| Plan No. | | | | M |
|---|---|---|---|---|

# The Master Program in Physics – Thesis Track (2011/2012)

## Offered Degree: Master in Physics

1) General Rules and Conditions:

- This Plan confirms to the regulations of the general frame of the higher graduate studies programs.
- Areas of specialty of admission in this program:
  - Holders of the Bachelor degree of Science in Physics
- The Student should study the elective course in the field of his thesis object.

2) Special Conditions: None

3) The Plan: Studying a total of (33) credit hours as follows

| Course No. | Course Title | Theoretical hrs | Experimental hrs | Credit hrs | Pre-Requisite |
|---|---|---|---|---|---|
| ❖ Obligatory Courses: (15 credit hours) | | | | | |
| 0342751 | Classical Mechanics-1 | 3 | - | 3 | - |
| 0362753 | Classical Electrodynamics-1 | 3 | - | 3 | - |
| 0332754 | Quantum Mechanics-1 | 3 | - | 3 | - |
| 0342756 | Statistical Mechanics-1 | 3 | - | 3 | - |
| 0322781 | Mathematical Physics-1 | 3 | - | 3 | - |
| ❖ Elective Courses: (9 credit hours) | | | | | |
| 0352712 | Advanced practical Physics | 1 | 5 | 3 | |
| 0352752 | Computational Physics | 3 | - | 3 | - |
| 0352762 | Atomic and Molecular Physics-1 | 3 | - | 3 | 0332754 |
| 0332763 | Nuclear Physics-1 | 3 | - | 3 | - |
| 0302765 | Theory of Relativity | 3 | - | 3 | - |
| 0352771 | Solid State Physics-1 | 3 | - | 3 | - |
| 0302775 | Properties of Materials | 3 | - | 3 | - |
| 0352792 | Special Topics in Physics | 3 | - | 3 | - |

❖ Preparing an Approved Thesis (0302799) assigned (9) credit hours and passing its defense.

# Transient Plan of the Courses for M.Sc. in Physics

| Old Study Plan (2005/2006) | | | New Study Plan (2011/2012) | | |
|---|---|---|---|---|---|
| Course No. | Course Title | Credit hrs | Course No. | Course Title | Credit hrs |
| 0302711 | Methods in Practical Physics | 3 | | | |
| | | | 0352712 | Advanced Practical | 3 |
| 0332751 | Classical Mechanics | 3 | 0342751 | Classical Mechanics-1 | 3 |
| 0352752 | Computational Physics | 3 | 0352752 | Computational Physics | 3 |
| 0342753 | Classical Electrodynamics-1 | 3 | 0342753 | Classical | 3 |
| 0302754 | Quantum Mechanics 1 | 3 | 0332754 | Quantum Mechanics-1 | 3 |
| 0342756 | Statistical Mechanics-1 | 3 | 0342756 | Statistical Mechanics-1 | 3 |
| 0332757 | Nonlinear Physics | 3 | | | |
| 0352762 | Atomic and Molecular Physics | 3 | 0352762 | Atomic and Molecular | 3 |
| 0332763 | Nuclear Physics-1 | 3 | 0332763 | Nuclear Physics-1 | 3 |
| 0342756 | Detecting and Measuring Radiation | 3 | | | |
| | | | 0302756 | Theory of Relativity | 3 |
| 0302771 | Solid State Physics | 3 | 0352771 | Solid State Physics-1 | 3 |
| 0302773 | Physics of Condensed Matter | 3 | | | |
| | | | 0302775 | Properties of Materials | 3 |
| 0352781 | Mathematical Physics (1) | 3 | 0322781 | Mathematical Physics-1 | 3 |
| 0342791 | Methods in Theoretical Physics | 3 | | | |
| 0352792 | Special Topics in Physics | 3 | 0352792 | Special Topics in Physics | 3 |
| 0302799 | Thesis | 9 | 0302799 | Thesis | 9 |

# Course Description (M.Sc. in Physics)

## (0352712) Advanced Practical Physics

3 Credit hrs

Pre-requisite: None

This course starts with an introduction on experimental methods and measurements. Then, a set of experiments based on the research facilities in the department should be carried out by the students after they become familiar with the relevant research methodology. A paper should be submitted including the data analysis, results and discussions, and the conclusions of each experiment. The course schedule consists of one theoretical hour a week for lecturing, and five practical hours a week for experimental work.

## (0342751) Classical Mechanics-1

3 Credit hrs

Pre-requisite: None

Constrained Motion and Generalized Coordinates; D'Alembert's Principle and Lagrange's Equations; Calculus of Variations; Hamilton's Principle and Lagrange's Equations; Forces of Constraints; Symmetry Principles and Conserved Quantities; Rotation of Rigid Bodies and Orthogonal Transformations; Euler's Angles; Motion in Rotating Systems and The Coriolis Effect; Angular Momentum and Kinetic Energy of Motion About A Point; The Inertia Tensor; Euler's Equations of Motion; Torque-Free Motion of a Rigid Body; Rotation of The Symmetrical Top About A Fixed Point; Formulation of the Problem of Small Oscillations; Normal Coordinates and Normal Modes; Coupled Problem and Applications.

## (0352752) Computational Physics

3 Credit hrs

Pre-requisite: None

Apply computer in basic algebraic and numerical computational methods for modeling and simulation of some physical systems. Develop computer algorithms to solve problems in various disciplines of physics. Write computer routines for numerical integration and for solving linear and non-linear equations, ordinary and partial differential equations. Handle, analyze, and plot any numerical data base.

## (0362753) Classical Electrodynamics-1

3 Credit hrs

Pre-requisite: None

Introduction to Electrostatics; Boundary-Value Problems in Electrostatics; Multipoles; Magnetostatics; Time-Dependent Fields and Maxwell's Equations.

## (0332754) Quantum Mechanics-1

3 Credit hrs

Pre-requisite: None

Stern-Gerlach Experiment and the Inadequacy of Classical Physics; Hilbert Space and the Mathematical Structure of Quantum Mechanics Representation of Operators; Time Evolution Operator; The Schrödinger and Heisenberg Pictures; Gauge Transformations; Particle in a Central Potential; Formal Theory of Angular Momentum; Eigen Values and Eigen States of Angular Momentum; Orbital Angular Momentum; Stationary Perturbation Theory and Applications. Variational Method and Applications.

## (0342756) Statistical Mechanics-1

3 Credit hrs

Pre-requisite: None

Contact Between Statistics and Thermodynamics; The Entropy of Mixing and the Gibbs Paradox; Phase Space and Liouville's Theorem; The Microcanonical, Canonical and Grand Canonical Ensemble; Partition Function; Quantum States; Deriving the Distribution Functions for a Classical gas, Fermi Gas, and Bose Gas; Thermodynamics of Ideal Gases; Energy Fluctuations; Statistics of a System of Harmonic Oscillators; Paramgnetism; Magnetic cooling; A System of Molecules with Internal Motion.

## (0352762) Atomic and Molecular Physics-1

3 Credit hrs

Pre-requisite: 0332754

General Review of Quantum Mechanics; Time Independent Perturbation Theory; Time Dependent Perturbation Theory; The Dirac Equation: The Hydrogen Atom, Electric and Magnetic Fields. Variational Techniques and Applications to Multi-Electron atoms. Molecular Physics: The Molecular Potential, Rotational-Vibrational Spectrum.

## (0332763) Nuclear Physics-1

3 Credit hrs

Pre-requisite: None

Hadrons: Nucleons, Pions, Isospin, Strangeness and Hypercharge. Properties of Nuclear Forces; Two-Nucleon System: Electrostatic Multipoles, Properties of the Deuteron, Partial Wave Expansion, Low Energy Scattering, Effective Range Expansion. General Properties of Nuclei. Nuclear Models: Shell Model; Magnetic Dipole and Electric Quadrupole Moments , Fermi-Gas Model. Radioactivity: Decay Chains, Secular Equilibrium, Theory of Alpha Emission.

## (0302765) Theory of Relativity

3 Credit hrs
Pre-requisite: None

Revision of Special Relativity and Lorentz transformation. Tensor Algebra; Integrals, Densities, Derivatives and Covariant Derivatives. The Notion of Parallel Transport; The Curvature Tensor. The Geodsics of an Affine Connection; The Law of Gravitation; Metric; Conservation Laws and Variational Principles in General Relativity.

## (0352771) Solid State Physics-1

3 Credit hrs
Pre-requisite: None

The Drude's Theory of Metals; The Sommerfeld Theory of Metals; Crystal Lattice; The Reciprocal Lattice; X-Ray Diffraction for Structure Determination; Symmetry Operations and Crystal Systems; Electron Levels in a Periodic Potential; Nearly Free Electrons in a Week Periodic Potential; Fermi Surface and Brillouin Zones; Classification of Solids; Cohesive Energy.

## (0302775) Properties of Materials

3 Credit hrs
Pre-requisite: None

Transformations, Symmetry Elements and Point Groups; Thermodynamics and Magnetoelectric Effect; Pyroelectricity; Dielectric Properties; Mechanical Properties; Thermal Expansion; Piezoelectricity; Magnetic Phenomena; Electrical Resistivity; Thermal Conductivity; Diffusion and Ionic Conductivity; Galvanomagnetic and Thermomagnetic Phenomena; Thermoelectricity.

## (0322781) Mathematical Physics-1

3 Credit hrs
Pre-requisite: None

Tensor Analysis, Group Theory, Functions of a Complex Variable; Calculus of Residues, Differential Equations, Sturm – Liouville Theory.

## (0302792) Special Topics in Physics

3 Credit hrs
Pre-requisite: None

This course lays down the foundations for experimental and theoretical backgrounds relevant to current research topics in the department. This course should assist students in their research fields, and equip them with a wealth of advanced knowledge in physics.