Details of

Programme of Study

&

Syllabus of Courses

Offered by

Department of Physics

Master of Sciences in Physics

Study & development of physics is important as it plays a key role in the future progress of humankind. Physics is an exciting intellectual adventure that inspires young people and expands the frontiers of our knowledge about Nature. Physics generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world. It contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries. Physics is an important element in the education of chemists, engineers and computer scientists, as well as practitioners of the other physical and biomedical sciences. It extends and enhances our understanding of other disciplines, such as the earth, agricultural, chemical, biological, and environmental sciences which happen to be the subjects of substantial importance to all peoples of the world. Physics improves our quality of life by providing the basic understanding necessary for developing new materials, instrumentation and techniques for various applications.

Considering above the programme has been designed with two elements namely core and specialization and initially the Department shall offer Electronics and Condensed Matter Physics (CMP) as the specializations. Subsequently based on the availability of infrastructure and faculty, other specializations can be added without any need to modify the core component.

Features:

- The programme has been designed broadly on the basis of UGC model curriculum, syllabus for NET and GATE examinations.
- Syllabus of various leading institutions has also been used as a reference while framing the curriculum.
- The programme has an excellent blend of the core and applied components.
- The programme has been designed on core and specialization pattern and initially two specializations namely electronics (Microcomputers and Interfacing) and Condensed Matter Physics (Materials properties and Nanotechnology) shall be offered with 15 students for each specialization.
- Based on the expertise of the faculty more specializations may be added in future.

Name of the Degree: Master of Science in Physics (M. Sc. Physics).

Course Structure of M.Sc(Physics)

Semester I **First Year**

Course Code	Course Title	L-T-P	Credits
PHL 6021	Classical Mechanics	4-0-0	4
PHL 6031	Mathematical Physics	4-0-0	4
PHL 6041	Quantum Mechanics-1	4-0-0	4
PHL 6051	Electronics	4-0-0	4
PHP 6121	General Laboratory-I	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credits
PHL 6061	Statistical Mechanics	4-0-0	4
PHL 6042	Quantum Mechanics-II	4-0-0	4
PHL 6071	Electrodynamics & Plasma Physics	4-0-0	4
PHL 6081	Atomic & Molecular Physics	4-0-0	4
PHP 6122	General Laboratory-II	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credits
PHL 7091	Nuclear & Particle Physics	4-0-0	4
PHL 7101	Condensed Matter Physics	4-0-0	4
PHL 7XP2	Special Paper I	4-0-0	4
PHL 7XP3	Special Paper II	4-0-0	4
PHP 7XP6	Special Paper Lab	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credits
PHL 7111	Computational Methods & Programming	2-0-4	4
PHL 7043	Relativistic Quantum Mechanics	4-0-0	4
PHL 7XP4	Special Paper III	4-0-0	4
PHL 7XP5	Special Paper IV	4-0-0	4
PHD 7131	Project	0-0-16	8
Total Credits		**16-0-16=32**	**24**

SEMESTER I

Classical Mechanics

PHL 6021 **4-0-0=4**

Unit I: Introduction to Mechanics and the Lagrangian Formulation: [10]
Mechanics of a system of particles in vector form. Conservation of linear momentum, energy and angular momentum, Degrees of freedom, Constraints, and generalized coordinates and velocities. Elementary idea of general dynamical systems: conservative versus dissipative systems. Lagrangian, action principle, external action, Euler-Lagrange equations. Generalised momenta and the conservation laws. Applications of the Lagrangian formalism.

Unit II: Two-Body Central Force Problem: [10]
Central force problem, Kepler problem, bound and scattering motions. Scattering in a central potential, Rutherford formula, and the Scattering cross section.

Unit III: Hamiltonian Formulation of Mechanics: [12]
Hamiltonian, Hamilton's equations of motion. Legendre transforms relation to Lagrangian formalism. Phase space, Phase trajectories. Applications to systems with one and two degrees of freedom. Hamiltonian systems and Liouville's theorem. Canonical transformations, Poisson brackets. Action-angle variables. Non- integrable systems and elements of chaotic motion.

Unit IV: Rigid Bodies and the Small Oscillations: [08]
Noninertial frames of reference and pseudoforces: centrifugal Coriolis and Euler forces. Elements of rigid-body dynamics, Euler angles, and the symmetric top. Small Oscillations: Normal mode analysis, and Normal modes of a harmonic chain.

Unit V: Special Theory of Relativity: [10]
Inertial frames. Principle and postulate of relativity. Lorentz transformations. Length contraction, time dilation and the Doppler effect. Velocity addition formula. Four- vector notation. Energy-momentum four-vector for a particle. Relativistic invariance of physical laws.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Classical Mechanics: H Goldstein.
2. Classical Mechanics: N C Rana and P S Joag
3. Mechanics: L. D. Landau and E. M. Lifshitz
4. Introduction to Classical Mechanics: R. G. Takwale and Puranik.

Mathematical Physics

PHL 6031 **4-0-0=4**

Unit-I. Vector and Tensor: [10]
Scalar and vector fields, Vector differential operators: gradient, curl. Divergence and Laplacian. Vector operators in curvilinear coordinates. Gauss's theorem. Green's theorem and Stoke's theorem: applications to physical problems. Tensors.

Unit-II. Boundary value problems: [15]
Partial differential equations: applications in electrostatics, Laplace and Poisson equations: heat conduction, diffusion, elastic and electromagnetic waves. Schrodinger wave equation. Solutions in rectangular, spherical polar and cylindrical polar coordinates. Boundary conditions.

Unit-III. Complex Variables: [10]
Elements of complex variables. Cauchy–Reimann eqn. Taylor and Maclaurine Expansion, Residue theorem and contour integration.

Unit-IV.Special Functions: [12]
Special functions: Bessel, Hermite, Legendre, Laugerre polynomials: generating functions and orthonormality. Addition theorem for spherical harmonics, application in heat conduction, diffusion, wave equations etc., Dirac delta function and its representations.

Unit-V. Fourier and Laplace Transformations: [08]
Fourier analysis. Fourier transforms, Laplace transforms and applications in physics.

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Recommended Books
1. Mathematical Methods for Physicists: George B. Arfken and Hans-Jurgen Weber.
2. Mathematics for Physicists and Engineers: Louis A. Pipes.
3. Mathematical Method of Physics: A.K. Ghatak.
4. Analytical Mathematics in Physics: C. Harper, 1st Edition Prentice Hall
5. Mathematical Physics: B S Rajput
6. Mathematical Method- Potter and Goldberg (Prentice hall of India)
7. Vector Analysis (Schaum Series) (McGraw Hill)

Quantum Mechanics-I

PHL 6041 **4-0-0=4**

Unit-I [10]
The principle of Superposition, One and three dimensional wave packets, Motion of wave packets, Differential equation satisfied by wave packets, Interpretation of wavefunction, Probability current density, equation of continuity, wave packet in momentum space, Ehrenfest's theorem, wavepackets and uncertainty relations and spread of wave packet.

Unit-II Application of Schrödinger equation: [10]
One dimensional finite square well potential, particle in one and three dimensional box, solution of free particle Schrödinger equation in spherical polar coordinates, solution of one and three dimensional harmonic oscillator in spherical polar co-ordinate, degeneracy of harmonic oscillator states. Rectangular potential barrier, application of barrier penetration.

Unit-III General Formalism: [10]
Fundamental postulates of wave mechanics, operator representation of dynamical variables, commutation of operators, Adjoint and hermitian operators, unitary operators, eigen value problem for operators, properties of eigen functions and eigen values of hermitian operators, simultaneous eigen functions, Dirac Delta function and box normalization of free particle wave function, uncertainity principle in operator approach. Bra and ket notations, matrix representationof wave function and operator, energy spectrum of of one dimensional harmonic oscillator using matrix mechanics.

Unit-IV Theory of Angular momentum-I: [10]
Definition of generalized angular momentum, operators for J_+, J_- and J_Z, Commutation relation of angular momentum operator. Spectrum of eigen values of J^2 and J_Z, operators for angular momentum L in spherical polar co-ordinates, Eigen values and eigen functions of L^2 and L_Z. Spin angular momentum, Eigen values and eigen functions of S^2 and S_Z.

Unit-V Theory of Angular momentum-II: [10]
Matrix representation of J^2, J_Z, J_+, J_-, J_x, J_y for j=1/2 and 1. Pauli's spin matrices and their properties, Addition of two angular momenta, coupled and uncoupled representation, Clebsch Gordon coefficients, Spectrum of eigen values of total angular momentum. Calculations of C. G. coefficients when (i) $j_1 = ½$, $j_2 = ½$ (ii) $j_1 = ½$, $j_2 = 1$.

Recommended Books

1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1st Edition, MacMillan India
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechamics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Quantum Mechanics: Suresh Chandra

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Electronics

PHL 6051 **4-0-0=4**

UNIT-I Amplifiers:
BJT and FET Amplifiers; Frequency response of amplifiers; Operational Amplifiers: Differential amplifiers, Principles of Operational Amplifiers, Transfer Characteristics, Offset parameters, Differential gain, CMRR, applications of operational amplifiers, linear circuits.

UNIT-II Digital Systems:
Combinational Systems: Binary Adder/Subtractor, Multiplexers, Demultiplexers, Encoders, Decoders, Parity checker/generators
Sequential Systems: Flip-Flops, Shift registers, Asynchronous (Ripple) and Synchronous counter, Applications of Counters
D/A and A/D Systems: Digital-to-Analog converters, Analog-to-Digital converters

UNIT-III Memories:
ROM, PROM, EPROM, RAM, Static and dynamic random access memory devices: SRAM and DRAM, CMOS and NMOS, non-volatile – NMOS, Magnetic, Optical and Ferromagnetic memories, Charge Couple Devices (CCDs).

UNIT-IV Microprocessor:
8085 Microprocessor Architecture, Instruction set - Addressing modes - Illustrative programmes - writing assembly language programmes, looping, counting and indexing - Counters and Timing delays - Stack and Subroutines

UNIT-V Interfacing Peripheral Devices:
Memory and I/O interfacing, Data transfer schemes, Interfacing Devices and I/O devices, programmable peripheral interface 8255A, 8279A programmable keyboard/display interface, direct memory access (DMA) and 8237 programmable DMA controller, Interrupts of intel 8085, programmable interrupt controller (PIC) intel 8259A.
Note for Paper Setting: Major examination paper will consists of 20% of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60% of total marks from the portion covered after minor II.

Recommended Books

1. "Electronic Devices and circuit theory" by Robert Boylested and Louis Nashelsky PHI, Eighth Edition New Delhi -110001, 2002
2. "Electronics Principles", 7th Edition TMH by A.P. Malvino, 2007
3. "Principles of Electronics" (7th Edition) S. Chand, V.K. Mehta
4. "Integrated Electronics" by Millman and Halkias, TMH Publishers
5. "OP-Amps & Linear integrated circuits," by Ramakant A. Gayakwad PHI, Fourth Edition, 2010
6. "Digital principles and Applications" by A.P. Malvino and Donald P. Leach, Tata Mcgraw - Hill company, Sixth Edition, New Delhi,
7. "Introduction to semiconductor devices, M.S. Tyagi", John Wiley & Sons
8. "Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer Publisher: Prentice Hall, Eighth Edition, 2010
9. "Linear Integrated Circuits" by D.R. Choudhury and S.B. Jain, New Age International, 2003, Second

Edition.
10. "Memory Mass Storage", by G. Campardo, F Tiziani, M. Iaculo, Springer, 2011
11. "Solid State Electronic Devices" by Ben G. Streetman, Prentice Hall, Fourth Edition, 1995.
12. "Douglas V. Hall, "Microprocessors and Interfacing, Programming and Hardware", second edition, McGraw Hill International Edition, 1992.
13. "Principles of microprocessor systems" by A.P. Godse, Technical Publications Pune, 2009
14. "Microprocessor Architecture, programming and Applications with 8085/8086" by Ramesh S. Gaonkar, Wiley – Eastern Ltd., Fifth Edition
15. "Fundamentals of Microprocessor and Microcomputers" by B. Ram, Dhanpat Rai Publications (p) Ltd.-new Delhi (2010)

General Laboratory-I

PHP 6121 **0-0-12=6**

Note: Students are required to perform at least 12 to 14 experiments from the below given list.

Group A Experiments

1. Study of He-Ne laser- measurement of divergence and wavelength
2. Verification of Cauchy's relationship.
3. To determine the value of Plank's constant by photocell and solar cell.
4. Normal Zeeman effect in transverse and longitudinal configuration using a LG plate.
5. Determination of wavelength of H_α, H_β, H_γ from the Balmer series of hydrogen.
6. To verify Fresnel's formula.
7. Emission and absorption spectra.

Group B Experiments

8. (a) Half wave, full wave and bridge wave rectifier.
   (b) Zener regulation with fixed input voltage and fixed load.
9. Temperature dependence of avalanche and Zener Breakdown diodes.
10. Barrier capacitance of a junction diode.
11. (a) Transistor characteristics, transistor as a switch.
    (b) Transistor feed back circuit design and verification.
12. Design a ground emitter amplifier and draw dc load line curve and measure the Voltage gain, input impedence and output-impedance.
13. Resistivity by four probe method.
14. DC Hall effect
15. Linear Voltage Differential Transformer
16. Characteristics of OP-AMP (741) i.e. input offset voltage, input bias current, and input off set current.
17. Design non-inverting and inverting voltage feed back circuit and measure voltage gain.
18. To design voltage summing and differential amplifier using 741 IC.
19. To design the Schmitt trigger circuit and measure UTP and LTP (in volt).
20. To design integrator and differentiator using 741 IC and also waveform conversion from sine to rectangular and rectangular to triangular.
21. To design Wien-Bridge oscillator of given frequency.
22. To design phase-shift oscillator of given frequency.

SEMESTER II

Statistical Mechanics

PHL 6061 **4-0-0=4**

Unit I: Classical Equilibrium Statistical Mechanics: [16]
Fundamentals of classical statistical mechanics. Micro canonical ensemble, equilibrium and entropy, classical ideal gas, phase space, ergodic hypothesis, liouville equation and Gibbs density, canonical ensemble and partition function, grand (macro) canonical ensemble and partition function, probabilities, ensemble averages and fluctuations, thermodynamic quantities and equation of state from statistical physics: properties of ideal classical gas, gas of oscillators, van der Waal gas and spin system.

Unit II: Quantum Equilibrium Statistical Mechanics: [16]
Fundamentals of quantum statistical mechanics, density matrices, quantum liouville equation and gibbs density, micro canonical, canonical, grand (macro) canonical ensembles, partition functions, probabilities, ensemble averages and thermodynamic quantities, most probable distributions from entropy principle for quantum ideal gases, partition functions for quantum ideal gases. For Fermi gas: thermodynamic quantities and equation of state, for Bose gas: thermodynamic quantities and equation of state, properties of Bose Einstein condensation, thermal radiation and relativistic gases.

Unit III: Phase Transitions and Critical Phenomena: [7]
Change of phase and first order phase transitions in van der Waal gas. Classification of phase transitions and thermodynamic potentials. Theory of first and second order phase transitions, order parameters, critical exponents. Phase transitions of super fluidity and superconductivity, phase transitions in magnetism.

Unit IV: Ising Model: [5]
Ising and Heisenberg models, partition functions for exactly solvable one and two dimensional systems,

Unit V: Non Equilibrium Statistical Mechanics: [6]
Random walk and Brownian motion, Diffusion and transport, Boltzman kinetic equation, Langevin equation, Fluctuation and dissipation theorem, Fokker Planck and Master equations, Wiener and Khintchine equations, Applications to noise, correlations, and other non equilibrium properties.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Walter Greiner, Ludwig Neise, Horst Stocker "Thermodynamics and Statistical Mechanics" Springer
2. Kerson Huang "Introduction to Statistical Physics" Taylor and Francis, 2001
3. P K Pathria "Statistical Mechanics" 2nd Ed.
4. J K Battacharjee, Statistical Physics; Allied Publishers (India)
5. F Reif, Statistical and Thermal Physics, McGraw Hill
6. C Kittel, Thermal Physics, CBS Indian edition

Quantum Mechanics-II

PHL 6042 **4-0-0=4**

Unit-I: Perturbation Theory [10]
Time independent non-degenerate perturbation theory upto second order. Applications to normal He atom, perturbed harmonic oscillator. Time independent degenerate perturbation theory upto first order. Application of degenerate perturbation theory to stark effect and Zeeman effect. Time dependent perturbation theory, calculation of 1^{st} order transition amplitude, transition probability, and derivation of Fermi Golden rule.

Unit-II: [10]
Semi Classical theory of radiations, Einstein's coefficients of emission and absorption, expression for transition probability for absorption and induced emission using electric dipole approximation. Adiabatic approximation for solving time dependent problems, sudden approximation.

Unit-III: [10]
Variational technique, its application to ground state of He, atom. W.K.B-approximation, classical turning points, connection formulae, Application to WKB to bound state problem and tunneling, α-decay derivation.

Unit-IV: Scattering Theory-I [10]
Differential and total scattering cross sections, scattering amplitude, relation between differential scattering cross section and scattering amplitude, Laboratory and centre of mass reference frames, relations of scattering angles and cross sections in laboratory and centre of mass reference frames. Partial wave analysis, expression for scattering amplitude and total scattering cross section in terms of phase shifts, scattering by perfectly rigid sphere and by square well potential, Deduction of optical theorem for scattering cross section.

Unit-V: Scattering Theory-II [10]
Free particle Green's Function, Green's function method for scattering, derivation of scattering amplitude and Born approximation, Application of Born approximation to square well, Yukawa and screen coulomb potential. Multiparticle wave function, particle exchange operator, collision of identical particles and their scattering amplitudes.

Recommended Books
1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1^{st} Edition, MacMillan India
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechamics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Quantum Mechanics: Suresh Chandra

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Electrodynamics & Plasma Physics

PHL 6071 **4-0-0=4**

Unit-I: Electrostatics [7]
Gauss's law and application, Poisson's and Laplace Eqns. Boundary Value Problems, Methods of Images, Green function and applications, Electrostatic field in Matter-Polarization, bound charges, susceptibility

Unit-II: Magnetostatics [8]
Biot- Savart's and Ampere's law, Concept of Vector Potential, Magnetic field in matter, Continuity Equation, Maxwell's Eqns, Vector and scalar Potential and Gauge, Pointings Theorem.

Unit-III: EM waves [15]
Electromagnetic waves –Introduction, Reflection and Refraction, Electromagnetic field tensor and its invariance, Lorentz force eqn.in covariant form, Retarded Potential, Electric dipole radiation, Magnetic dipole radiation, Radiation from arbitrary distribution of charge, Lienard Weichert potentials, Radiated power and angular frequency, The fields of a point charge in motion, The Abraham Lorentz formula, Collinear and perpendicular velocity and acceleration, Thomson scattering, Cherenkov radiation, Inhomogeneous wave Eqn., Multipole expansion of electromagnetic fields, Multipole moments

Unit-IV: Wave Guides [5]
Wave Guides- TE, TM and TEM modes, rectangular and cylindrical wave guides, resonant cavities, Energy dissipation, Q of a cavity

Unit V: Plasma [10]
Motion of charged particles in electromagnetic fields: uniform and nonuniform fields, time varying fields; Elementary concepts: Boltzmann eqn, Plasma oscillations, Debye shielding, Plasma parameters, magneto plasma, Plasma confinement; Hydro dynamical description of plasma, hydro magnetic waves, Alfven waves.

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Recommended Books

1. D.J. Griffiths- Introduction to Electrodynamics
2. J.D. Jackson- Classical Electrodynamics
3. F.F. Chen- Plasma Physics
4. Bittencourt- Plasma Physics

Atomic & Molecular Physics

PHL 6081 **4-0-0=4**

Unit-I: Atomic Spectra:
Introduction to Spectroscopy and Types of Spectra, Spectrum of Hydrogen Atom, Bohr Model for hydrogen atom, Bohr-Sommerfeld model of Hydrogen Atom, Sommerfeld's Relativistic Correction, Fine Structure of Hydrogen Atom. [10]

Unit-II: One Valence Electron Atoms:
Magnetic Dipole Moments, Electron Spin and Vector Atom Model and Sterrn-Gerlach Experiment, Spectra of one valance electron system, Fine structure of Hydrogen atom spectrum and alkali atoms, Zeeman Effect, Paschen-Back effect, Stark Effect in Hydrogen Atom, Spin-orbit interaction for two valance electron system (LS and JJ Coupling), Pauli's exclusion Principle, Singlet and Triplet States, Selection Rules, Hyperfine Structure of Spectral Lines, Interpretation of Helium Spetrum. [15]

Unit-III: The Breadth of Spectral Lines and X-Ray Spectra:
Breadth of Spectral Lines, Effect of Nuclear Properties on Spectral Lines, X-ray Spectra, Moseley's Law, Regular and Irregular Doublet Law, Photoelectron Spectra. [5]

Unit-IV: Molecular Structure:
Types of Molecular Spectra and Molecular Energy States, Classification of molecules, Rotation Rotational spectrum of a rigid diatomic molecule, Isotope effect in rotational spectra, Intensity of rotational lines, Non-rigid rotator, Rotation-vibration spectra of diatomic molecules. [10]

Unit-V: Various Techniques:
Raman spectroscopy, Nuclear Magnetic Resonance (NMR), and Electron Spin Resonance (ESR). Photoelectron spectroscopy, Mossbauer Spectroscopy, Visible and Ultraviolet Spectroscopy and Different Light Sources, Laser [10]

Recommended Books

1. G. Aruldhas, Molecular Structure and Spectroscopy, Second Edition 2007, Prentice Hall Of India, New Delhi
2. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, Third Edition 1972, McGraw-Hill book company, London
3. S. Chandra, Molecular Spectroscopy, 2009, Narosa Publishing House, New Delhi
4. S. Chandra, Physics of Atoms and Molecules, 2010, Narosa Publishing House, New Delhi
5. W. Demtroder, Molecular Physics, 2005, Wiley-VCH Verlag GmbH & Co., KGaA, Weinheim
6. S.L. Gupta, V. Kumar and R.C. Sharma, 2007, Elements of Spectroscopy, Twentieth Edition, Pragati Prakahsan, Meerut
7. J. M. Hollas, Modern Spectroscopy, 1987, Third Edition, John Wiley & Sons, New York
8. V.K. Jain, Introduction to Atomic and Molecular Spectroscopy, 2007, Narosa Publishing House, New Delhi
9. Sune Svanberg, Atomic and Molecular Spectroscopy, 1992, Second Edition, Springer Verlag, Berlin
10. H.E. White, Introduction to Atomic Spectra, 1934, McGraw-Hill Kogakusha Ltd., Tokyo

General Laboratory-II

PHP 6122 **0-0-12=6**

Note: Students are required to perform atleast 12 experiments from the list

General Physics Experiments

1. Determination of e/m ratio: (Millikan oil drop method)
2. To plot the current voltage characteristic of a CdS photo resistor at constant irradiance and to measure the photo current as a function of irradiance at constant voltage.
3. To verify Biot-Savart's Law.
4. To measure the wavelength using a millimeter scale as a grating (with Diode laser).
5. To study the polarization of Sugar solution at different concentration.
6. Febry-parot interferometer.
7. Determination of Planck's constant.
8. Determination of Rydberg constant

Digital Electronics experiments

9. Temperature on-off controller using IC.
10. Waveform generator using IC's.
11. Study of 8-bit DAC
12. 16 channel digital multiplexer and demultiplexer.
13. Design and verify the truth table for half adder and full adder logic circuits.
14. Active filter circuits (second order)
15. Delayed linear sweep using IC 555.
16. Constant current source using IC 741 and LM 317.
17. Regulated power supply using IC LM 317.
18. Design serial in –serial out and parallel in- parallel out shift registers.
19. Study of presettable counters 74190 and 74193.
20. Design of MOD-5 counter using 16-bit counter.
21. To design D/A and A/D converters IC.
22. Study of 8085 microprocessor and execution of simple programs.
23. SID and SOD using 8085.

SEMESTER III

Nuclear & Particle Physics

PHL 7091 **4-0-0=4**

Unit-I: Fundamentals [10]

Proton-electron theory of nucleus, proton-neutron theory of nucleus, nomenclatures of nuclei, Size, density and charge distribution for a nucleus, atomic mass unit, packing fraction, binding energy, Semi-empirical mass formula, nuclear forces, Yukawa theory, exchange force, neutron-neutron scattering, deuteron, ground and excited states of deuteron.

Unit-II: Nuclear Models & Nuclear Reactions: [15]

Nuclear fission, liquid drop model for fission, Bohr-Wheeler theory of nuclear fission, nuclear fusion, source of stellar energy, collective nuclear model , nuclear shell model, magic numbers

Kinds of nuclear reactions, various conservation laws, nuclear reaction kinematics, endothermic and exothermic reactions, Compound nucleus model, Breit-Wigner formula, optical model, nuclear transmutation

Unit-III: Detectors, Accelerators and Reactors [8]

Sensitivity of detector, response of detector, energy resolution of detector, efficiency of detector, dead time detector, ionization chamber, proportional counter, Geiger-Muller counter, scintillation detector, Van de Graaff generator, Cyclotron, Synchro-cyclotron, linear accelerator, nuclear chain reaction, general aspects of reactor design, classification of reactors,

Unit-IV : Decay Processes [7]

Displacement laws for alpha and beta decays, law of radioactive disintegration, law of successive disintegration, theory of alpha decay, theory of beta decay

Unit-V: Elementary Particles: [10]

Fundamental forces, discovery of elementary particles, classification of elementary particles, various conservation laws for elementary particles, CP violation in neutral K-decay, Gell-Mann-Nishijima formula, Gell-Mann-Okuba mass formula, Quarks model for elementary particles.

<u>Note for paper setting</u>: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Abhyankar K.D. and Joshi A.W., An Overview of Basic Theoretical Physics,2009, University Press (India) Private Limited, Hyderabad
2. Cohen, B.L., Concepts of Nuclear Physics, 2005, Tata McGraw-Hill, New
3. Devanathan, V., Nuclear Physics, 2006, Narosa Publishing House, New Delhi
4. Ghosh, S., An Introduction to the Engineering Asoects of Nuclear Physics, 2009, I.K. International, Publishing House Pvt. Ltd., New Delhi
5. Griffiths, D., Introduction to Elementary Particles, 1987, John Wiley & Sons,
6. Heyde, K., Basic Ideas and Concepts in Nuclear Physics, 2005, Overseas Press, India
7. Kaplan, I., Nuclear Physics, 1998, Narosa Publishing House, New Delhi
8. Kulkarni V.W., Atomic and Nuclear Physics, 2004, Himalaya Publishing

9. Tayal D.C., Nuclear Physics, 2009, Himalaya Publishing House, Delhi
10. Wong, S.S.M., Introductory Nuclear Physics, 2005, Prentice-Hall, India

Condensed Matter Physics

PHL 7101 **4-0-0=4**

Unit I : Crystal Physics and X-ray Crystallography [10]
Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, crystal systems, crystal planes and Miller indices, closed packed structures, symmetry elements in crystals, point groups and space groups, quasicrystals.

Unit II: Reciprocal Lattice and Experimental X-ray Diffraction Techniques [10]
Diffraction of X-rays, Laue equations, Bragg's law, Reciprocal lattice and its application to diffraction techniques, Ewald sphere, absorption of X-rays, Experimental diffraction techniques-Laue's diffraction technique, powder X-ray diffraction technique, application of powder method, general concept of scattering factor and structure factor.

Unit III: Disorder in Solids [10]
Point defects(Frenkel and Schottky), line defects (slip, plastic deformation, edge and screw dislocation, Burger's vector, concentration of line defects, estimation of dislocation density), Frank Reid mechanism of dislocation multiplication(dislocation reaction), surface (planar) defects, grain boundaries and stacking faults.

Unit IV: Electronic properties of solids [10]
Electrons in periodic lattice, Bloch theorem, Kronnig –Penny model, classification of solids on the basis of band theory, effective mass, tight bonding, cellular and pseudopotential methods, Fermi surface, De Hass Von alfen effect, Quantum Hall effect.

Unit V: Magnetic Properties of Solids [10]
Classification and general properties of magnetic materials, Weiss theory of ferromagnetism, temperature dependence of spontaneous magnetization, Heisenberg's model and molecular field theory, Curie and Curie Weiss law, Domains and hysteresis, spin waves and magnons, the Bloch $T^{3/2}$ law, Neel model of antiferromagnetism and ferrimagnetism. Soft and Hard magnetic materials, Superconductivity, type I and type II superconductors, Meissner effect, London equations, concept of coherence length.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Introduction to Solid State Theory: O. Madelung.
2. Solid State Physics: Neil W. Ashcroft and N. David Mermin.
3. Principles of Condensed Matter Physics: P.M. Chaikin and T.C. Lubensky.
4. Solid State Physics – An Introduction to Theory and Experiment: H. Ibach and H. Lüth.
5. Crystallography Applied to Solid State Physics: A.R. Verma and O.N. Srivastava.
6. Solid State Physics: A. J. Dekker
7. Introduction to Solid State Physics, 7th ed., John Wiley: C. Kittel.

SPECIAL PAPERS

Electronics Option (IIIrd Semester)

Special Paper I (Electronics)

PHL 7052 **4-0-0=4**

Unit I
Register organization of 8086, architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special processor activities, maximum mode 8086 system and timings.

Unit II
Machine language instruction formats. Addressing modes of 8086, instruction set of 8086, assembler directives and operators.

Unit III
A few machine level programs, machine coding of the programs, programming with an assembler, assembly level sample programs.

Unit IV
Review introduction to Microcontrollers and Microprocessors, Embedded vs external memory, Devices, 8-bit and 16 bit Microcontrollers, CISC and RISC processors. Harvard and Van Neumann Architectures, Commercial Microcontroller Devices. The architecture of the 8051 microcontroller- The plan of 8051 microcontroller, the registers in 8051 microcontroller, the data memory in 8051, the multiplexed port system, the internal and the external memory use

Unit V

The interrupt and the interrupt flags, the interrupt system- what is interrupt? Why do we use interrupts? The interrupt system of the 8051, setting up an interrupt jump table, servicing the interrupt, enabling and disabling the interrupts, interrupt from within the microcontroller, external hardware interrupt, how are the interrupts handled. Addressing Modes. Instruction Set, Instructions and simple programs. Using stack pointer, Assembly language programming, Development systems and tools, software simulations of 8051. microcontroller based applications.

Note: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Microprocessor Architecture, Programming , and Applications with 8085, R S Goankar, 5th Ed. Penram International
2. Advanced microprocessors and peripherals, architecture, programming and interfacing, A K Ray and K M Bhurchandi, TMH, 2001
3. Microcontrollers, Ajay V Deshmukh, TMH, 2005
4. Jan Axelson, Penram International
5. Microprocessors and Interfacing, programming and hardware, D V Hall, TMH
6. The 8051 microcontroller and Embedded systems, Rajiv Kapadia, Jaico Publishing House
7. 8086 Microprocessor, programming and interfacing, K J Ayla, Penram International
8. 8051 Microcontroller, K J ayla, Penram International
9. Programming and customizing the 8051 microcontroller, Mike Predko, TMH

Special Paper II (Electronics)

PHL 7053 **4-0-0=4**

Unit I:

PIC Microcontrollers: Overview and features, PIC 16C6X/7X. FSR (File Selection Register) [Indirect Memory Address Pointer]. PIC reset actions. PIC Oscillator connections. PIC memory organization, PIC 16C6X/7X instructions. Addressing modes. I/O ports, Interrupts in PIC 16C61/71.

Unit II

PIC 16C61/71 timers. PIC 16C71 analog to digital converter (ADC). Capture/ Compare/ PWM (CCP) Modules in PIC 16F877. Master synchronous serial port (MSSP) module. Universal synchronous asynchronous receiver transmitter (USART). Analog-to-digital converter (ADC).

Unit III

PIC 16F8XX flash Microcontrollers:- Introduction, Pin diagram, STATUS register, power control register (PCON) and OPTION REG register, program memory, data memory.
Design with Atmel Microcontrollers (89 CXX and 89C20XX):

Unit IV

PC parallel ports for interfacing- Study of PC parallel port: Essentials. Accessing ports (Data, status and control registers, bidirectional ports). Programming issues, Programming tools, Experiments, Interfacing.

Unit V

Interfacing and Microcontroller Applications- Light emitting diodes (LED's); push buttons, relays and latch connections, keyboard interfacing, interfacing 7-segment displays; LCD interfacing, ADC and DAC interfacing with 89C51 Microcontrollers.
Industrial applications of Microcontrollers- Introduction to measurement applications

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Microprocessor Architecture, Programming, and applications with 8085 – R.S. Gaonkar (5th edition, penram international)
2. Advanced microprocessors and peripherals, architecture, programming and interfacing A.K. Ray and K. M. Bhurchandi, TMH (2001)
3. Microcontrollers, Ajay V. Deshmukh (TMH, 2005)
4. Design with PIC microcontrollers John B Peatman, Pearson Education
5. Jan Axelson (Penram International Publications, India)

Special Paper Lab (Electronics)

PHP 7056 **0-0-12=6**

A1. Microprocessor based Experiments:
(Minimum two experiments from 1 to 4, and 5 (compulsory))

1. Study of 8085 interrupts
2. Complex waveform generation using microprocessor kit and 8 bit DAC
3. Simple I/O (mode 0) and I/O with handshake (mode 1) using DIP switches as the I/P and :LED's as the O/P devices
4. Study of operation of PTC 8253/8254; Mode 0,1,2,3,4

5. 8086 assembly language programming:-
    a) Simple data manipulation programs
    b) Simple programs to handle I/O ports
    (PC parallel port or I/O ports on a PC add-on card)
    (Assembly language programming of 8086 may be done by operating PC in a real mode by using 'Debug' program. Separate 8086 study kit is not needed)

A2: Microcontroller 8031/ 8051 based experiments: (Minimum 5)

1. Study of 8051 microcontroller kit
2. Study of IN and OUT port of 8051 (Interfacing switches, LED's and Relays)
3. Study of external interrupts of 8051
4. Study of Internal timer and counter in 8051
5. Study of serial communication with 8051
6. Interfacing 8 bit DAC with 8051 to generate complex waveforms.
7. Advanced programming and mathematical calculations using microcontroller

A3: PC Interfacing experiments: (Minimum four experiments)

1. Interfacing switches, LED's to PC printer parallel port
2. Interfacing DC motor, steeper motor, solenoid using PC printer parallel port
3. Interfacing 8 bit DAC to PC printer parallel port
4. Interfacing 8 bit ADC to PC printer parallel port
5. Study of multifunction I/O card
6. ON/OFF temperature control using PC and multifunction I/O card
7. Study of event counter using multifunction I/o card with PTC 8253/8254

Condensed Matter Physics Option (IIIrd Semester)

Special Paper I (Condensed Matter Physics)

PHL 7102 **4-0-0=4**

UNIT I: Introduction to materials and their classification; Crystalline and non-crystalline materials; Atomic structure and interatomic bonding in solids.

UNIT II: Mechanical properties of materials – elastic and plastic deformations, property variability and design/safety factors; Dislocations and strengthening mechanisms – dislocations and plastic deformation, mechanisms of strengthening in metals, recovery, re-crystallization, and grain growth; Failure – fracture, fatigue, and creep.

UNIT III: Phase diagrams – basic concepts (solubility limit, phases, microstructure, phase equilibria, one-component phase diagram), binary phase diagrams, the iron–carbon system, phase transformations in metals and metal alloys, fabrication and processing of metals, bulk and surface properties of metals.

UNIT IV: Optical properties of metals and nonmetals, applications of optical phenomena – luminescence and photoconductivity, laser, optical fibre.

UNIT V: Criterion for selection of materials, process and cost optimization. Engineering applications of materials. Economic, environmental, and societal issues in Materials science and Engineering.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Material Science and Engineering: An introduction, by William D. Jr., Callister Wiley Text Books
2. Element of Material Science and Engineering by Lawrence H. Van Vlack, Pearson Education India.
3. Science of Engineering Materials by C.M. Srivastava and C. Srivastava, New Age International Publishers.
4. Applied Physics of Solids by Rajnikant, Wiley International.
5. Material Science and Engineering- A first course by V.Raghavan, Prentice Hall India.

Special Paper II (Condensed Matter Physics)

PHL 7103 **4-0-0=4**

UNIT I : Polymer structures, classification; Characteristics, applications, and processing of polymers; mechanical behavior of polymers, mechanisms of deformation, degradation and strengthening of polymers, crystallization, melting, and glass transition phenomena in polymers, Polymer types, Polymer synthesis and processing; Degradation of Polymers; Electrical properties of polymers.

UNIT II: Composites – particle-reinforced composites, fiber-reinforced composites, and structural composites; corrosion and degradation of composites.

UNIT III: Ceramic Structures and mechanical properties of ceramics; types and applications of ceramics; fabrication and processing of ceramics; Electrical conduction in ionic ceramics.

UNIT IV: Dielectric behavior, and other electrical characteristics – ferro- and piezoelectric materials, thermal and magnetic properties of materials. Fabrication and processing of materials for semiconductors.

UNIT V: Materials for biomedical applications; Property requirements of biomaterials; Concept of biocompatibility; cell-material interactions; Important biomaterials; Design concept of developing new materials for bio-implant applications, bio-MEMS and bio-NEMS.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Material Science and Engineering: An introduction, by William D. Jr., Callister Wiley Text Books
2. Material Science and Engineering- A first course by V.Raghavan, Prentice Hall India.
3. Material Science by S.L.Kakani and Amit Kakani, New Age International Publishers.
4. Applied Physics of Solids by Rajnikant, Wiley International
5. Material Science by M.S.Vijaya and G. Rangaranjan, Tata Mc Graw Hill Publishing Company limited.
6. Material and Process in manufacturing by Garmo J.T., Nold A.Kohsor.

Special Paper Lab (Condensed Matter Physics)

PHP 7106 **0-0-12=6**

Students will be required to perform at least 10-12 experiments from the list below:

1. To Study the Curie Temperature of Ferro(/Ferri) – electric/magnetic Materials.
2. Study of Cooling Curve for Alloy Mixture (lead-tin/Pb-Sn) using Equilibrium Diagram by direct cooling.
3. Materials internal structure investigation by employing X-ray diffraction technique (Laue, Single Oscillation, Double Oscillation, Rotation, Weissenberg).
4. To measure the Susceptibility of a Paramagnetic solution by Quinck's Tube Method.
5. To study the mono atomic and diatomic lattice dynamics through
   (a) Dispersion relation for "Mono-atomic Lattice" and comparison with theory.
   (b) Determination of the Cut-off frequency of the mono-atomic lattice
   (c) Dispersion relation for the di-atomic lattice, acoustical mode and energy gap.
6. To study the ultrasonic velocity and compressibility of liquids with Ultrasonic Interferometer.
7. To study the Young s modulus and elastic constant in solids by Piezoelectric Technique.
8. Electron Spin Resonance (ESR) in DPPH – Determining the magnetic field as a function of the resonance frequency.
9. To Study the solar cell Characteristics.
10. To Study the B-H curves of given specimen and estimate the Hysteresis loss.
11. To Study the Hall effect in semiconducting crystal and estimate its Hall's coefficient and carrier concentration.
12. To determine the resistivity of given semiconductor crystal and hence the energy band gap using Four probe Method.
13. Any one of the following:
    (a) To determine the thickness of mica sheet using Michelson Interferometer.
    (b) To determine the thickness of given wire using He-Ne laser.
14. To study the dielectric constant of given materials (polystyrene, glass and PCB sheet etc.).
15. To determine the thermal conductivity of given material using Lee's Disc Method.
16. Demostration experiment based on PEM (proton exchange membrane) fule cells and electrolysis.
17. To determine theresistance of thermister at different temperatures and hence estimate its energy band gap.
18. To determine the numerical aperture of an optical fiber.
19. To measure the temperature dpendent viscosity of viscous liquids (e.g. glycerol).
20. To determine the the specific heat of given metals (copper, brass and aluminum etc.)

Note: Apart from above, course instructor can also pick few experiments from the UGC-Physics Model Curriculam and any other experiments meant for demonstration of concept and traning in condensed matter physics and nanotechnology, in general.

SEMESTER IV

Computational Methods & Programming

PHL 7111 **2-0-4=4**

FORTRAN Language [10]

Compiler, Interpreter and Flow charts. Characters used in Fortran. **Keywords.** Constants and variables. Data type declarations. Expression and statements. Input-output statements, READ, WRITE, OPEN, CLOSE, FORMAT, STOP, END statements, IMPLICIT declaration. COMMON statement. Labeled COMMON statement. SAVE statement, EQUIVALENCE statement. DATA statements. Logical IF and GO TO statements. Nested logical IF and Arithmetic IF statements. Computed GO TO statements. IF-THEN-ELSE. IF-ELSE and GO-TO structures. Loop statements - Indexed DO statements. DO loop continue statements. Nested DO loops and DO-IF structures. Array and Subscripted Variables. Function and Subroutines**.**

Interpolation: [8]

Graphical method, Linear interpolation, least square fitting, Cubic spline fitting, Lagrange's interpolation, Newton's divided difference interpolation, Gregory-Newton difference interpolation

Integration: [8]

Graphical method, integration with Lagrange's interpolation, Newton-cotes expression, trapezoidal rule, Simpson rule, Newton's three-eight rule, Gauss quadrature method, Monte Carlo method.

Solution of differential equations: [6]
Taylor series method, Euler method, Henn method, Runge-Kutta method, Predictor-Corrector method, Runge-Kutta method for second order first degree.

Roots of equations: [6]
Graphical method**,** limits for roots of polynomial equation, Bisectional method, false position method, Newton-Raphson method, Bairstow's method for complex roots.

Solutions of simultaneous equations: [6]
Elimination method, Gauss elimination method, Pivotal Condensation method, Gauss-Jordan method, Matrix inversion method

Eigen values and Eigen vectors: [6]
Determinant of a matrix, Characteristic equation of a matrix, Eigen values and Eigen vectors of a square matrix, power methods, Random numbers

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Suresh Chandra, Computer Applications in Physics with FORTRAN, BASIC and C, (2006) Narosa Publishing House, New Delhi
2. Suresh Chandra, Applications of Numerical Techniques with C, (2006) Narosa Publishing House, New Delhi
3. M.K. Jain, S.R.K.Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 2nd Edition, (1985), Wiley Eastern Limited, New Delhi
4. P.B. Patil and U.P. Verma, Numerical Computational Methods, (2006) Narosa Publishing House, New Delhi
5. K. Shankara Rao, Numerical Methods for Scientists and Engineers, 2nd Edition, (2004), Prentice-Hall of India, New Delhi

Relativistic Quantum Mechanics

PHL 7043 **4-0-0=4**

Unit-I: Second Quantization
Creation and annihilation operators for Bosonic and Ferionic states, Field operators, second quantized operators, (one –particle density operator and kinetic energy operator), pair correlation function (pauli's exclusion principle and Boson consideration).

Unit-II: Klein-Gordon Equation
Klein-Gordon Equation, Plain wave solution, probability current density and equation of continuity, difficulties due to the existence of negative energy states, Correct non on relativistic expression for probability current density, Klein-Gordon equation in electromagnetic field, solution of Klein-Gordon equation for a particle with coulomb potential V_0 (hydrogen atom problem), first order Klein-Gordon equation and its solution.

Unit-III: Dirac Equation:
Derivation of Dirac equation, β-matrices and their anti-commutation relations and their representations, plane wave solutions of Dirac equation (positive and negative energy solutions), Dirac equation with central potential and hydrogen atom problem, existence of electron spin for a Dirac particle.

Unit-IV: Covariance of Dirac Equation:
Covariant form of Dirac Equation, γ-matrices and their properties, γ_5-matrix and properties, Covariance of Dirac Equation under Lorentz transformationsand rotrations, Construction of plane wave solutions of Dirac equation by Lorentz Boost of particle at rest, Bilinear covariants.

Unit-V: Heisenberg Representation in Dirac Theory:
Dirac operator in the Heisenberg representation, Heisenberg equation of motion, constant of motion and spin of Dirac particle, velocity in Dirac theory, Zitterbewegung and negative energy solutions, Presence of negative energy components, Hole theory and charge conjugation.

Recommended Books

1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1st Edition, MacMillan India Ltd
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechanics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Relativistic Quantum mechanics, J. J. Sakurai

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

SPECIAL PAPERS

Electronics Option (IVth Semester)

Special Paper III (Electronics)

PHL 7054 **4-0-0=4**

Unit I

Programming concepts and embedded programming in C and C++ - Review of C++, Software programming in assembly language (ALP) and in High level language 'C', 'C' program elements: Header and source files and preprocessor directives.

Unit II

Program elements: Macros and functions, program elements; Data types, data structures, modifiers, statements, Loops & pointers, Queues, stacks, lists and ordered lists, embedded programming in C++, 'C' program compiler and cross compiler, source code engineering tools for embedded C/C++, optimization of memory needs.

Unit III

Embedded systems: Introduction to embedded systems, an embedded system, processor in the system, other hardware units, software embedded into a system. Exemplary embedded systems, embedded system-on-chip (SOC) and in VLSI circuit.

Processor and Memory Organization: Structural units in a processor, processor selection for a embedded system, memory devices, memory selection for an embedded system, allocation of memory to program segments and blocks, and memory map of a system, direct memory access, interfacing processor, memories and I/O devices.

Unit IV

Devices and Busses for Device networks: I/O devices, timer and counting devices, serial communication using the '12C', 'CAN' and advanced I/O buses between the networked multiple devices. Host system or computer, parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X and advanced buses.

Device Drivers and interrupts servicing mechanism: Device drivers, parallel port device drivers in a system, serial port device drivers in a system. Device drivers for internal programmable timing devices, interrupt servicing (handling) mechanism, context & the periods for the context switching. Deadline and interrupt latency.

Unit V

Real time operating system services - I/O subsystems, network operating systems, real time and embedded system operating system, interrupt routines in RTOS environment, handling of interrupt source call by the RTOS's. RTOS task scheduling models, interrupt latency and response times of the tasks as performance metrics, performance metric in scheduling models for periodic, sporadic and aperiodic tasks. List of basic actions in a preemptive scheduler and expected times taken at the processor. Fifteen-point strategy for synchronization between the processes. ISRs OS functions and tasks and for resource management, OS security issues, Mobile OS.

Real Time Operating System Programming tools: Micro C/OS-II and VxWoks:

a) Need of a well tested and debugged real-time operating system (RTOS).
b) Use of uC/OS-II
c) Use of VxWorks

Case studies of programming with RTOS:

a) Case study of coding for automatic chocolate vending machine using MUCOS, RTOS
b) Case study of coding for sending application layer byte streams on a TCP/IP network using RTOS Vx Works.
c) Case study of an embedded system for an adaptive cruise control system in a car 488.
d) Case study of an embedded system for a smart Card 502

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Starting out with C++, Tony Gladdis (3rd ed.) Dreamtech press
2. Embedded Systems, Architecture, programming and design, TMH, 2005
3. Embedded Microcomputer Systems: real time interfacing, Jonathan W Valvano, Thomson Learning
4. Object oriented programming with C++, E Balagurusamy, 2nd Ed, TMH
5. OOPS with C++ from the foundation, N R Parsa, Dream Tech Press India Ltd
6. Assembly language programming in IBM PC, Peter Norton & John Socha, PHI

Special Paper IV (Electronics)

PHL 7055 **4-0-0=4**

Unit I
Introduction to VHDL - VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process segment part.

Unit II
Process execution. Sequential statements, power of configurations. Behaviour modeling: Introduction to behaviour modeling, transport versus internal delay, internal delay, transport delay, internal delay model, transport delay model, simulation deltas, drivers, driver creation, bad multiple driver model, generics, block statements, guarded blocks.

Unit III
Sequential processing: Process statement, sensitivity list, process example, signal assignment versus variable assignment, incorrect Mux example, correct Mux example, sequential statements, IF statements, CASE statements, Loop statements, NEXT statement, EXIT statement, ASSERT statement, Assertion BNF, WAIT statements. WAIT ON signal, WAIT UNTIL expression, WAIT for time-expression, multiple WAIT conditions. WAIT time-out. Sensitivity list versus WAIT statement, concurrent assignment problem, passive processes.

Unit IV
Networking: Overview of data communication and networking: Introduction, data communication, networks, the internet, protocols and standards, network models, layered tasks. Internet model. OSI model.
Physical layer: Signals, analog and digital, analog signals, digital signals, analog vs digital, data rate limits, transmission impairment, more about signals, digital transmission, line coding block coding, sampling, Transmission mode.

Unit V
Multiplexing, frequency division multiplexing (FDM), Wave division multiplexing, time division multiplexing (TDM), transmission media, guided media, unguided media- wireless, high speed digital access, DSL technology, cable modem, SONET
Wireless LAN's, IEEE 802.11, Bluetooth.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Starting out with C++, by Tony Gladdus (3rd ed.) Dreamtech press
2. Embedded systems, architecture programming and design, TMH 2005
3. VHDL: Programming by example, TMH 4th ed. 2005
4. Data communications and networking by B. A. Forouzan (3rd ed. TMH)

Condensed Matter Physics Option (IVth Semester)

Special Paper III (Condensed Matter Physics)

PHL 7104 **4-0-0=4**

UNIT I: Crystal Growth techniques: Theories of crystal growth, Epitaxy, Thin films and coatings; Thin Film deposition, Vacuum evaporation, Chemical Vapour deposition, Thermal oxidation, Plasma deposition, and Sputtering, Homogeneous and heterogeneous nucleation

UNIT II: Surface and Bulk Characterization techniques for materials, Rheology, Differential scanning calorimetry (DSC), Thermal gravimetric analysis (TGA).

UNIT III: X-ray diffraction: X-ray spectrum, x-ray generating equipments, powder and single crystal diffractometer.

UNIT IV: Basic properties and uses of ESCA, FTIR and RBS, Raman Spectroscopy, UV-Visible Spectroscopy, Applications of laser and neutrons in material characterization.

UNIT V: Qualitative description of Atomic force microscopy, Scanning probe microscopy, and Optical Microscopy. Introduction to electron microscopy, electron diffraction. Transmission electron microscopy (TEM), and Scanning electron microscopy (SEM)

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Fundamental of Renewable Energy Process by Aldo V. DA ROSA.
2. Environmental and Natural Resource economics by Tom Tietenberg.
3. Applied Physics of Solids by Rajnikant, Wiley International
4. Fundamental of Renewable Energy Sources by G.N.Tiwari, M.K.Ghosal.

Special Paper IV (Condensed Matter Physics)

PHL 7105 **4-0-0=4**

UNIT I: Effects of confinement and finite size zero, one and two dimensional nanostructures.

UNIT II: Concepts of surface and interfacial energies, intermolecular and interfacial forces in organic, polymeric, biological and aqueous systems-Vander Waals, electrostatic, double layer, acid base, depletion interactions, hydrophobic force.

UNIT III: Mesoscale thermodynamics, Gibbs treatment of interfaces, mesoscale fluid dynamics, thin soft films, mesoscale phenomena in soft matter and applications: adhesion, wetting, nucleation.

UNIT IV: Nanofabrication: pattering of soft materials by self organization and other techniques, chemical self assembly, artificial multilayers, cluster fabrication, Langmuir-Blodget growth, nanolithography, scanning probe lithography, microcontact printing, intercalation, attrition, ion implantation gas phase condensation, chemical vapour deposition.

UNIT V: Nanosuspensions- ferrofluids, compaction of nanocrystalline materials, carbon nanotubes, short and long term applications and perspectives, demonstration of some techniques in preparation and characterization of nanomaterials.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Introduction to Nanotechnology, C.P. Poole Jr., F.J. Owens,Wiley (2003).
2. Nanosystems, K.E. Drexler, Wiley (1992).
3. The Physics of Low-Dimensional Semiconductors, John H. Davies, Cambridge University Press, 1998.
4. S. Datta, Electronic Transport in Mesoscopic Systems: Cambridge University Press, 1995.
5. K. L. Chopra, Thin Film Phenomena, Mcgraw Hill, 1968.
6. Applied Physics of Solids by Rajnikant, Wiley International
7. Jackie Ying, Nanostructured Materials, Academic Press, 2001.
8. M.Ohring, Materials science of Thin Films, Academic Press, 1992.
9. Surface Science, K.W. Kolasinski, John Wiley, 2002.
10. J.H. Fendler, Nanoparticles and Nanostructured Films, Springer, 2000.
11. D.L. Smith, Thin Film Deposition, Mcgraw Hill, 1995.