation laws; Energetic of nuclear reactions; Reaction cross section; Partial wave method of calculating cross section; Elementary idea of compound and direct reactions.

Lectures:- 10

Text and Reference Books:

1. Theory of Nuclear Structure by M.K. Pal (Affiliated east-West Press).
2. Introductory Nuclear Physics by Kenneth S. Krane (John Willy & Sons).
3. Nuclear Physics: An Introduction by W.E. Burcham, F. R. S. (Longmans).
4. Nuclear Physics by S. N. Ghoshal (S. Chand & Company LTD.).

M.Sc. Physics – Paper 1(a)
Semester IX – Electronics – 1

Total Lectures:- 45

Unit 1
Number system, Codes and Logic Gates :

Number system and Base Conversion, Binary Codes (BCD, gray, ASCII, EBCDIC), DTL, TTL, ECL, MOSFET, CMOS logics, Basic logic gates, Boolean law and theorem, SOP and POS method, Karnaugh map, pair, quad & octet, Don't care condition.

Lectures:- 11

Unit 2
Combinational logics :

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Controlled Inverter, BCD Adder, Adder/Subtractor, Multiplexer and De Multiplexer, Encoder (Decimal to BCD, Priority), Decoder (1 to 16, BCD to Decimal, LED decoder).

Lectures:- 12

Unit 3
Sequential logic and memory :

Flip-Flop: RS, D, T, JK, JK Master Slave, Race Problem, Introduction to the semiconductor memory; RAM, ROM, EPROM.

Lectures:- 12

Unit 4
Multi-vibrators and Register :

Multi-vibrators; Atable, Mono-stable, Bistable, Counters; Synchronous & asynchronous, Ring & Mod, Serial and Parallel shift register.

Lectures:- 10

Text and Reference Books :

1. Digital Principles and Applications- Malvino & Leach (Tata Mc Graw Hill)
2. Digital Fundamentals- Floyd (Pearson)
3. Digital Principles and Circuits- C.B. Agrawal (Himalaya Pub.)
4. Modern Digital Electronics- R.P. Jain (Mc Graw Hill)

M.Sc. Physics – Paper 1(b)
Semester IX – Electronics – 2

Unit 1 **Total Lectures:- 45**

Analog Communication :

Amplitude Modulation, Modulation and Demodulation Techniques, Frequency Modulation, Narrow band and wide band Frequency modulation, PLL as Frequency demodulator, Phase modulation. Equivalence between AM, FM & PM modulation.

Lectures:- 12

Unit 2

Digital Modulation :

Sampling and quantization,pulse code modulation, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying and Differential Phase Shift Keying, Frequency Division and time division multiplexing.

Lectures:- 11

Unit 3

Microwave Electronics :

Generation of microwave by reflex klystron and semiconductor gun diode, wave-guide and cavity resonator, Microwave antenna, microwave detector: VSWR, power and dielectric measurement, Isolator, Directional Coupler, Magic Tee.

Lectures:- 11

Unit 4

Fiber Optic Communication: Wave propagation in an isotropic media, Transmission and fiber losses in fiber, Dispersion, optical wave guide, optical fiber source and detector, Coupler, Modern telephonic optic mux.

Lectures:- 11

Text and Reference Books :

1. Electronic Communication Systems by Geoge Kennedy, Brendas Davis, Srm Prasanna, McGraw Hill Education.
2. Microwave Electronics by Andrey D. Grigoriev, Vyacheslav A. Ivanov, Springer Publishers.
3. Hand Book of Electronics by S. L.Gupta, V. Kumar, PragatiPrakashan Meerut.

List of Practical in Electronics
Semester - IX

1. Logic gates and their combinations.
2. Half & Full Adder.
3. Half & Full Subtractor.
4. RS Flip-Flop.
5. JK Flip-Flop.
6. D Latch.
7. Amplitude Modulation and Demodulation
8. Frequency Modulation and Demodulation

M.Sc. Physics – Paper 2 (a)
Semester IX – Condensed Matter Physics 1

UNIT 1 – Crystal Physics and X-ray crystallography : **Total Lectures:- 45**

Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, closed packed structure. Interaction of X-rays with matter, absorption of X-ray, Elastic scattering from a preface lattice. The Reciprocal lattice and its applications. The Laue, powder and rotating crystal methods. Crystal Structure factor and powder and intensity of diffraction maxima.

Lectures:- 11

UNIT 2 – Crystal Symmetry :

Rotation, Reflection, translation, inversion, Roto-inversion, Roto-reflection symmetry in crystal. External symmetry elements of crystals, concept of point groups, influence of symmetry on Physical properties, space groups, Experimental determination of space groups. Analytical indexing : Ito's method, Accurate determination of Lattice parameters-Least square method. Applications of powder method. Oscillation and Buerger's precession methods.

Lectures:- 12

UNIT 3 – Defects in Crystals :

Point defects, line defects and planer (stacking) faults. The role of dislocations in plastic deformation and crystal growth. The observation of imperfections in crystals. Influence of defects on Physical properties of crystals.

Lectures:- 10

UNIT 4 – Imperfection in Crystals :

Mechanism of plastic deformation in solids, stress and strain fields of screw and edge dislocations. Elastic energy of dislocation. Forces between dislocations, stress needed to operate Frank-Read source, dislocations in fcc, hcp and bcc lattices. Partial dislocations and stacking faults in close packed structures.

Lectures:- 12

Text and Reference Books :

1. Introduction to solid state physics by Charles Kittle.
2. Introduction of Solids by L.V. Azaroff
3. Solid State Physics by N.W. Ashcroft and N.D. Mermin.
4. Crystallography Applied to Solid State Physics by A.R. Verma and O.N. Srivastava
5. Principels of Condensed Matter Physics by P.M. Chaikin and T.C. Lubensky
6. Solid State Physics-Structure and Properties of Materials by M.A. Wahab

M.Sc. Physics – Paper 2 (b)
Semester IX – Condensed Matter Physics 2

Total Lectures:- 45

UNIT 1 – Lattice dynamics:

Inter atomic forces and lattice dynamics of simple metals, ionic and covalent crystals, optical phonons and dielectric constants. In-elastic neutron scattering. Debye Waller factor, Anharmonicity, Thermal expansion and thermal conductivity

Lectures:- 11

UNIT 2 – Optical properties of solids :

Interaction of electrons and phonons with photons. Direct and Indirect transitions, Absorptions in Insulators, Polaritons, and Phonon absorption, optical properties of metals, skin effect. Interaction of electrons with acoustic and optical phonons, Polarons.

Lectures:- 12

UNIT 3 – Electronic properties of solids :

Drude model of DC and AC conductivity. Electrons in a periodic lattice, Bloch theorem, Kronig-Penney model, band theory, classification of solids, Effective mass, Tight binding, cellular and Pseudopotential methods. Fermi surface, de Hass van Alfen effect. Hall effect. Cyclotron resonance , magneto-resistance.

Lectures:- 12

UNIT 4 – Quantum Electronic properties of solids :

Metal Insulator transition, Mott Insulators, Mott Hubbard Model, Electron transport in one, two and three dimensions of solid, quantum electronic transport, Landau levels, quantum and integral Hall effect.

Lectures:- 10

Text and Reference Books :

1. Introduction to solid state physics by Charles Kittle.
2. Introduction of Solids by L.V. Azaroff
3. Solid State Physics by N.W. Ashcroft and N.D. Mermin.
4. Crystallography Applied to Solid State Physics by A.R. Verma and O.N. Srivastava
5. Principels of Condensed Matter Physics by P.M. Chaikin and T.C. Lubensky
6. Solid State Physics-Structure and Properties of Materials by M.A. Wahab
7. Principles of theory of Solid by J. M. Zima

List of Practical Condensed matter Physics
For Semester IX

1. Measurement of lattice parameters and indexing of power photographs.
2. Interpretation of transmission Laue photography.
3. Determination of orientation of a crystal by back reflection Laue method.
4. Rotation/oscillation photogrphs and their interpretation.
5. To study the modulus of rigidity and internal friction in metals as a function of temperature.
6. To measure the cleavage step height of a crystal by multiple Fizeaue fringes.
7. To obtain multiple beam Fringers of equal chromatic order.
8. To determine magnetoresistance of a Bismuth crystal as a function of magnetic field.

M.Sc. Physics – Paper 1st
Semester X – Advanced Quantum Physics

Total Lectures:- 45

UNIT 1

Time dependent Perturbation Theory, First order perturbation, Harmonic perturbation Transition probabilities, Fermi Golden rule, Dipole approximation, Second order perturbation,

Lectures:- 11

UNIT 2

Physical meaning of identity, Distinguishability of identical particles, Symmetric and Antisymmetric wave functions, Construction from unsymmetrised function, Connection of spin and statistics, collision of identical particles with spin, Pauli Spin matrices.

Lectures:- 12

UNIT 3

Schrodinger relativistic equation for free particles (Klein-Gordan Equation), Dirac relativistic equation, Free particle equation, Properties of Dirac matrices, Free particles solutions, Electron spin, Magnetic moment, Dirac equation of a central field of force, Spin-Orbit coupling. Solution for hydrogen atom. Negative energy states.

Lectures:- 12

UNIT 4

Formulation in terms of transition probability, Matrix elements of the perturbation, Transition probability for absorption, Transition probability for emission, Einstein coefficients, Einstein transition probability for absorption and emission.

Lectures:- 10

Text and Reference Books :

1. Quantum Mechanics by Satya Prakash & C.K. Singh
2. Advance Quantum Mechanics by B.S. Rajput
3. Quantum Mechanics by L.I. Schiff

M.Sc. Physics – Paper 2nd
Semester X – Nuclear Physics 2

Total Lectures:- 45

Unit-I

Basic α- decay process & its systematic, Experimental information on α- decay (dependence of α-decay on mass number, energy-lifetime relationships, long range α-particles, fine structure of α- particles spectra), Theory of α- emission.

Lectures:- 11

Unit-II

Basic β- decay process; Energy released in β- decay; Shape of β- ray spectra; Neutrinos and antineutrinos; Fermi theory of β- decay; Kuri plots and the neutrino mass; Angular momentum and parity selection rule; Comparative half lives and forbidden decays.

Lectures:- 12

Unit-III

Energetic of γ- decay, Classical electromagnetic radiations and their quantum mechanical approach, Angular momentum and parity selection rule, Life times for γ-emission, Zero-zero transition, nuclear isomerism, Internal conversion.

Lectures:- 10

Unit-IV

Fundamental interactions, Classification of elementary particles on the basis of interactions and their quantum numbers, Symmetry and classification of elementary particles, Gellmann-Nishijima formula, CPT invariance, CP violation in K- decay, Quark model, colored quarks and gluons.

Lectures:- 12

Text and Reference Books:

1. Introductory Nuclear Physics by Kenneth S. Krane (John Willy & Sons).
2. Introductory Nuclear Physics by Smauel S. M. Wong (Wily-VCH, Second Edition)
3. Nuclear and Particle Physics: An Introduction by Brian R Maritn (John Willy & Sons).
4. Nuclear Physics by S. N. Ghoshal (S. Chand & Company LTD).

M.Sc. Physics – Paper 1(a)
Semester X – Electronics – 3

Unit 1 **Total Lectures:- 45**

Integrated Circuits: An overview :

Classification and fabrication of ICs, Materials and processing, idea of crystal growth, wafer preparation, oxidation & diffusion, photolithography and etching, connections & packaging.

Lectures:- 08

Unit 2

Operational Amplifier Basic and applications :

Op-Amp: Input/Output characteristics, parameters, inverting and non-inverting amplifier, Op-Amp in analog computation: adder, subtract, integrator, differentiator vollage follower, divider, log & anti-log amplifier.

Lectures:- 14

Unit 3

Op-Amp in Active Filters and Signal Translation :

Active Filters: low pass, high pass, band pass, band rejects filter (1^{st} order only) comparators, wave shape generator, Schmitt trigger, Voltage Controlled Oscillator (VCO), phase locked loop (PLL), A/D & D/A convertor, 555 timer.

Lectures:- 15

Unit 4

Basic of Microprocessor 8085 :

Microprocessor: Intel 8085 microprocessor, architecture, interfacing devices, BUS timing, instruction set, simple illustrative program.

Lectures:- 08

Text and Reference Books :

1. Op-Amp and liner Integrated Circuits - R.A. Gayakward (PHI)
2. Op-Amp and liner Integrated Circuits - Coughlin and Driscall (PHI)
3. Op-Amp and liner Integrated Circuits - D. Mahesh Kumar (Mac. Millan)
4. Integrated Electronics- Millman & Halkies (THL)

M.Sc. Physics – Paper 1(b)
Semester X – Electronics – 4

Unit 1 **Total Lectures:- 45**

Satellite Communication :

Satellite orbit, Satellite frequencies, Synchronous satellite, Satellite communication, Transponders.

Lectures:- 10

Unit 2

Radar Communication :

Basic radar system, Pulsed radar, Moving target indicator radar, CW radar, radar cross section, Radar display, PPI duplexer radar antenna, Modern radar.

Lectures:- 12

Unit 3

Television System :

TV system and standard, TV band width and channels, Interlaced scanning and video camera tube, TV transmitter and receiver, Colour television.

Lectures:- 13

Unit 4

Antenna System :

Short electric doublets, radiation from one pole and dipole aerials, Antenna Parameters, Antenna arrays, folded dipole application, Yagi antenna, parabolic reflectors.

Lectures:- 10

Text and Reference Books :

1. Electronic Communication Systems by Geoge Kennedy, Brendas Davis, Srm Prasanna, McGraw Hill Education.
2. Hand Book of Electronics by S. L.Gupta, V. Kumar, PragatiPrakashan Meerut.

List of Practical in Electronics
Semester - X

1. Study of Op-Amp characteristics.
2. Applications of Op-Amp.
3. Study of Schmitt Trigger.
4. Study of Analog to Digital Convertor.
5. Study of Digital to Analog Convertor.
6. Study of 555 timer.
7. Study of Microprocessor IC 8085.
8. Study of Multivibrators.

M.Sc. Physics – Paper 2 (a)
Semester X – Condensed Matter Physics 3

Total Lectures:- 45

UNIT 1 – Magnetic Properties of solids :

Origin of magnetism in materials, Magnetism, dia, para and ferro magnetic materials, Weiss Theory of ferromagnetism, Spin waves and magnons, Curie – Weiss law of susceptibility, Ferri and Anti ferromagnetic ordering, Domains and Bloch-wall energy.

Lectures:- 11

UNIT 2 – Superconductivity Properties :

Superconductivity, manifestations of energy gap, critical temperature, persistent currents, Meissner effect, Cooper pairing due to phonons, BCS theory of Superconductivity, Ginzburg-Landau theory, DC Josephson effect, ac Josephson effect. Vortices and type II superconductors, High super conductors, ultra low temperature oxide thin film superconductivity.

Lectures:- 12

UNIT 3 – Electron gas in solids :

Electron gas in 1D and 2D system, interacting electron gas : Hartee and Hartee Fock approximations. Correlation energy, Screening, Plasma Oscillations. Strongly-interacting Fermi system. Elementary introduction to Landau's quasi-particle theory of a Fermi liquid. Strongly correlated electron gas.

Lectures:- 12

UNIT 4 – Surface states :

Elementary ideas regarding surface states, metallic surfaces and surface reconstructions. Study of surface reconstructions in thin films, study of surface topography by multiple-beam interferometry.

Lectures:- 10

Text and Reference Books :

1. Introduction to solid state physics by Charles Kittle.
2. Introdction of Solids by L.V. Azaroff
3. Solid State Physics by N.W. Ashcroft and N.D. Mermin.
4. Crystallography Applied to Solid State Physics by A.R. Verma and O.N. Srivastava
5. Principels of Condensed Matter Physics by P.M. Chaikin and T.C. Lubensky
6. Solid State Physics-Structure and Properties of Materials by M.A. Wahab
7. Principles of theory of Solid by J. M. Ziman
8. Physics of Surfaces and Interfaces by Harald Ibach

M.Sc. Physics – Paper 2 (b)
Semester X – Condensed Matter Physics 4

Total Lectures:- 45

UNIT 1 – Nano-structure materials :

Structures and Symmetries of liquids, liquid crystals and amorphous solids. A periodic solids and quasi crystals; Fibonaccy sequence, Penrose lattices and their extension to 3 dimension,

Lectures:- 11

UNIT 2 – Exotic solids :

Special carbon solids, fullerences and tubules. Electronic properties of tubules. Carbon nanostructured materials, Method of synthesis of nanostructures materials, Quantum Size effect and its applications.

Lectures:- 10

UNIT 3 – Disordered systems :

Point defects : Shallow impurity of states in semiconductors. Localized lattice vibrational states solids, Vacancies, interstitials and colour centres in ionic crystals. Dis order in condensed matter, substitional, position and topographical disorder, short and long range order. Atomic correlation function and structural descriptions of glasses and liquids, Anderson model for random systems and electron localization, mobility edge.

Lectures:- 12

UNIT 4 – Thin films :

Thin film and ultra thin films, Conditions for accurate determination of step height and film thickness (Fizeau fringes), Electrical conductivity of thin films, difference of behavior of thin films from bulk, Boltzmann transport equation for a thin film (for diffused scattering), expression for electrical conductivity for thin films. Elementary concepts of surface crystallography, scanning, tunneling and atomic force microscopy.

Lectures:- 12

Text and Reference Books:

1. Introduction to Nanotechnology by Poole and Owners
2. Quantum Dots by Jacak, Hawrylak and Wojs
3. Handbook of Nanostructured Materials and Nanotechnology by Nalva (editor)
4. Nano Technology/ Principles and Practices by S.K. Kulkarni
5. Carbon Nanotubes by Silvana Fiorito
6. Nanotechlongy by Richard Booker and Earl Boysen

List of Practical Condensed matter Physics
For Semester X

1. Conductivity of Germanium in Vander Pauw Geometry.
2. Magneto-resistance of Ge
3. Four-probe method
4. Hall effect
5. Study of Fluorescence matrials
6. Study of Ferromagnetic materials.
7. Study of Superconducting materials.
8. Measurement of magnetic susceptibility.