New Course Structure of MSc (Physics) Programme

SEMESTER-I

Code	Name	L	T	P	C
PH401	Mathematical Physics I	2	1	0	6
PH403	Classical Mechanics	3	1	0	8
PH405	Quantum Mechanics I	3	1	0	8
PH407	Computer Programming	2	0	3	7
PH409	Electronics	3	1	0	8
PH411	Electronics Laboratory	0	0	6	6
		13	4	9	43

SEMESTER-II

Code	Name	L	T	P	C
PH402	Mathematical Physics II	2	1	0	6
PH404	Statistical Mechanics	3	1	0	8
PH406	Quantum Mechanics II	3	1	0	8
PH408	Numerical Methods and Computational Physics	2	0	3	7
PH410	Electrodynamics I	3	1	0	8
PH412	General Physics Laboratory I	0	0	6	6
		13	**4**	**9**	**43**

SEMESTER-III

Code	Name	L	T	P	C
PH501	Electrodynamics II	3	1	0	8
PH503	Atomic and Molecular Physics	3	1	0	8
PH505	Solid State Physics	3	1	0	8
PH507	Nuclearand Particle Physics	3	1	0	8
PH512	Measurement Techniques	2	0	2	6
PH511	General Physics Laboratory II	0	0	6	6
		14	**4**	**8**	**44**

SEMESTER-IV

Code	Name	L	T	P	C
PH516	Advanced Physics Laboratory	0	0	6	6
PH518	Project	0	0	16	16
PH5xx	Elective-I	3	0	0	6
PH5xx	Elective-II	3	0	0	6
PH5xx	Elective-II	3	0	0	6
		9	**0**	**22**	**40**

Total Credit=170

EXISTING Course Structure of MSc (Physics) Programme for comparison

SEMESTER-1

Code	Name	L	T	P	C
PH401	Mathematical Physics-I	3	1	0	8
PH403	Classical Mechanics	3	1	0	8
PH405	Quantum Mechanics-I	3	1	0	8
PH407	Computer Programming	2	0	2	6
PH409	Electronics	3	1	0	8
PH411	Physics Laboratory-I	0	0	4	4
		14	4	6	42

SEMESTER-2

Code	Name	L	T	P	C
PH402	Mathematical Physics-I I	3	1	0	8
PH404	Statistical Mechanics	3	1	0	8
PH406	Quantum Mechanics-II	3	1	0	8
PH408	Numerical Methods and Computational Physics	2	0	2	6
PH410	Electrodynamics-I	3	1	0	8
PH412	Physics Laboratory-II	0	0	6	6
		14	4	8	44

SEMESTER-3

Code	Name	L	T	P	C
PH501	Electrodynamics-II	3	1	0	8
PH503	Atomic and Molecular Physics	3	1	0	8
PH505	Solid State Physics	3	1	0	8
PH507	Nuclear and Particle Physics	3	1	0	8
PH511	Physics Laboratory-III	0	0	6	6
PH513	Project I	0	0	4	4
		12	4	10	42

SEMESTER-4

Code	Name	L	T	P	C
PH512	Measurement Techniques	2	0	3	7
PH514	Project II	0	0	12	12
PH5xx	Elective-I	3	1	0	8
PH5xx	Elective-II	3	1	0	8
PH5xx	Elective-III	3	1	0	8
		11	3	15	43

Total credit=171

Note: Electives have to be taken from at least two different groups: Condensed Mater, Lasers and Photonics, and Theoretical Physics. One of the electives can be taken from Institute electives.

New Syllabus for M.Sc. programme (Semester I)

PH401: Mathematical Physics I (2-1-0-6)

Linear Algebra: Vector Spaces, subspaces, linear independence, spans, basis, dimensions, linear transformations, image and kernel, rank and nullity, change of basis, similarity transformation, inner product spaces, orthonormal sets, Gram-Schmidt procedure, dual space, eigenvalues and eigenvectors, Hilbert space; Ordinary and Partial Differential equations: Series solution-Frobenius method, Sturm-Liouville equations; Special functions: Legendre, Hermite, Laguerre and Bessel functions, method of separation of variables for wave equations in cartesian and curvilinear coordinates, Green's function and its applications;Integral transformations: Laplace transformations and applications to differential equations

Texts:

1. G.B.Arfken, H.J.Weber and F.E. Harris, *Mathematical Methods for Physicists*, Seventh Edition, Academic Press(2012)
2. S. Andrilli & D.Hecker, *Elementary Linear Algebra*, Academic Press (2006)

References:

1. M.L.Boas, *Mathematical Methods in Physical Sciences*, John Wiley & Sons (2005)
2. S. Lang, *Introduction to Linear Algebra*, Second Edition, Springer (2012)
3. E.A. Coddington*, Introduction to Ordinary Differential Equations,* Prentice Hall of India (1989)
4. I. Sneddon, *Elements of Partial Differential Equations*, McGraw Hill
5. T. Lawson, *Linear Algebra*, John Wiley & Sons (1996)
6. P. Dennery & A. Krzywicki, *Mathematics for Physicists*, Dover Publications (1996)

PH403: Classical Mechanics (3-1-0-8)

D'Alembert's principle and Lagrange equation: Generalized coordinates, principle of virtual work, D'Alembert's principle, Lagrangian formulation and simple applications, Variational principle and Lagrange equation: Hamilton's principle, Lagrange equation from Hamilton's principle, Extension to non-Holonomic systems, Lagrange multipliers, symmetry and conservation laws;Central force problem: Two body problem in central force, Equations of motion, effective potential energy, nature of orbits, Virial theorem, Kepler's problem, condition for closure of orbits, scattering in a central force field, centre of mass and laboratory frame;Rotating frame: Angular velocity, Lagrange equation of motion, inertial forces;Rigid body motion: kinetic energy, momentum of inertia tensor; angular momentum, Euler angles, heavy symmetrical top, Euler equations, stability conditions; Hamiltonian formulation: Legendre transformations, Hamilton's equations, symmetries and conservation laws in Hamiltonian picture, Hamilton's principle, canonical transformations, Poisson brackets, Hamilton-Jacobi theory, action-angle variables; Small-oscillations: Eigenvalue problem, frequencies of free vibrations and normal modes, forced vibrations, dissipation;Classical field theory: Lagrangian and Hamiltonian formulation of continuous system.

Texts

1. H. Goldstein, C. P. Poole and J. Safko, *Classical Mechanics,* 3rd Edition, Pearson (2012).

References

1. N. C. Rana and P. S. Joag, *Classical Mechanics*, Tata Mcgraw Hill (2001).
2. L. Landau and E. Lifshitz, *Mechanics,* Oxford (1981).
3. S. N. Biswas, *Classical Mechanics*, Books and Allied (P) Ltd.,Kolkata (2004) .
4. F. Scheck, *Mechanics,* Springer (1994).

PH405: Quantum Mechanics I (3-1-0-8)

Overview of linear vector spaces: Inner product space, operators, expectation values of physical variables, bases, Dirac notation, eigenvalues and eigenvectors, commutation relations, Hilbert space; Postulates of Quantum Mechanics: Wave particle duality, wavefunction and its relation to the state vector, probability and probability current density, conservation of probability, equation of continuity, density matrix; Schroedinger equation: Simple potential problems,infinite potential well, step and barrier potentials, finite potential well and bound states, linear harmonic oscillator, operator algebra of harmonic oscillator;Three dimensional problems:spherical harmonics, free particle in a spherical cavity, central potential, Three dimensional harmonic oscillator, degeneracy, Hydrogen atom;Angular momentum: Commutation relations,spin angular momentum, Pauli matrices, raising and lowering operators, L-S coupling, Total angular momentum, addition of angular momentum, Clebsch-Gordon coefficients.

Texts:

1. R. Shankar, Principles of Quantum Mechanics, Springer (India) (2008).

References:

1. J. J. Sakurai, Modern Quantum Mechanics, Pearson Education (2002).
2. K. Gottfried and T-M Yan, Quantum Mechanics: Fundamentals,2nd Ed., Springer (2003).
3. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson Education (2005).
4. P. W. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill(1995).
5. F. Schwabl, Quantum Mechanics, Narosa (1998).
6. L. Schiff, Quantum Mechanics, Mcgraw-Hill (1968).
7. E. Merzbacher, Quantum Mechanics, John Wiley (Asia) (1999).
8. B. H. Bransden and C. J. Joachain, Quantum Mechanics, Pearson Education 2nd Ed. (2004

PH409: Electronics (3-1-0-8)

Bipolar junction transistor: configurations, small signal amplifier, oscillators; JFET and MOSFET: characteristics, small signal amplifier; OP-AMP: Differential amplifiers, IC 741 circuits - amplifiers, scalar, summer, subtractor, comparator, logarithmic amplifiers, Active filters, multiplier, divider, differentiator, integrator, wave shapers, oscillators. Schmitt trigger; 555 Timer: Astable, monostable and bistable multi-vibrators, voltage controlled oscillators; Voltage regulator ICs; Number systems and their inter-conversion;

Boolean algebra; Logic gates; De-Morgan’s theorem; Logic Families: TTL, MOS and CMOS; Combinational Circuits: Adders, subtractors, Encoder, De-coder, Comparator, Multiplexer, De-multiplexers, Parity generator and checker; Sequential Circuits: Flip-flops, Registers, Counters, Memories; A/D and D/A conversion. INTEL 8085 microprocessor: Architecture and programming; I/O interfacing using PPI 8255 and 8155; Architectural evolution in 16-bit, 32-bit and 64-bit microprocessors.

Texts/References:

1. A. S. Sedra and K. C. Smith, Electronics Circuits, (6^{th} Edn), Oxford University Press (2009)
2. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory (10^{th} Edn), Prentice Hall (2008)
3. D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications (6^{th} Edn), Tata McGraw Hill (2007)
4. R. Gaekwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India (1995).
5. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085, Penram India (1999).

PH411: Electronics Lab (0-0-6-6)

Typical experiments: Half-wave and full-wave rectifiers; voltage regulation using Zener diode and IC 78xx; Regulated dual voltage power supply using IC 78xx and IC79xx; I/O characteristics of BJT in CB and CE configuration; Single stage amplifier using a FET; OP-AMP Circuits: Summer, subtractor, differentiator, integrator and active filters; Colpitts and Wien bridge oscillators; monostable and astable multivibrator using NE555; Universality of NOR/NAND gates; Verification of De Morgan's theorem, half-adder, full adder, multiplexers and de-multiplexers; comparators; JK flip-flop, mod-counters; assembly language programming exercises with INTEL 8085 microprocessor kit; Simple interfacing experiments with 8155/8255.

References:

1. P. B. Zbar and A. P. Malvino, Basic Electronics: a text-lab manual, Tata McGraw Hill (1983).
2. D. P. Leach, Experiments in Digital Principles, McGraw Hill (1986).
3. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085, Penram India (1999).

New Syllabus for M.Sc. programme (Semester 2)

PH402: Mathematical Physics II (2-1-0-6)

Tensors, inner and outer products, contraction, symmetric and antisymmetric tensors, metric tensor, covariant and contravariant derivatives;Complex Analysis: Functions, derivatives, Cauchy-Riemann conditions, analytic and harmonic functions, contour integrals, Cauchy-Goursat Theorem Cauchy integral formula; Series: convergence, Taylor series, Laurent series, singularities, residue theorem, applications of residue theorem, conformal mapping and application;Group Theory: Groups, subgroups, conjugacy classes, cosets, invariant subgroups, factor groups, kernels, continuous groups, Lie groups, generators, SO(2) and SO(3),SU(2), crystallographic point groups.

Texts:

1. J. Brown and R.V.Churchill, *Complex Variables and Applications*, McGraw-Hill, 8th Edition (2008)
2. A.W.Joshi, *Elements of Group Theory*, New Age Int. (2008)
3. A.W.Joshi, *Matrices and Tensors in Physics*, 3rd Edition, New Age Int. (2005)

References:

1. M.L.Boas, *Mathematical Methods in Physical Sciences*, John Wiley & Sons (2005)
2. G.B.Arfken, H.J.Weber and F.E. Harris, *Mathematical Methods for Physicists*, Seventh Edition, Academic Press (2012)
3. M. Hamermesh, *Group Theory and Its Applications to Physical Problems*, Dover (1989)

PH404: Statistical Mechanics (3-1-0-8)

Statistical description: macroscopic and microscopic states for classical and quantum systems, connection between statistics and thermodynamics, entropy, classical ideal gas, entropy of mixing and Gibb's paradox; Microcanonical Ensemble: Phase space, Liouville's theorem, applications of ensemble theory to classical and quantum systems; Canonical Ensemble: partition function, thermodynamics in canonical ensemble, classical systems, ideal gas, energy fluctuation, equipartition andVirial theorem, system of harmonic oscillators, statistics of paramagnetism, negative temperature;

Grand Canonical Ensemble: equilibrium between a system and a particle-energy reservoir, partition function, density and energy fluctuation. Formulation of Quantum Statistics: Quantum mechanical ensemble theory, density matrix,statistics of various ensembles, examples;Theory of quantum ideal gases: Ideal gas in different quantum mechanical ensembles, identical particles, many particle wave function, occupation numbers, classical limit of quantum statistics, molecules with internal motion;Ideal Bose Gas: Bose-Einstein condensation, blackbody radiation, phonons,Helium II;Ideal Fermi Gas: Pauli paramagnetism, Landau diamagnetism, thermionic and photoelectric emissions, white dwarfs;Interacting Systems: Models of interacting systems, Ising, Heisenberg and XY models, Solution of Ising model in one dimension by transfer matrix method.

Texts:

1. R. K. Pathria and P. D. Beale, Statistical Mechanics, 3rd ed. Butterworth-Heinemann (2011).
2. S. R. A. Salinas, Introduction to Statistical Physics, Springer (2004).

References:

1. W. Greiner, L Neise, and H. Stocker, Thermodynamics and Statistical Mechanics, Springer (1994).
2. K. Huang, Statistical Mechanics, John Wiley Asia (2000).
3. L. D. Landau and E. M. Lifshitz, Statistical Physics, Pergamon (1980).

PH406: Quantum Mechanics II (3-1-0-8)

Perturbation Theory: Non-degenerate and Degenerate cases, Zeeman and Stark effects, induced electric dipole moment of Hydrogen; Real Hydrogen Atom: relativistic correction, spin-orbit coupling, hyperfine interaction, Helium atom, Pauli's exclusion principle, exchange interaction; Schroedinger equation for a slowly varying potential: WKB approximation, turning points, connection formulae, derivation of Bohr-Sommerfeld quantization condition, applications of WKB; Variational method: trial wave function, applications to simple potential problems; Time Dependent Perturbation Theory: Sinusoidal perturbation, Fermi's Golden Rule;Special topics in radiation theory: semi-classical treatment of interaction of radiation with matter, Einstein's coefficients, spontaneous and stimulated emission and absorption, application to lasers; Scattering Theory: Born approximation, scattering cross section, Greens functions, scattering for different kinds of potentials, applications; Relativistic quantum mechanics, Lorentz invariance, free particle Klein-Gordon and Dirac equations.

Texts:

1. B. H. Bransden and C. J. Joachain, Quantum Mechanics, Pearson Education 2nd Ed. (2004)
2. R. L. Liboff, Introductory Quantum Mechanics, Pearson Education, 4th Ed. (2003).

References:

1. P. W. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill(1995).
2. F. Schwabl, Quantum Mechanics, Narosa (1998).
3. L. I. Schiff, Quantum Mechanics, Mcgraw-Hill(1968).
4. J. J. Sakurai, Modern Quantum Mechanics, Pearson Education (2002)
5. R. Shankar, Principles of Quantum Mechanics, Springer; 2nd edition (1994).

PH408: Numerical Methods and Computational Physics (2-0-3-7)

Errors: its sources, propagation and analysis;Roots of functions: bisection, Newton-Raphson, secant method, fixed-point iteration, applications;Linear equations: Gauss and Gauss-Jordan elimination, Gauss-Seidel, LU decomposition; Eigenvalue Problem: power methods and its applications;Least square fitting of functions and its applications;Interpolation: Newton's and Chebyshev polynomials; Numerical differentiation: forward, backward and centred difference formulae;Numerical integration: Trapezoidal and Simpson's rule, Gauss-Legendre integration, applications; Solutions of ODE: initial value problems, Euler's method, second and fourth order Runge-Kutta methods; Boundary value problems: finite difference method, applications.

Texts:

1. K. E. Atkinson, *Numerical Analysis,* John Wiley (Asia) (2004).
2. S. C. Chapra and R. P. Canale, *Numerical Methods for Engineers,* Tata McGraw Hill (2002).

References:

1. J. D. Hoffman, *Numerical Methods for Engineers and Scientists*, 2nd ed. CRC Press, Special Indian reprint (2010).
2. J. H. Mathews, *Numerical Methods for Mathematics, Science, and Engineering,* PrenticeHall of India (1998).
3. S. S. M. Wong, *Computational Methods in Physics,* World Scientific (1992).
4. W. H. Press, S. A. Teukolsky, W. T. Verlling and B. P. Flannery, *Numerical Recipes in C,*Cambridge (1998).

PH410: Electrodynamics I (3 1 0 8)

Electrostatics: Poisson and Laplace equations, Dirichlet and Neumann boundary conditions;Boundary value problems: Method of images, Laplace equation in Cartesian, spherical and cylindrical coordinate systems, applications; Green function formalism: Green function for the sphere, expansion of Green function in spherical coordinates; Multipole expansion; Boundary value problems for dielectrics; Magnetostatics: vector potential, magnetic induction for a circular current carrying loop, magnetic materials, boundary value problems, Magnetic shielding, magnetic field in conductors; Electrodynamics: Maxwell's equations, Gauge transformations, Poynting's theorem, Energy and momentum conservation; Electromagnetic waves: wave equation, propagation of electromagnetic waves in non-conducting medium, reflection and refraction at dielectric interface, total internal reflection, Goos-Hänchen shift, Brewster's angle, complex refractive index.

Texts:

1. J. D. Jackson, *Classical Electrodynamics,* John Wiley (Asia) (1999).

References:

1. H J W Muller Kirsten, Electrodynamics, World Scientific (2011).
2. J. R. Reitz and F. J. Millford, *Foundation of Electromagnetic Theory,* Narosa (1986).
3. W. Greiner, *Classical Electrodynamics,* Springer (2006).
4. L. D. Landau and E. M. Lifshitz, *Electrodynamics of Continuous Media,* ButterworthHeimemann (1995)

PH412: General Physics I (0-0-6-6)

A typical set of experiments:

Faraday Effect, Magnetic susceptibility of a liquid; Diffraction by grating, Fresnel Bi-prism, Fourier Optics, Raman Effect, Frank-Hertz experiment, Electrical resistivity of semiconductors, Hall effect in semiconductors, Study of magnetic hysteresis, Temperature dependent characteristics of *p-n* junction.

References:

1. R. A. Dunlop, Experimental Physics, Oxford University Press (1988).
2. A. C. Melissinos, Experiments in Modern Physics, Academic Press (1996).
3. E. Hecht, Optics, Addison-Wesley; 4 edition (2001)
4. A. Lipson, S G Lipson, H Lipson, Optical Physics, Cambridge University Press; 4th (2010)
5. Laboratory Manual with details about the experiments.

New Syllabus for M.Sc. programme (Semester III)

PH501: Electrodynamics - II (3 1 0 8)

Frequency dependence of permittivity, permeability and conductivity, electrons in conductors and plasma; Electromagnetic waves in conducting medium: reflection and transmission; Wave Guides: waves between parallel conductors, TE and TM waves, rectangular and cylindrical wave guides, resonant cavities; Radiating Systems and Multipole fields: retarded potential, field and radiation of a localized oscillating source, electric dipole fields and radiation, quadrupole fields, multipole expansion, energy and angular momentum, multipole radiations; Scattering: scattering at long wavelengths, perturbation theory, Rayleigh scattering; Radiation by Moving Charges: Lienard-Wiechert potential, radiation by nonrelativistic and relativistic charges, angular distribution of radiations, distribution of frequency and energy, Thomson's scattering, bremsstrahlung in Coulomb collisions; Relativistic Electrodynamics: covariant formalism of Maxwell's equations, transformation laws and their physical significance, relativistic generalization of Larmor's formula, relativistic formulation of radiation by single moving charge.

Texts:

1. J. D. Jackson, Classical Electrodynamics, John Wiley (Asia) (1999).

References:

1. H J W Muller Kirsten, Electrodynamics, World Scientific (2011).
2. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall (1995).
3. J. Schwinger et al, Classical Electrodynamics, Persesus Books (1998).
4. G. S. Smith, Classical Electromagnetic Radiation, Cambridge (1997).

PH 503: Atomic and Molecular Physics (3-1-0-8)

Review of one-electron and two-electron atoms: spectrum of hydrogen, helium and alkali atoms; Many electron atoms: central field approximation, Thomas-Fermi model, Slater determinant, Hartee-Fock and self-consistent field methods, Hund's rule, L-S and j-j coupling, Equivalent and nonequivalent electrons, Spectroscopic terms, Lande interval rule; Interaction with Electromagnetic fields: Zeeman, Paschen Back and Stark effects; Hyperfine structure and isotope shift, selection rules; Lamb shift; Molecular spectra: rotational, vibrational, electronic, Raman and Infra-red spectra of diatomic molecules; electronic and nuclear spin, Hund's rule, Frank–Condon principle and selection rules; Molecular structure: molecular potential; Born-Oppenheimer approximation, diatomic molecules, electronic angular momenta; Approximation methods; linear combination of atomic orbitals (LCAO) approach; states for hydrogen molecular ion; shapes and term symbols for simple molecules; Spectroscopic techniques: basic principles of microwave, infrared, Raman, NMR, ESR and Mossbauer spectroscopies; Modern developments: optical cooling and trapping of atoms, Bose-Einstein condensation, molecular spectroscopy in a magneto-optical trap, time resolved spectroscopy in the femtosecond regime.

Texts:

1. B. H. Bransden and C. J. Joachain, Physics of Atoms and Molecules,2nd Ed. Pearson (2008).
2. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed.,Tata McGraw (2004).

References:

1. G. K. Woodgate, Elementary Atomic Structure, Clarendon Press (1989).

2. I. N. Levine, Quantum Chemistry, PHI (2009).
3. F. L. Pilar, Elementary Quantum Chemistry, McGraw Hill (1990).
4. H. E. White, Introduction to Atomic Spectra, Tata McGraw Hill (1934).
5. W. Demtroder, Atoms, Molecules and Photons, 2nd Ed., Springer (2010).
6. C. J. Foot, Atomic Physics, Oxford (2005).

PH505: Solid State Physics (3-1-0-8)

Crystal structure: symmetry operations, Bravais lattices, point groups, examples of simple crystal structures, Miller indices and reciprocal lattice, Bragg and von Laue diffraction, structure factor; Crystal binding: molecular crystals, repulsive interaction, cohesive energy, ionic metallic and covalent crystals; Lattice vibration and thermal properties: harmonic approximation, monatomic and diatomic lattices, Brillouin zone, phase and group velocities, density of states, acoustic and optical modes, quantization of linear chain, phonons, crystal momentum, determination of dispersion relations, Debye model of specific heat, anharmonic effects, thermal expansion, thermal conductivity; Free electron theory: Fermi gas, specific heat, Ohm's law, magneto-resistance, thermal conductivity Wiedemann-Franz law; Band theory: Bloch theorem, nearly free electron model, classification of metal, insulator and semiconductor, motion of electron in energy bands, effective mass, tight binding model, Fermi surfaces of metals, de Hass-van Alphen effect; Semiconductor: Intrinsic and extrinsic semiconductors, mobility and electrical conductivity, Fermi level, Hall effect, cyclotron resonance; Magnetism: Diamagnetism, Hund's rules, Lande g-factor, quantum theory of paramagnetism, Pauli paramagnetism, exchange interaction, ferromagnetism, Ising model, Heisenberg model, mean field theory, magnons and spin waves, ferromagnetic domains, magnetic anisotropy energy, hysteresis; Superconductivity: Meissner effect, London equations, type-I and type-II superconductors; Ginzburg-Landau theory, outlines of BCS theory, flux quantization.

Text:

1. Introduction to Solid State Physics, C. Kittel, 8^{th} ed; John Wiley & Sons (2005).
2. Solid State Physics, J.D. Patterson and B.C. Bailey; Springer (2007).

References:

1. Solid State Physics, N. W. Ashcroft and N. D. Mermin; Harcourt Asia Pte. Ltd. (2001).
2. Solid State Physics, M. S. Rogalski and S. B. Palmer; Gordon and Breach Science Publishers (2001).

PH507: Nuclear and Particle Physics (3-1-0-8)

Nuclear properties: radius, size, mass, spin, moments, abundance of nuclei, binding energy, semi-empirical mass formula, excited states; Nuclear forces: deuteron, n-n and p-p interaction, nature of nuclear force, Yukawa hypothesis; Nuclear Models: liquid drop, shell and collective models; Nuclear decay and radioactivity: radioactive decay, detection of nuclear radiation, alpha, beta and gamma decays, radioactive dating; Nuclear reactions: conservation laws, energetics, isospin, reaction cross section, Rutherford scattering, nuclear scattering, optical model, compound nucleus, direct reactions, resonance reactions, neutron physics, fission and fusion reactors; Particle accelerators and detectors: electrostatic accelerators, cyclotron, synchrotron, linear accelerators, colliding bean accelerators, ionization chamber, scintillation detectors, semiconductor detectors; Elementary particles: Fundamental forces, properties mesons and baryons, symmetries and conservation laws, quark model, concept of colour charge, discrete symmetries, properties, of quarks and leptons, gauge symmetry in electrodynamics, particle interactions and Feynman diagrams.

Texts:

1. K. S. Krane, Introductory Nuclear Physics, John Wiley (1988).

Reference:

1. R. R. Roy and B. P. Nigam, Nuclear Physics: Theory and Experiment, New Age (1967).
2. A. Das and T. Ferbel, Introduction to nuclear and particle physics, John Wiley (1994).
3. M. A. Preston and R. K. Bhaduri, Structure of the nucleus, Addison-Wesley (1975).
4. I. S. Hughes, Elementary Particles, Cambridge (1991).
5. F. Halzen and A. D. Martin, Quarks and Leptons, John Wiley (1984).
6. D. Perkins, Introduction to High Energy Pysics, Cambridge University Press; 4^{th} edition (2000)

PH509: Measurement techniques (2-0-2-6)

Principles of measurement systems; low pressure generation and measurement; low temperature generation and measurement; Instruments: X-ray diffractometer, LASER, Spectrometers - FTIR, UV-Vis, near IR, Raman, Photoluminescence; Microscopes - optical, SPM, SEM, TEM; Magnetic measurement systems: VSM, SQUID, thermal measurement system: DSC, Resonance Spectroscopy: ESR, NMR; Optical spectrum analyzer.

Scientific seminar on related topics

Texts / References:

1. A. D. Helfrick and W.D.Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI (1996).
2. J. P. Bentley, Principles of measurement systems, Pearson Education Ltd, England (2005).
3. A. S. Morris, R. Langari, Measurement and Instrumentation: Theory and Application, Academic Press, London (2012).
4. G.C.M. Meijer, Smart Sensor Systems, John Wiley & Sons Ltd, UK (2008).
5. A. Ghatak and K.Thyagarajan, Optical Electronics, C.U.P. (1991).
6. D. A. Skoog, F. J. Holler and T. A. Nieman, Principles of Instrumental Analysis, Saunders Coll. Publ. (1998).
7. H. J. Tichy, Effective Writing for Engineers, Managers, Scientists, John Wiley & Sons (1988).
8. M. Alley, The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid, Springer-Verlag New York (2003).

PH511: General Physics Lab II (0-0-6-6)

Optics: Michelson interferometer, Fabry-Perot interferometer; Solid State Physics: Monatomic and diatomic lattice characterization, four probe measurement of magneto-resistance of semiconductors, electron spin resonance (ESR) spectroscopy; Atomic and Molecular Physics: emission spectra of gases, absorption spectrophotometry; Nuclear Physics: study of alpha, beta and Gamma-rays.

References:

1. R. A. Dunlop, Experimental Physics, Oxford University Press (1988).
2. A. C. Melissinos, Experiments in Modern Physics, Academic Press (1996).
3. E. Hecht, Optics, Addison-Wesley; 4 edition (2001)
4. J Varma, Nuclear Physics Experiments, New Age Publishers (2001)
5. Laboratory Manual with details about the experiments.

New Syllabus for M.Sc. programme (Semester IV)

PH516: Advanced Physics Lab (0-0-6-6)

Atomic spectra by constant deviation spectrometer; polarization, Fraunhofer diffraction and Bragg diffraction using microwave; Holography: construction of the hologram and reconstruction of the object beam; Zeeman effect; X ray diffraction; Radioactive decay: counting statistics; Optical fiber: mode field diameter and numerical aperture, bend loss measurement; superconducting, ferroelectric and ferromagnetic transitions, characterization of quantum dot structures.

Texts/References:

1. E. Hecht, Optics, Addison-Wesley; 4 edition (2001)
2. R A Dunlop, Experimental Physics: Modern Methods, Oxford University Press, USA; 1 edition (1988)
3. A Ghatak, K Thyagarajan, Introduction to fiber optics, Cambridge University Press, First Edition (1999)
4. A C Melissinos, J Napolitano, Experiments with Modern Physics, Academic Press, Secod edition (2003)
5. J Varma, Nuclear Physics Experiments, New Age Publishers (2001)
6. Laboratory Manual with details about the experiments.