Master Degree in Physics

The Master Degree in Physics is awarded by the Faculty of Graduate Studies at Jordan University of Science and Technology (JUST) upon the fulfillment of the following requirements:

1. Compliance with the JUST Master Degree regulations approved by the Dean Council (No. 492/2006), dated August 8th 2006, and its amendments.

2. Successful completion of (34) credit hours in the following tracks:

First: Thesis Track

1. Compulsory Requirements: (16) credit hours as follows:

Course Symbol and Number	Course Name	Credit
Phy701	Mathematical Physics	3
Phy711	Classical Mechanics	3
Phy731	Electrodynamics (1)	3
Phy751	Quantum Mechanics (1)	3
Phy761	Statistical Mechanics	3
Phy791	Seminar	1

2. Elective Requirements: (9) credit hours from the following*:

Course Symbol and Number	Course Name	Credit
Phy704	Computational Physics	3
Phy705	Characterization of materials	3
Phy721	Advanced Laboratory in Physics	3
Phy732	Electrodynamics (2)	3
Phy733	Magnetism and Magnetic Materials	3
Phy740	Radiation Physics	3
Phy741	Atomic Physics	3
Phy744	Atomic and Molecular Physics	3
Phy752	Quantum Mechanics (2)	3
Phy771	Solid State Physics	3
Phy772	Physics of Semiconductors	3
Phy773	Solar Cells	3
Phy774	Thin Films Technology	3
Phy 775	To be filled by Dr. Ahmad Al-Omari	3
Phy781	Advanced Optics	3
Phy783	Medical Physics	3
Phy795	Special Topics	3

* The student may study not more than (3) credit hours from courses of 700 or 800 level offered by other programs related to his field of study upon the decision of the Dean of Graduate Studies based on the recommendation of the departmental

committee for the graduate studies and the approval of the faculty committee for graduate studies

3. Master Thesis (Phy799): total of (9) credit hours as follows:

Course Symbol and Number	Course Name	Credit
Phy799 A	Master Thesis	9
Phy799 B	Master Thesis	6
Phy799 C	Master Thesis	3
Phy799 D	Master Thesis	0

Second: Comprehensive Exam Track

1. Compulsory Requirements: (19) credit hours as follows:

Course Symbol and Number	Course Name	Credit
Phy701	Mathematical Physics	3
Phy711	Classical Mechanics	3
Phy731	Electrodynamics (1)	3
Phy751	Quantum Mechanics (1)	3
Phy761	Statistical Mechanics	3
Phy771	Solid State Physics	3
Phy791	Seminar	1

2. Elective Requirements: (15) credit hours from the following*:

Course Symbol and Number	Course Name	Credit
Phy704	Computational Physics	3
Phy705	Characterization of materials	3
Phy721	Advanced Laboratory in Physics	3
Phy732	Electrodynamics (2)	3
Phy733	Magnetism and Magnetic Materials	3
Phy740	Radiation Physics	3
Phy741	Atomic Physics	3
Phy744	Atomic and Molecular Physics	3
Phy752	Quantum Mechanics (2)	3
Phy772	Physics of Semiconductors	3
Phy773	Solar Cells	3
Phy774	Thin Films Technology	3
Phy 775	To be filled by Dr. Ahmad Al-Omari	3
Phy781	Advanced Optics	3
Phy783	Medical Physics	3
Phy795	Special Topics	3

* The student may study not more than (6) credit hours from courses of 700 or 800 level offered by other programs related to his field of study upon the decision of the Dean of Graduate Studies based on the recommendation of the departmental committee for the graduate studies and the approval of the faculty committee for graduate studies

3. Passing the Comprehensive Exam (Phy798): zero credit hour.

Course Description

Phy701 – Mathematical Physics (3 credits)
Homogeneous boundary value problem, special functions, inhomogeneous problems, Green's functions, integral equations, complex analysis calculus of variations.

Phy704 – Computational Physics (3 credits)
Introduction to Linux first programs, ordinary differential equations, solving systems of equations, analysis of data, partial differential equations, special functions and quadrature and stochastic methods.

Phy705 Characterization of materials (3 credits)
Measurements and error analysis, Microscopy, Spectroscopy, Structural analysis, Elemental analysis, Thermal analysis.

Phy711- Classical Mechanics (3 credits)
Survey of elementary principles, variational principles and Lagrangian equations, the tow body central force problem, kinetics of rigid bodies, rigid body equations of motion, Hamilton equations of motion, canonical transformations, small oscillations.

Phy721- Advanced Laboratory (3 credits)
Experiments in nuclear physics, detection of nuclear radiation and determination of nuclear properties, experiments in low temperature and solid state physics, the course emphasizes research methods and interpretation of data encouraging independent work.

Phy731-Electrodynamics 1 (3 credits)
Electrostatics, Laplace and Poisson equations, Green theorem, method of images, boundary value problem in cartesian, spherical and cylindrical coordinates, spherical harmonics, Bessels function, multipole expansion, electrostatics of macroscopic materials, dielectrics, magnetostatics, vector potential, magnetic moments, Maxwells equations for time - varying fields, energy and momentum conservation, plane electromagnetic waves.

Phy732- Electrodynamics 2 (3 credits)
Time varying fields, Plane Electromagnetic waves and wave propagation, Wave guides and Resonant cavities, Simple radiation systems, scattering and diffraction, Radiation by moving charges.

Phy733- Magnetism and Magnetic Materials (3 credits)
Introduction to magnetism and experimental methods, Magnetization curves, Magnetic susceptibility, Faraday balance, VSM and SQUID magnetometers, Origin of atomic moment, Diamagnetism, Classical and Magnetic theory of paramagnetism, Magnetically ordered states, The Heisenberg exchange interaction and Weiss theory, Ferromagnetism, antiferromagnetism, Ferrimagnetisms, Magnetic anisotropy, Crystal anisotropy, shape anisotropy, Domains and domain wall motion.

Phy740- Radiation Physics (3 credits)
Types of radioactive decays, interaction of charged particles with matter, radiation detection and instrumentation, radiation dosimetry, chemical and biological effects of

radiation, exposure limits, nuclear fuel cycle, management of nuclear waste.

Phy741- Nuclear Physics (3 credits)
Nucleon - nucleon scattering, nuclear structure and nuclear volume, multipole moments, shell model, collective states, instrumentation methods in nuclear physics.

Phy744- Atomic and Molecular Physics (3 credits)
Relativistic correction to non-relativistic atomic spectra, coupling schemes, polarizability, radiative transitions, atomic collisions.

Phy751- Quantum Mechanics I (3 credits)
Review of the basic concepts of wave mechanics, addition of angular momentum, dynamics of two level system, linear vector space, quantum dynamics, rotation and other symmetry operations.

Phy752- Quantum Mechanics II (3 credits)
Time independent perturbation theory, The formal theory of scattering , identical particles, photons and the Electromagnetic field, Dirac theory for the electron.

Phy761 – Statistical Mechanics (3 credits)
The statistical basis of thermodynamics, elements of ensemble theory, canonical and grand canonical Ensembles, formulation of quantum statistics, theory of simple gases, ideal Bose systems, ideal Fermi systems, statistical mechanics of interacting systems.

Phy771 – Solid State Physics (3 credits)
Electron energy bands in crystalline solids, crystal symmetry and Brillouin zones, approximate methods of calculation, electrons and holds under applied fields, lattice dynamics and thermal conductivity, electron –lattice interaction, transport phenomena in metals and semiconductors.

Phy772– Physics of Semiconductor (3 credits)
Elementary physical theory of semiconductors, nonequilibrium characteristics of semiconductors, Device-fabrication technology, the p-n junction, metal semiconductor junction.

Phy773 – Solar Cells (3 credits)
Physical principles of photovoltaic energy conversion, fundamental solar cell parameters, technology of solar cell devices, fundamental material parameters, monocrystalline and polycrystalline silicon, single crystal and epitaxial compound semiconductors.

Phy774– Thin Films Technology (3 credits)
Overview of crystal structure, imperfections in crystals, amorphous nucleation and diffusion in solids (Fick's Law), mechanism of diffusions in solids, activation energy for diffusion applications. methods of film deposition, thin film characterization techniques.

Phys. 775: Plasma of semiconductors processing
Physics of plasmas and gas discharges, includes basic collisional theory, the Boltzman

equation and the concept of electron energy distributions. Results are related to specific gas discharge systems used in semiconductor processing, such as sputtering, etching, and deposition systems.

Phy781 – Advanced Optics
Wave equation, superposition principle, interference of light, matrix treatment of polarization, diffraction, Fresnel equations, laser physics, fiber optics, nonlinear optics, optical properties of materials.

Phy783 – Medical Physics (3 credits)
An overview of phototherapy, classical description of light interaction with matter, molecular description of light interaction with matter, phototechnology, tissue optics, applications of tissue to light dosimetry in phototherapy, laser interaction with tissue, photodynamics therapy, UV phototherapy of skin diseases, ultra sound, bio-statistics, K.M. theory.

Phy791 Seminar (1 credit)
Phy798 Comprehensive Exam (0 credit)
Phy799 Thesis (9 credits)