Physics Core Curriculum at IIT-Mandi will consist of a total of 11 credits.

PH101 : Foundations of Classical Mechanics

(3 credits lecture course in the 1st semester)

PH101P: Physics Laboratory 1

(1 credit lab course in the 1st semester)

PH102: Foundations of Electrodynamics

(3 credits lecture course in the 2nd semester)

PH102P: Physics Laboratory 2

(1 credit lab course in the 2nd semester)

PH201: Methods of Contemporary Physics

(3 credits lecture course in the 3rd semester)

In the 'August-December, 2010' semester, the courses PH101 and PH201 will be offered, respectively to the 1st and 3rd semester students. PH101 will be offered by PCD and PH201 by HRV/PJ/BR/.

The general plan of the two lecture based courses that will be offered in the August-December 2010 semester is appended below.

PH 101: Foundations of Classical Mechanics

– this course will be offered by P.C.Deshmukh

This 3-credit course is to be given over 14-weeks of instruction providing for 42 lecture hours.

A schedule for the 40 classes is given below, leaving two hours for two '1-hour' quizzes.

Unit 1: Equations of Motion. Principle of Causality and Newton's I & II Laws. Interpretation of Newton's 3rd Law as 'conservation of momentum' and its determination from translational symmetry. Alternative formulation of Mechanics via 'Principle of Variation'. Determination of Physical Laws from Symmetry Principles, Symmetry and Conservation Laws. Lagrangian/Hamiltonain formulation. Application to SHO.

Unit 1 is to be covered in 5 Lectures & 2 tutorials

Unit 2: Oscillations. Small oscillations. SHM. Electromechanical analogues exhibiting SHM. Damped harmonic oscillator, types of damping. Driven and damped & driven harmonic oscillator. Resonance, Quality Factor. Waves.

Unit 2 is to be covered in 4 Lectures & 2 tutorials

Unit 3: Plane polar, cylindrical polar and spherical coordinate systems.

Motivation: Description of planetary motion in solar system, and other dynamics wherein the central interaction has a center of symmetry, or at least an axis of symmetry.

Unit 3 is to be covered in 3 Lectures & 1 tutorials

Unit 4: Kepler Problem. Laplace-Runge-Lenz vector, 'Dynamical' symmetry. Relationship between 'Conservation principle' and 'Symmetry'.

Unit 4 is to be covered in 2 Lectures & 1 tutorials

Unit 5: Inertial and non-inertial reference frames. Pseudo forces. Centrifugal and Coriolis acceleration. Period of 'plane of oscillation' of the Foucault pendulum.

Unit 5 is to be covered in 3 Lectures & 1 tutorials

Unit 6: Galilean & Lorentz transformations. Introduction to 'Special Theory of Relativity'. Time dilation and Lorentz contraction. Twin paradox.

Unit 6 is to be covered in 2 Lectures & 1 tutorials

Unit 7: Physical examples of fields. Potential energy function. Gradient, Directional Derivative, Divergence of a vector field.

Unit 7 is to be covered in 2 Lectures & 1 tutorial

Unit 8: Gauss' Law; Equation of Continuity. Hydrodynamic and Electrodynamic illustrations.

Unit 8 is to be covered in 2 Lectures & 1 tutorial

Unit 9: Fluid Flow, Bernoulli's Principle. Equation of motion for fluid flow. Definition of curl, vorticity, Irrotational flow and circulation. Steady flow. Bernoulli's principle, some illustrations. Introduction to applications of Gauss' law and Stokes' theorem in Electrodynamics.

Unit 9 is to be covered in 3 Lectures & 1 tutorial

Unit 10: Chaos: Complex behavior of simple systems. Malthus and Verhulst population models. Logistic map difference equation. Bifurcation, period doubling, Feigenbaum constant. Lorenz/strange attractor. Fractal/Hausdorff dimension. Mandelbrot set.

Unit 10 is to be covered in 3 Lectures & 1 tutorial

In addition to PH101 lecture based 3-credits course, I semester students will have a 3-hours laboratory once each week.

The curriculum for PH201 course, for II year students now entering their 3rd semester, is appended below.

PH 201: Methods of Contemporary Physics

This 3-credit course is to be given over 14-weeks of instruction providing for 42 lecture hours.

A schedule for the 40 classes is given below, leaving two hours for a two '1-hour' quizzes.

Unit 1: Quantum Theory – Beginnings!

Success of Bohr's 'old quantum theory' in explaining Balmer-Rydberg's empirical formula describing the hydrogen atom spectrum. Planck's radiation formula.

Unit 1 is to be covered in 2 Lectures & 1 tutorials

Unit 2: What is 'quantization'

Difficulty in using classical equation of motion to describe evolution of the state of a system. Introduction of alternative method to describe the state of the system using Hilbert state vectors instead of using point (q,p) in phase space. Quantization as using operators instead of classical dynamical variables, and the algebra of linear vector space. Matrix representation of operators.

Unit 2 is to be covered in 2 Lectures & 1 tutorials

Unit 3: Uncertainty principle. Quantitative determination of 'uncertainty' as root-mean-square deviation. Algebra of commuting and non-commuting operators.

Unit 3 is to be covered in 2 Lectures & 1 tutorials

Unit 4: One-dimensional problems. Illustration of the uncertainty principle resulting in penetration past potential barriers.

Unit 4 is to be covered in 3 Lectures & 1 tutorials

References for Units 1-4: Merzbacher- Quantum Mechanics; Sakurai – Modern Quantum Mechanics

Unit 5: Statistical Basis of Thermodynamics. Elements of Ensemble Theory.

Reference: First two chapters of 'Statistical Mechanics' by R.K.Pathria

Unit 5 is to be covered in 3 Lectures & 1 tutorials

Unit 6: Quantum Statistics.

Reference: Chapter 11 of 'Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles' by Eiseberg and Resnik

Unit 6 is to be covered in 3 Lectures & 1 tutorials

Unit 7: Quantum Mechanics of Atoms and Molecules

Reference: Chapter 7 & 12 of 'Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles' by Eiseberg and Resnik

Unit 7 is to be covered in 4 Lectures & 2 tutorials

Unit 8: Solids – conductors and semiconductors.

Reference: Chapter 13 of 'Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles' by Eiseberg and Resnik

Unit 8 is to be covered in 3 Lectures & 1 tutorials

Unit 9: Introduction to Nuclear and Particle Physics

Reference: Chapter 15, 16, 17 of 'Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles' by Eiseberg and Resnik

Unit 9 is to be covered in 4 Lectures & 1 tutorials

Unit 10: Introduction to some problems of contemporary interest

Laser cooling of atoms and BEC, Nanoscience

Reference: 'Atomic Physics' by C.Foot; 'Nano – the essentials' by T.Pradeep

Unit 10 is to be covered in 3 Lectures & 1 tutorials

- P. C. Deshmukh

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