PRINCIPAL SUBJECT AREA

PHYSICS

300 LEVEL COURSES

PH 304 Relativity (2 credits)
Background, Postulates of Special Relativity, Derivation of Lorentz Transformation equations, Consequences of LT Equations. Relativistic Dynamics, Relativity and Electromagnetism, Invariance of Maxwell's equations, Possible limitation of special relativity; Special Topics: Geometric representation of space-time; Solutions of twin paradox; Principle of equivalence and General Relativity.

Recommended Texts:
1. Resnick, Robert, *Introduction to special Relativity* (1968), John Wiley & sons
2. French, A.P., *Special Relativity* (1990), Chapman & Hall, 2nd ed

PH 313 Physical Optics and Optical instruments (2 credits)
Interference, Diffraction, Polarization, Lasers. Introduction to optical Instruments: Holography, Opticall spectroscopy, Fibre optics: Optical fibers and their importance, Different types, Inter model dispersion, Fiber modes, signal attenuation, Basics of optical fiber communications; Display devices: Neon displays, Cathode ray tube, liquid crystals, LED's, Electrocrhromic and photochromic, devices, Laser writing and reading.

Recommended Texts:
1. Jenkins, F.A. and White, H.E., *Fundamentals of Optics* (1975), McGraw-Hill, 3rd ed
2. Longhurst, R.S., *Geometrical and Physical Optics* (1967, 1973), Longman, 3rd ed
3. Fowles, G.R., *Modern Optics* (1989), Dover publications, 2nd ed, New York

PH 323 EM Waves and Communication (2 credits)
Summary of vector algebra. Maxwell's equations, Properties of plane e-m waves in free space, Poynting's theorem, Waves in ponderable media, Radio and TV transmission. : polarization of em waves, dipole antennas, wireless communications, transmission line theory and concepts, antennas and equivalent principles.

Recommended Texts:
1. Lorrian and Carson, *Electromagnetic fields and Waves* (1988),W.H. Freeman company, 3rd ed
2. Kong, J.A., *Electromagnetic Wave Theory*, EMW 2000.
3. Griffiths, David J., *Introduction to Electrodynamics* (!989), Prentice Hall, 2nd ed

PH 333 Introductory Nuclear Physics (2 credits)
Compulsory for Special Degree
***Distribution of Nuclear matter*:** α -particle scattering: Rutherford's formula, differential cross-session; other experimental evidence for the nuclear structure; nuclear density variation; nuclear radius; skin thickness; ***Nuclear Binding energy*:** neutron and proton separation energies; features of binding energy curve; liquid drop model; semi empirical mass formula; nuclear stability of isobars; ***Nuclear Reaction*:** reaction energy; threshold energy; exothermic and endothermic reactions; ***Nuclear Decay*:** conservation laws; α - decay: basic α-decay processes, energy release, theory of α-emission; β-decay: basic β-decay process, energy release, β-spectrum, neutrino, electron capture; γ-decay: nuclear excited states, internal conversion, isometric states; ***Nuclear Fission*:** spontaneous fission, activation energy, explanation using semi empirical formula, induced fission, mass distribution of fragments, energy released, neutrons emitted, chain reaction, fission reactors; ***Nuclear Fusion*:** basic process, characteristics of fusion thermonuclear fusion, fusion reactors.

Recommended Texts:
1. Krane, K.S., *Introductory Nuclear Physics* (1998), John Wiley & sons
2. Evans, *Introduction to Nuclear Physics*.
3. Burcham, *Nuclear Physics* (1995), Longmn group limited, U.K

PH 334 Introductory Particle Physics (1 credit)

Introduction*:** standard model, leptons, quarks and gauge bosons; fundamental interactions; relativistic wave equations; Dirac's interpretation of particles and antiparticles; introduction to Feynman diagram; ***Production of charged particles: charge particle accelerates, center of mass energies; charge particle detectors; ***Leptons and Quarks*:** hadrons; quantum numbers; strangeness, charm and beauty, hypercharge space- time symmetries and conservation laws; spin, parity, charge conjugation, time reversal CP invariance and the CPT theorem; ***Isospin and the Quarks model*:** mass splitting of hadrons; Y - I_3 diagrams for mesons, and quarks and baryons; colour and colour confinement, introduction to quantum chromo dynamics (QCD) and gluons; weak interaction, $W^{\pm}$ and Z^{O} bosons, charge current and neutral current reactions; search for the top quarks grand unification of fundamental interactions; Nuclear and particle astrophysics and the big bang.

Recommended Texts:

1. Martin, R. and Shaw, G., *Particle Physics* (1992), John Wiley & sons
2. Fraunfelder and Henley, *Sub-atomic Physics* (!974), Prentice Hall, New Jersey

PH 341 Semiconductor Physics and Devices (2 credits)

Conductors, insulators and semiconductors, thermal equilibrium, carrier life time, diffusion, mobility and its measurements; Band structure in semiconductors, Semiconductor junctions: theory of p-n junction, capacitance, work function, Schottky barriers, avalanche and Zener breakdown, homo and hetero junctions, ohmic contacts, thermionic emission; Introduction to Simple devices and Fabrication: LED, Solar cell, and LSR. Elemental semiconductors, III-IV, II-VI and ternary compounds; Growth and characterisation of semiconductor materials. Bipolar transistor, JFET, and MOSFET. Optical Devices: Photodetectors, Photodiodes, LEDs, Laser diodes, Solar cells and Quantum well devices.

Recommended texts:

1. Sze, S.M., *Physics of Semiconductor Devices* (1981), John Wiley & sons, 2^{nd}ed
2. Neamen, D.A.,*Semiconductor Physics and Devices* (1992), Richard D.Irwin,U.S.A
3. Allison, E*lectronic Engineering Materials and Devices*.

PH 345 Electronics Theory II (2 credits)

(Prerequisites: PH245, PH285)

Advanced BJT circuits, Ebers-Moll equation. Differential amplifier; G_{diff}, G_{CM}, CMRR, dc amplifier, current mirrors and applications, power amplifiers; Miller effect; bootstrapping; Field Effect Transistor; JFET; I_C, V_{DS} characteristics, comparison with BJT, FET current source; FET amplifiers; FET as a variable resister; , FET switches; multiplexes, sample and hold, MOSFET logic switches; PMOS, NMOS, CMOS, CMOS inverter, CMOS logic gates, NAND and NOR circuits, MOSFET power switching; Op Amp; logarithmic amplifier, Schmitt trigger, op amp departure from ideal; instrumentation amplifier; power supplies; ac-to-dc conversion, IC regulators, switching regulators, dual power supplies, dc-to-dc conversion; batteries, solar cells; oscillators; relaxation oscillator, sinusoidal , Wien bridge, LC , IC and crystal oscillators, timer chip 555; unwanted oscillations in electronic circuits, phase-locked loops, Integrating logic families.

Recommended Texts:

1. Horowitz, P. and Hill,W., *The Art of Electronics* 2^{nd} ed. (1989),Cambridge Uni. Press, 2^{nd}.
2. Malvino, A.P., *Electronics Principles* 5^{th} ed. (1953), McGraw-Hill
3. Lenk, J.D., *Simplified Design of Linear Power Supplies*.

PH 350 Microstructure and Properties of Materials (2 credits)

(Prerequisite: PH240)

Structure–Property relations, Elastic and plastic behaviour, microplasticity of single crystals, behaviour of polycrystalline materials; fracture and creep theories. Mechanical testing of materials, Microstructure and properties, phase diagrams, phase equilibria, nucleation and growth, non-equilibrium phase transformation, some commercial alloy and ceramic systems.

Recommended Texts:

1. Lovell, M., Avery, A. and Vernon, M., *Physical Properties of Materials*.
2. Moffat, W.G., Pearsall, G.W. and Wulff, J.,*The Structure and Properties of Materials*.
3. Bolton, W., *Engineering Materials Technology* (1998), Butterworth-Heinemann, 3^{rd}ed.

PH 361 Biophysics (2 credits)
Cell: introduction to cell, biopolymers, biomembranes, Biophysics of transport of matter in biosystems: diffusion, Fick's law, diffusion through membranes, compartment systems, flow of fluids, Stokes's law, Hagen-Poiseuill's law, Reynolds number; Thermodynamics of biosystems: equilibrium thermodynamics, Gibbs free energy, chemical potential; Neurobiophysics: neurons, membrane potential, transference equation, electric analog of membrane, nerve excitation, action potential, conduction of action potential; Bioenergetics: photosynthesis; Radiation biology: biological effects of radiation, ionization radiation and biomaterials, radiation safety.

Recommended Texts:
1. W.Hoppe, W. Lohmann (1983) *Biophysics*), Springer-Verlag Berlin Heidelberg.
2. M.J. Cotterill (2002) *Biophysics: An Introduction*, JOHN Wiley & Sons Ltd.
3. P.K. Srivastava (2005) *Elementary Biophysics*, Narosa Publishing House.
4. R. Glaser (1996) B*iophysics*, Springer-Verlag Berlin Heidelberg.

PH 363 Astrophysics (1 credit)
Physics prelude: orbits in and outside solar system, special relativity, particles, forces, stars, radiation processes, cosmology; The solar system, Stars, HR diagram. The Milky Galaxy: preview, interstellar medium, evolution and death of stars, The Universe: galaxies beyond Milky Way, large scale structure of the universe, active galaxies and quasars, cosmology.

Recommended Texts:
1. Zeilik, Michael and Gregory, Stephen A., *Introductory Astronomy and Astrophysics* 4th Ed. (1998), Saunders College, 4thed
2. Shu, Frank, *The Physical Universe*.

PH 364 Physics of Weather and Climate (1 credit)

PH 370 Mathematical Methods in Physics (2 credits)
Vectors, coordinate systems, determinants; matrices; infinite series; Ordinary differential equations, Method of Lagrange multipliers; Legendre transformations. Functions of complex variables; Partial differential equations; Legendre, Bessel, Hermite, Laguerrer and Special functions; Fourier series ; Integral transformations: Laplace and Fourier transformations; Green's function; Calculus of variations, Tensors.

Recommended Texts:
1. Arfken, George B., *Mathematical methods for Physicists* (1995),Academic press,2nded
2. Boas, Mary L., *Mathematical Methods in the Physical Science* (1993), John Wiley & sons, 2nded

PH 373 Computational Physics (2 credits)
Basic mathematical operations, ordinary differential equations, boundary value and eigan value problems, special functions of Gaussian quadrature, partial differential equations, Monte Carlo methods.

Recommended Texts:
1. Koonin, Steven E.,*Computational physics* (1986),Addision -Weley pub.

PH 374 Experimental Techniques and Material Characterization (2 credits)
Introduction to experimentation, Topics of current interest: High vacuum techniques, cryogenics: Electron microscopy: SEM and TEM, Analytical microscopy; XRD, XRF, SIMS, AES etc. Optical Techniques: Optical reflectivity, Absorption and Modulation techniques, Monochromators and Spectrophotometers. FTIR and Raman techniques; Electrical Techniques: Electrical conductivity, Four probe method, Impedance analysis, I-V, C-V techniques. Thermal techniques.

Recommended Texts:
1. Preston,D.W and Dietz,E.R., *The Art of Experimental Physics*
2. Baird,D.C., *Experimentation: An Introduction to Measurement theory and Experimental Design*
3. Grundy, P.J. and Jones, G.A., *Electron Microscopy and the Study of Materials*

PH 375 Nanoscience (2 Credits)
(Prerequisites: CH 231 or PH 230)

Introduction: Why size matters, Units Review. ***The Scaling Laws:*** How size alters the dynamics of electricity, optics, heat transfer. ***Scanning Probe Microscopy:*** Atomic Force Microscopy, Dipole-dipole interaction, Laser-detecting mechanism, Force-distance curves, Scanning Tunneling Microscopy, Tunneling mechanism, Imaging atoms, Lithography. ***Carbon Nanotubes:*** Fabrication and Characterization, Electronic structure, Optical and mechanical properties, Examples of applications using nanaotubes. ***Quantum Dots:*** Schrodinger's Equation for confined systems, Electronic states and transitions, Density of states, Plasmon resonance in metallic dots, Fabrication methods, Applications of quantum dots in optics, electronics & Biology. ***Self Assembly:*** Thermodynamics of self-assembly, Examples of self assembly on silicon and gold substrates, Soft lithography, Porous materials, Optical anisotropy and its detection. ***Photonic Crystals:*** Maxwell's equations for periodic structures, Dispersion relationship, Growth and Characterization, Opals and inverse-opals, Defect-layer based structures.

Recommended Texts:

1. The Physics and Chemistry of Nanosolids, Frank Owens and Charles Poole, John Wiley, 2008
2. Fundamentals of Nanoelectronics, George Hanson, Pearson, 2008
3. Nano-The Essentials, T. Pradeep, McGraw Hill, 2008

PH 380 General Physics Laboratory III (1 credit)
(Prerequisites: PH 103 & PH 104)

PH 381 General Physics Laboratory IV (1 credit)
(Prerequisites: PH 103 & PH 104)
Compulsory only for General degree students who are not offering Electronics Laboratory-I

PH 383 Advanced Physics Laboratory I (2 credits)
(Prerequisites: PH 280 & PH 281)

PH 384 Advanced Physics Laboratory II (2 credits)
(Prerequisite: PH 383)

PH 385 Electronics Laboratory II (1 credit)
(Prerequisites: PH 245, PH 285)

PH 392 Seminar (1 credit)
A student is expected to carry out an extensive literature survey on a topic assigned to him/her by a senior faculty member. At the completion of the project the student is expected to write a report of not less than twenty pages and make a presentation.

PH 395 Industrial Training (1 credit)