PHYSICS CURRICULUM

Semester 1

PH 101: Introductory Physics I - Mechanics, oscillations and waves (2:1)

Physical quantities, measurements and vectors, Kinematics: Description of Motion, The Laws of Motion, Simple applications of the laws of motion, Work and Energy, Linear momentum and collisions, Rigid bodies and Angular momentum, Universal Gravitation, Simple harmonic motion, Waves-I, Small oscillations and Solid mechanics, Fluid mechanics, Waves-II, Nonlinear dynamics

Semester 2

PH 102: Introductory Physics II – Electricity, Magnetism and Optics (2:1)

Charges, Electric Fields and Gauss's law, Electric Potential, Electrostatics Laws in differential form, Capacitance and Dielectrics, Currents, Resistance, EMF and RC circuits, Magnetic Fields, Sources of Magnetic Fields, Electromagnetic Induction, Inductance and AC circuits, Electromagnetic Waves, Light and the Laws of Geometric Optics, Image Formation, Interference of Light Waves, Diffraction and Polarization

Semester 3

PH 103: Introductory Physics III - Thermal and Modern Physics (2:1)

Temperature, The First Law of Thermodynamics, Kinetic Theory of Gases and Maxwell -Boltzmann Statistics, Heat Engines, Entropy and the Second Law of Thermodynamics, Relativity, Introduction to Quantum Physics, Basics of Quantum Mechanics, Atomic , Molecular and Solid state Physics, Nuclear Physics, Particle Physics and Cosmology

Text books:

Serway and Jewitt, Physics for Scientists and Engineers (7th Edition)
Young and Friedman, University Physics (12th Edition)
Halliday, Resnick and Walker, Fundamentals of Physics, Extended (8th Edition)
Harris Benson , University Physics, Revised Edition

Semester 4:

PH 112: Intermediate Mechanics, Oscillations and Waves (2.1) (Core)

Newton's Laws of Motion, Energy, Motion of Projectiles and Charged Particles, Momentum and Angular Momentum, Two Body Central Force Problems, Collision Theory, Relativistic Mechanics, Rotational Motion of Rigid Bodies, Lagrangian and Hamiltonian Formulations of Mechanics, Small Oscillations, Coupled Oscillators and Normal Modes, Continuum Mechanics of solids and fluids, Mechanics in Non-inertial Frames.

Text books:

Stephen T. Thornton and Jerry B. Marion: *Classical Dynamics of Particles and Systems*
Kleppner and Kolenkov: *An Introduction to Mechanics*
Mahendra K Verma: *Introduction to Mechanics*

PH 114: Intermediate Electromagnetism and the Quantum Physics of Radiation (2.1) (Core)

Maxwell ‘s Equations in free space, Electrostatics, Electric fields in matter, Magnetostatics, Magnetic fields in matter , Electrodynamics, Electromagnetic Waves in Vacuum, Electromagnetic Waves in Media, Relativistic Electrodynamics, Recap of Basics of Quantum Physics, Quantum theory of EM waves, Atomic Transitions and Radiation, Lasers and Applications, Electrons in a magnetic Field.

Text books:

D J Griffiths, *Introduction to Electrodynamics*

Robert Eisberg and Robert Resnick , Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles

PH 116: Intermediate Thermal Physics and the Physics of Materials (2.1) (Core)

Free energies, Phases and phase transitions, Van der Walls gas and the liquid gas transition, Magneto-thermal and Electro-thermal effects, Ensembles and rules of Statistical Mechanics, The Ideal Maxwell-Boltzmann Gas, The Ideal Fermi Gas, The Ideal Bose Gas, Elements of time dependent statistical Mechanics, Crystal Structure, Lattice Vibrations, Mechanical and Thermal properties, Band Theory of electrons in Crystalline solids, Magnetic Properties of materials.

Text book: Arthur Beiser: Concepts of Modern Physics

Core Physics courses, required for physics majors, from among existing courses:

Semester 5:

PH 201 Classical Mechanics	2:1
PH 203 Quantum Mechanics I	2:1
PH 205 Mathematical methods of Physics	2:1

Semester 6:

PH 202 Statistical Physics I	2:1
PH 204 Quantum Mechanics II	2:1
PH 206 Advanced level Electromagnetism and Optics	2:1

Semester 7:

PH 211 Condensed matter physics I	2:1
PH 215 /HE 215 nuclear and particle physics	2:1
PH 217 Fundamentals of astrophysics	2:1

Semester 8 will be devoted entirely to a research project (0:16). Alternatively, the research project may be started in the summer between Semesters 6 and 7, and completed during Semester 8. This will allow a student to take a few advanced elective courses in Semester 8. Elective courses can be chosen, in consultation with the student's Academic Advisor, from among the PH 200 or 300 level courses, or any other 200 or 300 level course from other Streams or

from the Engineering Departments, as listed in the IISc Scheme of Instructions. The PH course list is given below.

PH 213 0:4 Advanced Experiments in Condensed Matter Physics
PH 316 / HE 316 3:0 Advanced Mathematical Methods
PH 320 3:0 Condensed Matter Physics II
PH 322 3:0 Molecular Simulation
PH 325 3:0 Advanced Statistical Physics
PH 326 3:0 Principles & Techniques of Magnetic Resonance I
PH 327 3:0 Principles & Techniques of Magnetic Resonance II
PH 330 0:3 Advanced Independent Project in Physics
PH 347 2:0 Bioinformatics
PH 350 2:0 Soft Matter Physics
PH 351 2:0 Crystal Growth and Characterization
PH 352 3:0 Semiconductor Physics and Technology
PH 353 3:0 Principles of Magnetism in Solids
PH 359 3:0 Physics at the Nanoscale
PH 360 3:0 Biological Physics
PH 340 4:0 Quantum Statistical Field Theory
HE 392 / PH 392 3:0 Standard Model of Particle Physics
PH 395 / HE 395 3:0 Quantum Mechanics III
PH 396/ HE 396 3:0 Gauge Field Theories