SYLLABUS FOR M.Sc IN PHYSICS
FOR THE SESSION 2005-06 AND ONWRAD

Reference: No.381-41/Acad-II dated 15-8-2005 Annexure III, Part –D **Updated on 16/02/2015**

M.Sc. (Physics) Courses are divided into the following categories.

1.	M.Sc. Physics program (General)	(Option-I)
2.	M.Sc. Physics With Specialization	(Option-II)
i.	Specialization in Solid State Physics.	(Category-i)
ii.	Specialization in Nuclear Physics.	(Category-ii)
iii.	Specialization in Digital Communication.	(Category-iii)
iv.	Specialization in Microwave Communication.	(Category-iv)
v.	Specialization in Nuclear Radiations.	(Category-v)
vi.	Specialization in Computational Physics	(Category-vi)
vii.	Specialization in Medical Physics	(Category-vii)
viii.	Specialization in Electronics.	(Category-viii)
ix.	Specialization in Geophysics	(Category-ix)
x.	Specialization in Materials Physics	(Category-x)
xi.	Specialization in Plasma Physics	(Category-xi)
xii.	Specialization in Environmental Physics	(Category-xii)

1. M.Sc. Physics Program (General)

M.Sc. Physics (Part-I)

There is no change in the courses or the weights given to the courses in this category. The existing courses will run as they are, both in M.Sc. Physics (Part I) and (Part II). The structure of the M.Sc. (Part I) is as under.

Subjects	Paper	Marks
PHY-511 Mathematical Methods of Physics	I	100
PHY-512 Electrodynamics	II	100
PHY-513 Classical Mechanics	III	50
PHY-514 Thermal Physics and Statistical Mechanics	IV	50
PHY-515 Atomic and Molecular Physics	V	100
Laboratories		
Lab-I		50
Lab-II		50
	Total	**500**

M.Sc. Physics (Part-II)

Subjects	Paper	Marks
PHY-631 Quantum Mechanics	VI	100
PHY-632 Electronics	VII	100
PHY-633 Solid State Physics	VIII	100
PHY-634 Nuclear Physics	IX	100
Laboratories		
Lab-III		50
Lab-IV		50
Comprehensive Viva-Voce		100
	Total	**600**

2. M.Sc. Physics with Specialization

The specialized scheme is offered in the M.Sc (Part II), preferably after a successful completion of the M.Sc. (Part I). The distribution of the courses is as under:

Specialization in Solid State Physics (Category-i)

Subjects	Paper	Marks
PHY-631 Quantum Mechanics	VI	100
PHY-638 Introductory Electronics	XIII	50

PHY-633 Solid State Physics	VIII		100
PHY-634 Nuclear Physics	IX		100
PHY-635 Special Solid State Physics	X		50
Laboratories:			
Lab-III			50
Lab-IV			50
Comprehensive Viva-Voce			100
		Total	**600**

Specialization in Nuclear Physics (Category-ii)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-638 Introductory Electronics	XIII	50
PHY-633 Solid State Physics	VIII	100
PHY-634 Nuclear Physics	IX	100
PHY-636 Special Nuclear Physics	XI	50
Laboratories		
Lab-III		50
Lab-IV		50
Comprehensive Viva-Voce		100
	Total	**600**

Specialization in Digital Communication (Category-iii)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-633 Solid State Physics	VIII	100
PHY-632 Electronics	VII	100
PHY-639 Introductory Nuclear Physics	XIV	50
PHY-637 Digital Communication	XII	100
Laboratories		
Lab-III		50
Digital Signal Processing Lab		50
THES-649		50
	Total	**600**

Specialization in Microwave Communication (Category-iv)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-633 Solid State Physics	VIII	100
PHY-632 Electronics	VII	100
PHY-639 Introductory Nuclear Physics	XIV	50
PHY-6310 Microwave Communication.	XV	100
Laboratories		
Lab-III		50
Microwave Laboratory		50
THES-649		50
	Total	**600**

Specialization in Nuclear Radiation (Category-v)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-638 Introductory Electronics	XIII	50

PHY-633 Solid State Physics	VIII		100
PHY-634 Nuclear Physics	IX		100
PHY-6311 Nuclear and radiation Physics	XVI		100
Laboratories			
Lab-III			50
Lab-IV			50
THES-649			50
		Total	**600**

Specialization in Computational Physics (Category-vi)

Subjects	**Paper**		**Marks**
PHY-631 Quantum Mechanics	VI		100
PHY-633 Solid State Physics	VIII		100
PHY-638 Introductory Electronics	XIII		50
PHY-634 Nuclear Physics	IX		100
PHY-6312 Computational Physics	XVII		75
Laboratories			
Lab-III			50
Lab-IV			50
Computational Laboratory			25
THES-649			50
		Total	**600**

Specialization in Medical Physics (Category-vii)

Subjects	**Paper**		**Marks**
PHY-631 Quantum Mechanics	VI		100
PHY-638 Introductory Electronics	XIII		50
PHY-633 Solid State Physics	VIII		100
PHY-634 Nuclear Physics	IX		100
PHY-6313 Medical Physics	XVIII		100
Laboratories			
Lab-III			50
Lab-IV			50
THES-649			50
		Total	**600**

Specialization in Electronics (Category-viii)

Subjects	**Paper**		**Marks**
PHY-631 Quantum Mechanics	VI		100
PHY-633 Solid State Physics	VIII		100
PHY-632 Electronics	VII		100
PHY-639 Introductory Nuclear Physics	XIV		50
PHY-6314 Advanced Electronics Circuit Theory	XIX		100
Laboratories			
Lab-III			50
Lab-IV			50
THES-649			50
		Total	**600**

Specialization in Geophysics (Category-ix)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-633 Solid State Physics	VIII	100

PHY-634 Nuclear Physics	IX		100
PHY-638 Introductory Electronics	XIII		50
PHY-6315 Geo-Physics	XX		100
Laboratories:			
Lab-III			50
Lab-IV			50
THES-649			50
		Total	**600**

Specialization in Materials Physics (Category-x)

Subjects.	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-636 Introductory Electronics	XIII	50
PHY-633 Solid State Physics	VIII	100
PHY-634 Nuclear Physics	IX	100
PHY-6316 Special Material Physics	XXI	50
Laboratories:		
Lab-III		50
Lab-IV		50
THES-649		100
	Total	**600**

Specialization in Plasma Physics (Category-xi)

Subjects.	**Paper**	**Marks.**
PHY-631 Quantum Mechanics	VI	100
PHY-636 Introductory Electronics	XIII	50
PHY-633 Solid State Physics	VIII	100
PHY-634 Nuclear Physics	IX	100
PHY-6317 Special Plasma Physics	XXII	50
Laboratories		
Lab-III		50
Lab-IV		50
THES-649		100
	Total	**600**

Specialization in Environmental Physics (Category-xii)

Subjects	**Paper**	**Marks**
PHY-631 Quantum Mechanics	VI	100
PHY-633 Solid State Physics	VIII	100
PHY-636 Introductory Electronics	XIII	50
PHY-634 Nuclear Physics	IX	100
PHY-6318 Special Environmental Physics	XXIII	75
Laboratories		
Lab-III		50
Lab-IV		50
Computational Laboratory		25
THES-649		50
	Total	**600**

Note

Present we have merged three laboratories namely "Atomic and Molecular Physics Lab", "General Physics Lab" and "Optics and Spectroscopy Lab" are reshaped/regrouped as Lab-I and Lab-II, for the M.Sc. Part I. Similarly the labs "Electronics Lab", "Solid State Physics Lab" and "Nuclear physics Lab" for MSc. Part II are revised into Lab-III and Lab-IV. There are also some special laboratories in for M.Sc. Par II such as Digital Signal Processing. These laboratories have to be strengthened up to the level of UGC curriculum. Digital Signal Processing laboratory has to

be enhanced to have hardware for the understanding of the fundament concepts involved A/D and D/A converts, and basic types of audio and video digital filters. Microwave Laboratory has to be set up for the Microwave Communication. We have also Centralized Resource Laboratory for Material Science, which can be used for the understanding of the crystal structure. External examiners as well as internal examiners will be appointed for each laboratory. The Chairman of the Department will be ex-officio-internal examiner for all the laboratories.

COURSE CONTENTS OF M.Sc. (PART-I)

PHY-511 MATHEMATICAL METHODS OF PHYSICS (Paper-I) **Marks: 100**

Vectors in Classical Physics: Differentiation of vectors, Fields, Directional derivatives and gradients, Line integrals, Green's theorem in the plane, Divergence and divergence theorem. The Curl and Stokes's theorem

Differential Equations in Physics, First and second order linear differential equations (homogeneous and inhomogeneous). Solutions of linear homogeneous differential equations: Series solution of differential equations, Partial differential equations in Physics, Sturm-Liouville systems, Introduction to nonlinear system.

Complex Variable, Functions of a complex variable, Catchy Riemann conditions and analytic functions, Catchy integral theorem and integral formula, Taylor and Laurent series. Fourier series, Examples of Fourier series, point wise and mean convergence of Fourier series, Applications of Fourier Series. Calculus of residue, Complex integration

Linear Vector Spaces and Matrices, Linear vector spaces, Gram-Schmidt orthogonalization, Matrices, Eigen-values and eigenvectors of a matrix, Hilbert spaces, Orthogonalization.

Special Functions, Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, Associated Legendre polynomials, Spherical harmonic Laugerre polynomials, Hermite polynomials.

Integral transform, The Laplace transform, Applications of Laplace transform, Fourier transform, Convolution, Parseval's theorem, Integral transform solution of partial differential equations, The Dirac Delta function.

Tensors in Physics, Tensor algebra, vectors of manifolds, the fundamental tensor, Tensors in non-relativistic Physics.

Boundary Value Problems and Green's Functions: Boundary value problems in Physics, Non-Homogeneous boundary value problems and Green's functions, k Green's functions for one dimensional problem, Eigen-function expansion of Green's function. Construction of Green's functions Green's functions in higher dimensions.

Group Theory, Groups, Invariant subgroups and factor groups, Group representation, Character of a representation, Character tables, Decomposition of a reducible representation into irreducible ones, Lie groups and lie algebras.

BOOKS RECOMMENDED

1. George B. Arfken, & Hans J. Webber, "Mathematical Methods for Physicists" 5th ed., Academic Press, London (1985).
2. Erwin Kreyszic., "Advanced Engineering Mathematics". 6th ed., John-Willey & sons (1993).
3. Murry R. Spiegel, "Advanced Mathematics". 1st ed., Schaum's Series, McGraw Hill (1971).
4. Dass H. K., "Mathematical Physics". S. Chand Inc. India (2011).
5. Guptha B. D., "Mathematical Methods with Special Functions". 1st ed., Stosius Inc/Advent Books Division India (1992).
6. Boas M. L., "Mathematical Methods in Physical Sciences". John Wiley & Sons, New York (1989).

PHY-512 ELECTRODYNAMICS (Paper-II) **Marks: 100**

Fundamental Concepts, Recapitulation of the fundamental concepts, Induction B, Magnetic intensity H, Maxwell's equations in differential and integral forms, Poynting theorem and energy conservation.

Boundary value Problems: Poisson and Lap lace's equations in spherical and cylindrical coordinates, conducting sphere in a uniform electric field, cylindrical harmonics. Electrical images: a point charge near a conducting plane, a point charge and conducting sphere, line charge and line image.

Static Electromagnetic Fields, Electrostatic fields in several dielectric media, Magneto static fields of magnetized matter, Mangetostatic field of stationary current, Magnetization current.

Time Dependent Electromagnetic Fields, Maxwell's equations for quasi stationery fields, Potentials of a rapidly varying field, Fields of uniformly moving and accelerated charges, Radiation from an accelerated charge, Field of oscillating magnetic fields, multiple fields.

Reflection Refraction of Electromagnetic Waves, Laws of reflection and refraction, Fresnel's formula, Total reflection, Refraction in a conducting media, Reflection from a conducting surface.

Propagation of Plane Electromagnetic Waves, Forced oscillation of an electronic oscillator, Scattering by a bound electron, Dispersion in dilute medium and dense media, Dispersion in metallic conductor, Group Velocity.

Skin Effect and Wave Guides, Higher frequency current in a semi infinite conductor, internal impedance at high frequencies, Waves guided by parallel plane conductor, Transmission by a rectangular. Power transfer and attenuation, Wave guides as cavity resonators, Q of a cavity resonator, Waves guided by dielectrics.

Electrodynamics and Special Relativity, Covariance of Maxwell's equations, Principle of Lorentz transformation and applications, the four vector systems, Transformation of electromagnetic field vectors and potentials, The Doppler effect, Covariant formulation of Physical laws and vacuum electrodynamics, The Lorentz force, Motion of a charge in electromagnetic field, Electromagnetic Momentum – Energy tensor.

BOOKS RECOMMENDED

1. Frederick J. Milford, Robert W. Christy, "Foundation of Electromagnetic Theory". 4th ed., Addison Wesley (2008).
2. Lorrain P. C, & Corson D. R., "Electromagnetic Fields and Waves". W.H. Freeman & Co. New York (1978).
3. David J. Griffiths, "Introduction to Electrodynamics". 3rd ed., Prentice Hall, New Jersey USA (1999).
4. Jackson J. D, "Classical electrodynamics". 3rd ed., John Willey & Sons, New York (1998).

PHY-513 CLASSICAL MECHANICS (Paper-III) **Marks: 50**

Elementary principles, Brief survey of Newtonian mechanics of a single particle and system of particles, Constraints, D' Alembert's principle, Lagrange's equations for conservative and non-conservative systems and their applications.

Variational Principles, Calculus of variation and Hamilton's some techniques of calculus of variation, Application of Variation principle. Derivation of Lagrange's equations from Hamilton's principle.

Two Body Central Force problem, Two body problem and its reduction to one body equivalent problem, equation of motion and solution for one body problem, Kepler's laws, laboratory and center of mass coordinate systems and their mutual transformations, Rutherford Scattering formula.

Hamilton's Equation of motion, Hamiltonian functions, Legendre transformation and Hamilton's equation of motion, conservation theorems, cyclic coordinates, Physical significance of Hamiltonian for simple cases.

Canonical Transformations, Examples of canonical transformations, Lagrange's and Poisson's brackets, Condition for transformation to Canonical Legendre equation of motion, Lioville's theorem

BOOKS RECOMMENDED

1. Goldstein H., "Classical Mechanics". 2nd ed., Addison Wesley, Reading Massachusetts (1980).
2. Arnold V. I., "Mathematical Methods of Classical Mechanics". 1st ed., Springer Vertag, New York (1980)
3. Rasband S. N., "Dynamics". 1st ed., John Wiley and Son. New York (1983).
4. Matzner R. A., "Classical Mechanics". 1st ed., Prentice Hall London (1991).

5. Woodhuse N. M. J., "Introduction to Analytical Dynamics". 1st ed., Oxford Science Publications Oxford (1987).

PHY-514 THERMAL PHYSICS AND STATISTICAL MECHANICS (Paper-IV) Marks: 50

Equilibrium Thermodynamics, Basic postulates, fundamental equations and equations of state, response functions Maxwell's relations, reduction of derivatives. Cavity radiators and Black body radiations, Kirchhoff's laws, radiation density and pressure of radiation, Stefan's law, Wein's Law, Rayleigh Jean's law, and their inadequacies, Planck's law.
Elements of Probability Theory, Probabilities, thermodynamic Probabilities, statistical interpretation of entropy, Boltzmann H-theory,

Formulation of Statistical Methods, Ensembles, counting of states (in classical and quantum mechanical systems with examples)

Statistical Systems, Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac and Planck statistical systems. Distribution functions (M.B, B.E & F.D). Examples of thermodynamics of these systems: a. Black body radiations. b. Gas of electrons in solids

Partition Function, Relation with thermodynamic variables, examples (collection of simple harmonic oscillators, Pauli and Van Vleck paramagnetic, Theorem of equipartition of energy)..

Statistical Mechanics of Interacting Systems, Lattice vibrations in solids; Van der Waals Gas: mean field calculation; Ferromagnets in Mean Field Approximation.

BOOKS RECOMMENDED

1. Francis W. Sears, & Gerhard L. Salinger., "Thermodynamics, Kinetic Theory, and Statistical Mechanics". 3rd ed., Narosa Publishing House. New Delhi (1998).
2. Frederick Reif, "Fundamentals of Statistical and Thermal Physics". 1st ed., McGraw Hill (1965).
3. Gould H, & Tobochnik J., "Thermal and Statistical Physics". 1st ed., John Wiley and Sons, New York (1995).
4. Mandl F., "Statistical Physics". 2nd ed., ELBS/John Willey (1988).
5. Huang K., "Statistical Mechanics". 2nd ed., John Willey (1987).

PHY-515 ATOMIC AND MOLECULAR PHYSICS (Paper-V) Marks: 100

Atomic Models, Rutherford scattering. Nuclear dimensions. Bohr's model of the atom, Energy levels and atomic spectra, Frank-Hertz experiment, the correspondence principle, nuclear motion and reduced mass, Hydrogen atom. Normal Zeeman Effect, Spin-Orbit coupling, Exclusion principal, Electron configuration in many-electron atoms, Hund's electron spectra, X-ray spectra.

X-rays, Production of X-rays, measurement of the intensity of X-rays, Diffraction of X-rays and Bragg's law, single Crystal X-ray spectrometer, typical X-ray spectra, diffraction of X-rays Spectra, X-ray powder crystal diffraction, the scattering of X-rays by the atoms and number of electron per atom, characteristic X-ray spectra, X-ray energy level diagram, X-ray absorption spectra, X-ray critical voltage, X-ray terms and selection rules, Radiation less transitions, Auger Effect, production of characteristic X-ray spectra, Related problems.

Theories of Bonding, The chemical bond, Molecular structure, Molecular spectra. Valence-bond approach. Molecular orbital: Polyatomic molecules. Hybrid orbital. Carbon-carbon-bonds. The benzene ring.

Rotational Energy Levels, Diatomic molecules, Ploy-atomic molecules, Vibrational energy-levels, Vibration-rotation spectra, Electronic spectra.

BOOKS RECOMMENDED

1. Beiser A., "Concepts of Modern Physics". 6th ed., McGraw Hill (2009).
2. Henry Semat and Albright J. R., "Introduction to Atomic and Nuclear Physics" 2nd ed., McGraw Hill (1972).
3. Kakani S. L, & Shubra Kakani., "Modern Physics". Volume II, Viva Books Pvt. Ltd. (2006).
4. Beiser A., "Perspective of Modern Physics". 5th ed., McGraw Hill (1969)
5. Kenneth S. Krane., "Modern Physics". 2nd ed., John-Willey & Sons, USA (2008)
6. Paul A. Tipler., "Elementary Modern Physics". 1st ed., W.H. Freeman (1992).

COURSE CONTENTS OF M.Sc. (PART-II)

PHY-631 QUANTUM MECHANICS (Paper-VI) **Marks: 100**

Quantum Mechanics of One dimensional Problems: Review of concepts of classical mechanics, State of a system, Properties of one dimensional potential functions, Functions and expectation values, Dirac notation and Hermitian operators, Solutions of Schrodinger equations for free particles, The potential barrier problems, The linear harmonic oscillator.

Formalism of Quantum Mechanics, The state of a system, Dynamical variables and operators, Commuting observable, Heisenberg uncertainty relations, Time evaluation of a system, Schrodinger and Heisenberg pictures, symmetry principles and conservation laws.

Angular Momentum, Orbital angular momentum, Angular momentum and rotations, The eigenvalues and eigen functions of Land L_z, Matrix representation of angular momentum operators, Spin angular momenta, Addition of angular momenta.

Schrodinger Equation in Three Dimensions: Separation of Schrodinger equation in Cartesian coordinates, Central potentials, the free particle, and three dimensional squares well potential, the hydrogen atom, three dimensional isotropic oscillator.

Approximate Methods, Time independent perturbation theory for non degenerate levels, the variational method, The WKB approximation, and Time dependent perturbation theory.

Identical Particles and Second Quantization: Indistinguishability of identical particles, Systems of identical particles, Quantum dynamics of identical particle systems, Angular momenta and spin ½ boson operators.

The Theory of Scattering: Scattering experiments and cross sections, Potential scattering, The method of partial waves, The Born approximation.

The Interaction of Quantum Systems with Radiations, Electromagnetic field and its interaction with one electron system, Transition rates, Spontaneous emission, Selection rules for electric dipole transitions, The spin of photon and helicity.

Relativistic Quantum Mechanics: Schrodinger relativistic equation, Probability and current densities, Klein-Gordon equation and hydrogen atom Dirac relativistic equation,

BOOKS RECOMMENDED

1. Richard L. Liboff., "Introductory Quantum Mechanics". 2nd ed., Addison Wesley Publishing Company (1993).
2. David J. Griffiths, "Introduction to Quantum Mechanics". 2nd ed., Pearson Education, Inc. India (2008)
3. Greiner W, "Quantum Mechanics: an Introduction". 4th ed., Springer Verlag, Berlin Germany (2nd Indian Reprint 2007).
4. Schwable F, "Quantum Mechanics". 1st ed., Narosa Publishing House, New Delhi (1992).
5. Bransden B. H, & Jochain C. J., "Introduction to Quantum Mechanics". 2nd ed., Prentice Hall (2000).
6. Bialynicki-Birula, Cieplak M, & Kaminski J., "Theory of Quanta". 1st ed., Oxford University Press, New York (1992).

7. Townsend J. S, "A Modern Approach to Quantum Mechanics". 2nd ed., University Science Books, California (2000).

PHY-632 ELECTRONICS (PAPER-VII) **Marks: 100**

DC circuit analysis, circuit theorems: Kirchhoff's laws, superposition, reciprocity theorem, Thevenin and Norton's theorems, maximum power transfer theorem.

AC circuit analysis, Circuit transient; capacitor and inductor as circuit elements: wave shaping. Network analysis in frequency domain; mesh current method, node voltage method, thevenin's and Norton's methods. RLC series and parallel resonance circuits, Q-factor, low pass, high pass circuits, differentiating and integrating circuits.

Diode as circuit element: circuit model of diode; diodes arrays. Rectification with filter circuits, ripple factor, rectification efficiency, regulation. Clamping, clipping and switching circuits of elementary level. Zener diode as regulator.

BJT, CB, CE and CC biasing circuits, stability factors, bias compensation. Quiescent point, Graphical method, dc and ac load lines. Approximate methods.

BJT. As small signal low frequency amplifier: Circuit models for the transistor, input/output impedances, current and voltage gains, and input/output phase relationship. Low frequency analysis, Bode plots.

Feedback amplifiers: The concept of feedback, feedback connections, feedback amplifiers (Phase and frequency considerate) positive feedback, stability analysis, and oscillation. Basic oscillator circuits, Phase-shift, Collpitts, Hartley and crystal oscillators.

Small signal high frequency amplifier, BJT circuit models, frequency analysis, general frequency considerations, gain-bandwidth trade-off, Bode diagram, Zeros and poles.

Operational amplifies, 741 operational amplifiers: Basic characteristics, DC offset parameters, Non-inverting and inverting, differentiator and integrator, voltage summing, voltage buffer. High pass, low pass and band pass filters of elementary level.

Power amplifiers: Compound configuration, Cascade and cascade connections, Darlington and complementary symmetry pairs, Class A, Class B, Class C and Class D amplifications, and auto frequency amplifiers.

Digital circuits: Switching algebra, gates, Flip-flops, product of sums, and sum of products, K-map reduction method. Combinational logic circuits, adder, subtractor circuits of elementary level sequential logic circuits, counters, registers, circuits of elementary level.

Special devices: SCR, DIAC, TRIAC, Unijunction transistor as circuit elements, circuit models and elementary level circuits involving these elements.

BOOKS RECOMMENDED

1. Schilling D. L, and Belove C., "Electronic Circuits". McGraw-Hill (1999).
2. Boylestad R. L. and Nashelsky L., "Electronic Devices and Circuit Theory". 10th ed., Prentice-Hall New York (2009).
3. Floyd T. L, "Electronic Devices". 7th ed., Pearson Education (2008).
4. Floyd T. L, "Digital fundamentals". 8th ed., Pearson Education (2009).
5. Mano M. M, "Digital Design". Prentice-Hall New Jersey (1995).
6. Administer J. A, "Electric Circuits". Schaum's outline series (1983).

7. Bell D. B, "Electronic devices & Circuits". Reston Publishing Company Inc., Virginia (1980).
8. Savant C. J. Jr, Roden M. S, and Carpenter G. L, "Electronic Design Circuit & Systems". The Benjamin/Cummings Publishing Co., California (1991).

PHY-633 SOLID STATE PHYSICS (Paper-VIII) **Marks: 100**

Crystal Growth and Structure, Equilibrium phase4 diagrams and growth kinetics, Equilibrium Freezing, Principles of zone melting, Nucleation, Various methods of crystal growth, A Review of crystal structure and diffraction, Scattering from atoms and crystals, Diffraction conditions and intensities.

Imperfection in Solids, Point defects: Schottky, interstitial, Impurity, atoms, Frankel, Linear Defects: Edge and screw dislocations, Planner defects: Grain boundaries, Higher and low angle boundaries, Stacking faults and twin boundaries, Volume defects, thermal movements.

Free Electron Theory, Classical theory, Somerfield model, Quantum mechanical treatment, Fermi Dirac statistics, and applications.

Band Theory, Block theorem, Kroning-Penny model, Ziman model, Feynman model, applications, Nearly Free electron approximation, and tight binding approximation.

Lattice Dynamics, Vibration of one-dimensional mono as well as diatomic lattices, Vibrational modes of crystals, Optical modes in ionic crystals, Scattering and interactions of phonons.

Semiconductors, Theory of semiconductors, Extrinsic semiconductors, Mobility of current carriers, Minority carriers, Life time, Surfaces, Contacts Semiconductor devices; Theory of p.n. junctions, tunneling, p-n junction devices and their circuit models.

Dielectric Properties, Terminology, Equivalent circuits, Mechanisms of polarization, Effective field, Electronic, ionic and Orientational polarization, distortional and interfacial polarization.

Magnetism, Weiss theory of electromagnetism, Ferromagnetism, Para magnetism and diamagnetism.

BOOKS RECOMMENDED

1. Kittle C., "Introduction to Solid state Physics". John Wiley and sons. New York (1989).
2. Blakemore J.S., "Solid state Physics". 2nd ed., Cambridge University press UK (1985).
3. Ashcroft N. W, and Mermin N. D., "Solid State Physics". 1st ed., Saunders College (1976)
4. Levy, R. A., "Principles of Solid State Physics". Academic Press, London (1968).
5. Christman J. R., "Solid State Physics". John Wiley & Sons, New York (1998).
6. Hall H. E., "Solid State Physics". John Wiley & Sons, New York (1982).
7. Kachaava C. M., "Solid State Physics". Tata McGraw Hill Company, New Delhi (1989).
8. Guinier A. & Jullien R.,"The Solid State". Oxford University Press, Oxford (1989).

PHY-634 NUCLEAR PHYSICS (Paper-IX) **Marks: 100**

Basic Properties of Nucleus, Nuclear size, mass, binding energy, semi empirical mass formula, angular momentum, nuclear moment, parity and statistics, quadrupole moment. Aston and Bainbridge mass spectrometer

Nuclear Models, Liquid Drop Model, Calculation of semi empirical formula, Shell model, Collective model.

Nuclear Forces, Central and non central forces, Nuclear potentials (exponential, Square-well, Gaussian And Yukawa); Bartlett and Majorana exchange forces, Yukawa's theory of nuclear forces.

Nuclear Reactions, Direct reactions, Reactions involving the formulations of compound nucleus, Stripping reactions, Resonance reactions, Bohr's theory of compound nucleus and its limitations, Breit-Wigner one level formula including the effect of angular momentum. Cross section for nuclear reactions

Theories of Radioactive decay, Alpha Decay Energy, range, ionization potential and stopping power of alpha particles, Quantum mechanical theory of alpha decay, alpha particle spectra, long range particles and fine structure, nuclear energy levels, Beta Decay, Energy, velocity, and range of beta particle, Fermi's theory of beta decay, Neutrino hypothesis, direct evidence of anti-neutrino, non-conservation of parity, Gamma Decay, Energy, range and nature of gamma rays, theory of gamma decay, classification of gamma decays, internal conversion.

Charged particle Accelerator, Van de Graff generator, Cyclotron, Synchrocyclotrons, Betatron, Electron-Synchrotron, Alternating Synchrotron, Linear Accelerator.

Nuclear Radiation Detection and Measurements, Interaction of nuclear radiation with matter, photographic emulsions, Gas-filled detectors, Scintillation counters and solid state detectors, Cloud chambers and bubble chambers.

Elementary Reactor Physics, Strong, electromagnetic and weak interactions, Conservation laws, Violation of parity Conservation in weak interactions, neutrino and anti-neutrino, direct evidence of antineutrino, muons, the mean life of muons, spin and magnetic moment of muons, the pions, spin and mean-life of charged and neutral pions, the strange particles, k-mesons, hyperons and hyprefragments.

Neutron Physics, Neutron sources, Radioactive sources, Photo neutron sources, charged particle sources, Reactor as a neutron source, slow neutron detectors, fast neutron detectors, measurement of neutron cross-section as a function of energy, slowing down of neutrons, nuclear fission, Description of fission reaction, Mass and energy distribution of fission fragments, average number of neutron released, theory of fission and spontaneous fission, nuclear chain reaction and application.

Thermonuclear Reactions K, Mechanism of fusion process, Energy released in fusion process, Sources of energy in stars controlled thermonuclear fusion, The Pinch effect and its types.

BOOKS RECOMMENDED

1. Tayal D. C., "Nuclear Physics". 4th ed., Himalaya publishing house India (1990).
2. Kenneth S. Krane., "Introductory Nuclear Physics". 1st ed., John Wiley & Sons (1987).
3. Patel S. B., "Nuclear Physics". 1st ed., New age International Publication, New Delhi, India (1991).
4. Puri R. K, and Babbar V. K., "Nuclear Physics". 1st ed., Narosa Publishing House, India (1996).
5. Richard T. Weidner, "Elementary Modern Physics". 1st ed., Pearson Allyn and Bacon, Boston, USA (1980).
6. Henry Semat and Albright J. R., "Introduction to Atomic and Nuclear Physics". 5th ed., Chapman and Hall (1973).
7. Irving Kaplan, "Nuclear Physics". 2nd ed., Addison Wesley Company (1961).
8. Burcham W. E., "Nuclear Physics: an introduction". 2nd ed., Longman (1973).
9. John M. Blatt, Victor F. Weisskopf., "Theoretical Nuclear Physics". 1st ed., Dover Publication, USA (2010).
10. Evans R. D., "The Atomic Nucleus".1st ed., Krieger Pub Co (1982).
11. Kakani S. L, and Shubhra Kakani., "Nuclear and Particle Physics". 1st ed., Anshan Publishers, India (2008).

PHY-635 SPECIAL SOLID STATE PHYSICS (Paper-X) **Marks: 50**

Crystal Defects, Point defects: line defects, surface defects, volume defects. Importance of crystal defects in relation to the properties of materials (introduction)

Phase Transformation, Equilibrium phase diagram for complete and portal miscibility, phase changes in materials, Eutectic, Eutectoid, peritectic, pertitectoid, hyper eutectoid and hypo-eutectoid reactions, martensites, commercial alloys, Iron-Caron system, Alloy Steel, Aluminum- Copper system, Copper Zinc system, Strengthening mechanism, Heat Treatment.

Ceramics and Composite, Introduction to ceramics, crystal structures of ceramics, AX type, AmXp type, AmBnXp type structures, Imperfections in ceramics, impurities in ceramics, Stress Strain behavior of ceramics,
Introduction to Composites, Microscopic composites, Dispersion strengthened composites, Particle reinforced composites, fire reinforce composites, Matrix phase, fire phase, Influence of fire length, orientation and concentration Metal-Matrix fire composites, Hybrid Composites, Macroscopic Composites, Composites, Structure Laminates.

Macro Properties and Microstructure Study Techniques: Stress-Strain curve, Mechanical testing, Compression test, Hardness test Impact test, Fatigue and Creep Tests, X-ray Diffraction, Optical microscopy and Electron Microscopy of Materials.

Superconductivity, Introduction, Type I and type II superconductors, Meissner Effect, Critical Temperature and Critical Field, BCS theory.

BOOKS RECOMMENDED

1. Azaroff L. V., "Introduction to Solids". 1st ed., McGraw-Hill, New York (1960).
2. Anderson J. C., "Materials Science". 3rd ed., Wiley and Sons, New York (1974).
3. Leaver R. D, and Alexander J. M., "Material Science and Engineering". 1st ed., Van-No Strand Reinhold Co. UK (1985).
4. Callister W. D. Jr., "Materials Science and Engineering: An Introduction". 7th ed., John Wiley & Sons, New York (2007).

PHY-636 SPECIAL NUCLEAR PHYSICS (Paper XI) **Marks.50**

Nuclear Structure and Spectroscopy, Semi-empirical mass formula, detailed study of symmetry effects, nuclear angular momentum and nuclear states, shell model, liquid drop model and optical model, theory of deuteron.

Basic Scattering Theory, General theory of scattering, concept of differential and total scattering cross section, method of partial wave analysis, neutron-proton scattering, and neutron-neutron scattering.

Elementary Particles, Brief introduction of nuclear forces, basic properties of elementary particles, decay schemes and conservation laws.

Nuclear Fission, Fusion and Plasma, Theory of Nuclear Fission and Nuclear Fusion, Sub-Critical and super-critical chain reactions, Controlled thermonuclear reactions, confinement of plasma, Kurchatov experiment for the confinement of plasma.

BOOKS RECOMMENDED

1. Tayal D. C., "Nuclear Physics". 4th ed., Himalaya publishing house India (1990).
2. Kenneth S. Krane., "Introductory Nuclear Physics". 1st ed., John Wiley & Sons (1987).
3. Patel S. B., "Nuclear Physics". 1st ed., New age International Publication, New Delhi, India (1991).
4. Puri R. K, and Babbar V. K., "Nuclear Physics". 1st ed., Narosa Publishing House, India (1996).
5. Richard T. Weidner, "Elementary Modern Physics". 1st ed., Pearson Allyn and Bacon, Boston, USA (1980).
6. Henry Semat and Albright J. R., "Introduction to Atomic and Nuclear Physics". 5th ed., Chapman and Hall (1973).
7. Irving Kaplan, "Nuclear Physics". 2nd ed., Addison Wesley Company (1961).
8. Burcham W. E., "Nuclear Physics: an introduction". 2nd ed., Longman (1973).
9. John M. Blatt, Victor F. Weisskopf., "Theoretical Nuclear Physics". 1st ed., Dover Publication, USA (2010).
10. Evans R. D., "The Atomic Nucleus".1st ed., Krieger Pub Co. USA (1982).
11. Kakani S. L, and Shubhra Kakani., "Nuclear and Particle Physics". 1st ed., Anshan Publishers, India (2008).

PHY-637 DIGITAL COMMUNICATION (Paper–XII) **Marks: 100**

Theory of Signals, Introduction to communication systems, signals and systems, classification of signals, Fourier Series and Transforms., Parseval's relation, Frequency-domain, Time-domain and spatial-domain, concepts of

signals processing, convolution, band limiting of waveforms, energy and power spectral densities, autocorrelation and cross correlation of periodic and non-periodic signals, Wiener-Khinchin theorem, sampling theorem.

Analogue Modulation systems, Amplitude Modulation: Mathematical representation of AM modulation, frequency spectrum and power relation in the AM wave, frequency translation, recovery of the base-band signal, maximum allowable modulation, the square-law demodulator, modulator spectrum, single-sideband modulator, balanced modulator, vestigial sideband and compatible single sideband modulator, frequency multiplexing, a base-band signal receiver, Frequency Modulation: Angle and phase modulation, spectrum of FM modulation, modulation index, bandwidth of modulated signals, frequency multiplication, FM demodulator.

Digital Modulation systems, Pulse amplitude, pulse width, pulse position and pulse code modulation, bandwidth requirements, generation and detection of PAM, PWM, PPM and PCM signals, quantization of signals, electrical representation of binary digits, techniques of digital modulation, probability error in digital modulation schemes.

Noise in Communication System, Introduction, some sources of noise, statistical interpretation of noise, frequency-domain, representation of noise, Gassing noise, short noise, white noise, thermal noise, noise temperature, noise figure, signal-to-noise ratio, probability density of Gaussian noise, noise in PCM and delta modulation, equivalent noise temperature of a linear network and of cascaded systems.

Analogue and Digital Filters, Laplace Transform, Z-Transform, Low pass and high pass filters (Butterworth and Chebyshev types), introduction to digital filters, and design of digital filters.

Information Theory and Coding, Discreet messages, concept of amount of information, average information, entropy, information rate, Shanon's theorem, channel capacity, relationship between bandwidth and signal-to-noise ratio, polynomial coding, hamming coding, parity check coding, coding for error detection and correction, convolution error control code, upper bound of the probability error with coding, comparison of error rates in coded and uncoded transmission.

Data Transmission and Networks, Introduction, Switching centers, packet switching centers, packet format, software control, store and forward, protocols, error correction and detection, Hagen burger error correcting system.

BOOKS RECOMMENDED

1. Taub H, and Schilling D. I., "Principles of Communication Systems". 1st ed., Tata MeGra-Hill, New Delhi (1991).
2. Lathi B. P., "Modern Digital and Analogue Communication systems". 1st ed., Holt, Rinehart and Winston, London (1983).
3. Kennedy G. and Davis B., "Electronics Communication Systems". 1st ed., MeGraw-Hill, Mission Hills, California (1992).
4. Information, Transmission, Modulation and Noise by Schawarts.
5. Communication system by Hayking.
6. Proakis, J. G. and Masoud, S., "Communication Systems Engineering". 1st ed., Prentice-Hall Inc., New Jersey (1994).

PHY-638 INTRODUCTORY ELECTRONICS (Paper-XIII) **Marks: 50**

Semiconductor diode and applications, Diode, characteristics, applications as half and full wave rectifiers, bridge rectifier, simple capacitor input filter, diode detector.
Transistor amplifiers, Transistor, characteristics in CE & CB configurations, use as CE, CB & CC amplifier, graphical treatment of CE amplifier, self-biasing, frequency- bandwidth of an amplifier.
Transistor Oscillators, Negative and positive feedback, transistor as an oscillator phase shift, Hertley and Collpit oscillators.
Special Circuit, Devices, FET,UJT, Darlinggton pair, complementary symmetry, Logic gates (AND, NAND, OR NOR, INVETER).

BOOKS RECOMMENDED

1. Schilling D. L. and Belove C., "Electronic Circuits". 1st ed., McGraw-Hill (1999).
2. Boylestad R. L. and Nashelsky L., "Electronic Devices and Circuit Theory". 10th ed., Prentice-Hall New York (2009).

3. Floyd T. L, "Electronic Devices". 7th ed., Pearson Education (2008).
4. Floyd T. L, "Digital fundamentals". 8th ed., Pearson Education (2009).
5. Mano M. M, "Digital Design". 1st ed., Prentice-Hall New Jersey (1995).
6. Administer J. A, "Electric Circuits". 1st ed., Schaum's outlines series (1983).
7. Bell D. B, "Electronic devices & Circuits". Reston Publishing Company Inc., Virginia (1980).
8. Savant C. J. Jr, Roden M. S, and Carpenter G. L, "Electronic Design Circuit & Systems". 1st ed., The Benjamin/Cummings Publishing Co., California (1991).

PHY-639 INTRODUCTORY NUCLEAR PHYSICS (Paper XIV) **Marks:50**

Basic properties of Nucleus, Size of the Nucleus, mass of nucleus, isotopic masses, Energy and mass units, spin moments of nucleus, parity, and statistics.
Particle Accelerators, Electrostatic Accelerators, the Cyclotron, the Betatron, Linear Accelerators, Frequency-Modulated Cyclotron, Electron Synchrotron, Proton Synchrotron.
Beam Transport and Detecting Devices, Bending magnets, Quadrupole magnets, Velocity Spectrometers, photographic Emulsion, Gas-Filled Detectors, Scintillation Counters and solid State Detectors, Cerenkov Counters, Cloud Chambers, Principles of particle identification.
Radioactivity, Natural Radioactive Transformations, The Curie radio-active Series, The Neptunium Series, Branching, Nuclear Isomers, Radioactive isotopes of the lighter elements, Alpha Particle Disintegration Energy, Range of Alpha particles, Alpha Decay, Beta Ray spectra, Beta Decay, Gamma Decay, Selection Rules for gamma Decay , Isomeric States.
Nuclear Reactions, Discovery of Artificial Disintegration, The (x..p.) Reaction the (x.m.) Reaction, simple Alpha particle capture, Radioactive Capture, Disintegration by proton, Deuteron, Photons, Neutron, Electron Capture by Nuclei.
Fission and Fusion of Nuclei, Discovery of nuclear fission, fission of Uranium, Energies of the fission fragments, neutrons from thermal fission of U, Energy of neutrons tertiary fission U, Delayed Neutron, Spontaneous fission, Fission of heavy nuclei, fission of lighter nuclei, fission of heavy nuclei, chain reaction process within a reactor, types of nuclear reactors, transuranin elements, stellar energy of nuclear origin, stellar fusion of light Nuclei.
Nuclear Processes, Stability of nuclei, Nuclear spins, nuclear induction and resonance absorption, orbital angular Momentum of the Deuteron, nuclear models, properties of the compound nucleus, nuclear shell structure Intermediate Energy Reactions Charge Distribution in Nuclei.

BOOKS RECOMMENDED

1. Henry Semat and Albright J. R., "Introduction to Atomic and Nuclear Physics". 5th ed., Chapman and Hall (1973).
2. Irving Kaplan, "Nuclear Physics". 2nd ed., Addison Wesley Company (1961).
3. Kakani S. L, and Shubhra Kakani., "Nuclear and Particle Physics". 1st ed., Anshan Publishers, India (2008).
4. David Halliday, "Introductory Nuclear Physics". 2nd ed., John Wiley and Sons Inc., New York (1955)
5. Kenneth S. Krane., "Introductory Nuclear Physics". 1st ed., John Wiley & Sons (1987).

PHY-6310 MICROWAVE COMMUNICATION (Paper XV) **Marks: 100**

Radio-wave propagation, Factors involved in propagation of radio waves, ground wave propagation, space wave propagation, reflection of waves by Earth, effects of earth imperfection and geographical terrain, maximum usable frequency, extended range propagation.
Guided Waves, Transmission lines, characteristic impedance, Schmith Chart, impedance matching, TE and TM waves, cutoff frequencies, coaxial cable, conducting wave guides, dielectric slab wave guides, optical fiber, micro strip, micro strip as a transmission line.

Modulation, Demodulation and Noise, Need for modulation, amplitude and frequency modulation, recovery of the base-band signal, maximum allowable modulation, the square-law demodulator, modulator spectrum, single-side-band modulator, balanced modulator, method of generating SSB modulator, vestigial sideband and compatible single sideband modulator, sources of noise.

Microwave Circuit Analysis, Microwave amplifiers, equivalent circuits of microwave amplifiers, small signal amplifications, frequency bandwidth and power output, microwave oscillators, equivalent circuits of microwave oscillators, frequency of oscillation of single resonator line and coaxial resonator-line.

Antennae: Short electric dipole, antenna radiation resistance, gain and effective aperture, Array theory, horizontal and vertical pattern, introduction to various antenna (e.g. linear, traveling waves, small loop, helical ect), micro strip as an antenna, radiation from a micro strip antenna.

Radar and Navigation Aids, Basic Radar theory, pulse continuous wave Doppler Radar, pulse Radar, MTI Radar, aircraft landing systems, Radar beacons, beacons, Electronic countermeasures, Radio direction finding.

Geostationary and Sun-synchronous Satellites, satellite position (Clark's orbit), antenna alignment, satellite charts, path losses, uplink and downlink, TDMA in satellite communication, factors involved in determining the performance of digital satellite linked, INTELSAT IV and INTELSATV.

BOOKS RECOMMENDED

1. Taub H. and Schilling D. I., "Principles of Communication Systems". 1st ed., Tata McGraw-Hill, New Delhi (1991).
2. Reich J. B., "Microwave principles". 1st ed., East-West press, New Delhi (1957).
3. Rajeswari Chatterjee., "Antenna Theory and Practice". 1st ed., Wiley Eastern Ltd. New Delhi (1988).
4. Paul D., "Wave Transmission and Fiber Optics". 1st ed., Macmillan publishing company, New York (1990).
5. Bahl I. J. and Bhartia P., "Microstrip Antennas". 1st ed., Artech House Massachusetts (1980).
6. Rainger P. et al., "Satellite Broadcasting". 1st ed., John Wiley & Sons Singapore (1985).

PHY-6311 NUCLEAR AND RADIATION PHYSICS (Paper XVI) **Marks: 100**

Dosimetry, Absorbed dose, unit of absorbed dose, equivalent dose, effective dose, Kerma, Roentgen, Related problems.

Biological Effects of Radiation, Interaction of Radiation with Human body, deterministic effect, stochastic effects, RBE (Radiobiological effectiveness), cell cycle and radio-sensitivity, fractionation and radio-sensitivity, the oxygen effect, Tissue Control Probability (TCP) and Normal Tissue Complication Probability (NTCP). Related problems.

Radiological Protection and Management, Severity of dose, source of radiation, Radiation protection factors distance, time, activity, annual limit of intake, radioactive waste and its classification, management of radioactive waste (disposal of low, intermediate and high level waste), Related problems.

Radiation Detection, Gamma Camera, Ionization Chamber, Scintillation counter, (organic & inorganic).

Basic Scattering Theory and Reaction Rate, Rate of reaction, cross-section, and general theory of scattering. Concept of differential and total scattering cross section, neutron-proton scattering, proton- proton scattering and neutron-neutron scattering, Related problems.

Elementary Particles, Brief introduction of nuclear forces, basic properties of elementary particles, decay schemes and conservation laws.

Nuclear Fission, Fusion and Plasma Physics, Theory of Nuclear Fission and Nuclear Fusion, sub-critical and super-critical chain reaction. Controlled thermonuclear reaction, Confinement of Plasma, Kurchatov experiment for the confinement of plasma, related problems.

Reactor Physics and Diffusion Theory, Theory of nuclear reactors, mechanism of reactors critical mass/size, diffusion theory, neutron flux, mean crow flight distance, related topics and problems

BOOKS RECOMMENDED

1. Alan Martin, & Samuel A. Harbison., "An Introduction to Radiation Protection". 4th ed., Hodder Arnold Publication UK (1998).
2. David J. Dowsett, Patrick A. Kenny, and R. Eugene Johnston., "The Physics of Diagnostic Imaging". 1st ed., Hodder Arnold Publication UK (1998).
3. Faiz Muhammad Khan., "The Physics of Radiation Therapy". 4th ed., Lippincott Williams & Wilkins UK (2009).
4. Hunt S. E., "Nuclear Physics for Engineers and Scientists: low energy theory with applications and their environmental impact". 1st ed., Eills Horwood Limited, Chichester (1987).
5. John R. Lamarsh, and Anthony J. Baratta., "Introduction to Nuclear Engineering". 3rd ed., Prentice Hall (2001).
6. Evans R. D., "The Atomic Nucleus". 1st ed., Krieger Pub Co. USA (1982).
7. John M. Blatt, and Victor F. Weisskopf., "Theoretical Nuclear Physics". 1st ed., Dover Publications, USA (2010).

PHY-6312 COMPUTATIONAL PHYSICS (Paper XVII) **Marks: 75**

Numerical Methods, Numerical Solutions of equations, Regression and interpolations, Numerical integration and differentiation. Error analysis and technique for elimination of systematic and random errors

Modeling & Simulations, Conceptual models, The Mathematical models, random numbers and random walk doing Physics with random numbers computer simulation Relationship of modeling and simulation. Some systems of interest for Physicists such as motion of falling objects, Keplers problems Oscillatory motion Many particle systems Dynamic systems, wave phenomena, field of static charges and current diffusion, populations genetics etc.

Computer Language, A level language or Computational Software such as Mat-lab

BOOKS RECOMMENDED

1. De Jong M. L., "Introduction to Computational Physics". 1st ed., Addison Wesley publishing Inc, Massachusetts (1991).
2. Koonini S. T., "Computational Physics". 1st ed., The Benjamin/Coming Publishing Inc. California (1986).
3. Macheown P. K, & Merman D. J., "Computational Techniques in Physics". 1st ed., Taylor & Francis; Hilger, Bristol (1987).
4. Gould H, & Tobochnik J., "An Introduction to Computer Simulation Methods". 1st ed., Addison Wesley publishing company, Massachusetts (1988).
5. Chapra S. C, & Chanle R. P., "Numerical Methods for Engineers with Personal Computer Applications". 1st ed., McGraw Hill Book Company, New York (1965).

PHY-6313 MEDICAL PHYSICS (Paper XVIII) **Marks: 100**

PHY-6314 ADVANCED ELECTRONIC CIRCUIT THEORY (Paper XIX) **Marks: 100**

PHY-6315 GEO-PHYSICS (Paper XX) **Marks: 100**

PHY-6316 SPECIAL MATERIAL PHYSICS (Paper XXI) **Marks: 50**

Types of Materials, Introduction to various types of materials, single and multiphase materials, metals and alloys, ceramics, glasses, glass-ceramics, composites, polymers, Advanced nano-materials

Structure of Materials, Atomic bonding, Primary and secondary bonding, amorphous and crystalline materials, Crystal structures (Single and polycrystalline), Crystal systems, Polymorphism, Rules for packing of ionic materials, Types of ionic materials, Imperfections and Impurities in materials, Perovskite and spinel structures.

Processing, phase and microstructural analysis, Material designing and processing, Solubility limit, Solid solutions, Gibbs phase rule, Hume-Rothery rules, Unary and binary phase diagrams, Proper and improper binary systems, Scattering of X-rays by materials, phase analysis, micro-structural analysis of materials using optical and scanning electron microscopy

Properties of materials, Mechanical, electrical, dielectric, optical and magnetic properties of materials in terms of atomic behavior, composition-microstructure-property-relationships

Diffusion in solids, Introduction, Diffusion mechanisms, Fick's Ist and 2nd law of diffusion, Steady state diffusion, Non-steady state diffusion, Factors influencing diffusion.

BOOKS RECOMMENDED

1. Askeland D. R, and Phule P. P., "The Science and Engineering of Materials". 4th ed., Bangalore, India (2005).
2. William C, Callister D. Jr., "Material Science and Engineering an Introduction". 7th ed., John Wiley & Sons, New York (1985).
3. Hajra Choudhury S. K., "Material Science and Processes". India Book Distributing Co. Calcutta, India (1994).
4. Graef M. D, and Mchenry M. E., "Structure of Materials". Cambridge University Press, UK (2008).
5. Shackelford J. F., "Introduction to Materials Science for Engineers". 7th ed., John Wiley & Sons, New York (2007).

PHY-6317 SPECIAL PLASMA PHYSICS (Paper XXII) **Marks: 50**

Occurrence of plasma in nature, definition of Plasma, concept of temperature, Debye Shielding, the plasma parameters, Criteria of plasma, application of Plasma, single particle motion in uniform E and B fields in non uniform E and B fields, time varying , Adiabatic Invariants, the fluid Equation of motion, Fluid drifts perpendicular to B field, electron plasma waves, sound waves, ion waves, validity of the plasma approximation, comparison of ion and electron waves, electrostatic ion waves perpendicular to B, the lower hybrid frequency, electromagnetic waves with B = 0, electromagnetic waves perpendicular to B, cut offs and resonance, electromagnetic waves parallel to B, hydro magnetic waves, magneto sonic waves.

BOOKS RECOMMENDED:-

1. Chen F. F., "Introduction to Plasma Physics and Control Fusion". 2nd ed., Springer (1984).
2. Shalom Eliezer, and Yaffa Eleizer., "The Forth State of Mater: An Introduction to Plasma Physics". 2nd ed., Taylor & Francis (2001).
3. Paul M. Bellan., "Fundamental of Plasma Physics". Illustrated ed., Cambridge University Press (2006).
4. Dinklage A, Klinger T, Marx G, and Schweikhard L., "Plasma Physics: Confinement, transport and collective effects". 1st Indian ed., Lecture Notes in Physics, Springer (2005).

PHY-6318 SPECIAL ENVIRONMENTAL PHYSICS (Paper XXIII) **Marks: 75**

Introduction the Essentials of Environmental Physics, The econ system, living in green house, enjoying the sun, transport of matter, energy and momentum, the social and political context.

Basic Environmental Spectroscopy: Black body radiation, the emission spectrum of Sun, the transition electric dipole moment, the Einstein coefficients, Lambert -Beer's Law, the spectroscopy of bio molecules, solar uv and life, the ozone filler.

The Global Climate, The energy balance, a zero-dimensional Greenhouse Model, elements of weather and climate, climate variations and modeling.

Transport of Pollutants, Diffusion, flow in rivers, ground water flow, equations of fluid dynamics, turbulence, turbulence diffusion, Gaussian plumes in air, turbulent jets and planes.

Radiation: General laws of radiation, natural Radiation, interaction of electromagnetic radiation and plants, utilization of photo synthetically active radiation.

Aerosol Physics: Introduction, size distribution, shape, and structure of aerosol particles, combustion aerosols, marine aerosols, aerosol sources and formation, aerosol properties, aerosol impact on air quality and cloud properties.

Atmosphere and Climate, Structure of the atmospheres, vertical profiles in the lower layers of the atmospheres, lateral movements in the atmosphere, atmospheric circulation, cloud and precipitation, the atmospheric greenhouse effect

Climatology and Measurements of Climate Factor, Data collection and organization, statistical analysis of climatic data, climatic indices, general characteristics of measuring equipments, measurement of temperature, air humidity, surface wind velocity, radiation balance, precipitation, atmospheric pressure, automatic weather stations

BOOKS RECOMMENDED

1. Egbert, B. and Rienk, V, G, B; 1999: Environmental Physics 2nd ed., John Wiley and Sons, Guyot Praxis Publication, 1998: Physics of Environmental and Climate.
2. John H. Seinfeld & Spyros N. Pandis, "Atmospheric Chemistry and Physics: From Air Pollution to Climate Change" John Willey & Sons, Inc., 1998.