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

Offered Degree: Master in Physics

1) **General Rules and Conditions:**

- **This plan conforms to the valid regulations of programs of graduate studies.**
- **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	-
0302754	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	0302754
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.**

The Master Program in Physics – Comprehensive Track (2012/2013)

Offered Degree: Master in Physics

4) <u>General Rules and Conditions:</u>

- **This plan conforms to the valid regulations of programs of graduate studies.**
- **Areas of specialty of admission in this program:**
  - **Holders of the Bachelor degree of Science in Physics**

5) <u>Special Conditions:</u> **None**

6) <u>The Plan:</u> **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	-
0302754	Quantum Mechanics-1	3	-	3	-
0342756	Statistical Mechanics-1	3	-	3	-
0352762	Atomic and Molecular Physics-1	3	-	3	0302754
0332763	Nuclear Physics-1	3	-	3	-
0352771	Solid State Physics-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	-
0302765	Theory of Relativity	3	-	3	-
0342765	Radiation Detection and Measurement	3	-	3	-
0302775	Properties of Materials	3	-	3	-
0352792	Special Topics in Physics	3	-	3	-

c) Students must pass a comprehensive exam (0302798) after passing all course

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
0302711	Methods in Practical Physics	3			
			0352712	Advanced Practical Physics	3
0302751	Classical Mechanics	3	0342751	Classical Mechanics-1	3
0302752	Computational Physics	3	0352752	Computational Physics	3
0302753	Classical Electrodynamics-1	3	0362753	Classical Electrodynamics-1	3
0302754	Quantum Mechanics 1	3	0332754	Quantum Mechanics-1	3
0302756	Statistical Mechanics-1	3	0342756	Statistical Mechanics-1	3
0302757	Nonlinear Physics	3			
0302762	Atomic and Molecular Physics	3	0352762	Atomic and Molecular	3
0302763	Nuclear Physics-1	3	0332763	Nuclear Physics-1	3
0302756	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
0302781	Mathematical Physics (1)	3	0322781	Mathematical Physics-1	3
0302791	Methods in Theoretical Physics	3			
0302792	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

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

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

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

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.