Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites
		Theo.	Lab.	Credit	ECTS			
Particle Physics	PHYS661	3	-	3	9	1st/ 2nd	2nd/ 3rd	-

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	Preparation for classes	90
Laboratory	-	Case studies	-
Exams and quizzes	5	Working on lab experiment	-
Lab demo	-	HW/Assignments	64
		Study for exam	41
Total	50	Total	195
Total Learning Hours = 245		Equivalent ECTS points = Total LH/28 = 9	

BRIEF COURSE DESCRIPTION

- This course is designed to provide advanced training for students in particle physics phenomenology and experimental methods, to enable them to take part in theoretical particle physics research.

COURSE OBJECTIVES

The main objectives of this course are focused on the following:

1. Outline the symmetries of gauge field theory.
2. Evaluate the interaction between cross-sections and energy losses in media.
3. Describe the difference between weak and electroweak interaction.
4. Identify the foundations of the Standard Model and physics beyond it.
5. Describe the Lagrangian of the Standard Model.

COURSE CONTENTS

- Gauge Symmetries and Quarks: Symmetries in Physics, Symmetries and Groups, SU(2) and SU(3) Gauge Groups, Isospin, Quark States, Hadron Masses, Color Factors,The Lagrangian and Single-Particle Wave Equations, Noether's Theorem,U(1) LocalGauge Invariance, Non-Abelian Gauge Invariance, Spontaneous Symmetry Breaking.
- The Structure of Hadrons: Electron-Proton Scattering, Inelastic Electron-Proton Scattering, Inelastic Electron-Proton Scattering. Partons: Bjorken Scaling, Partons and Bjorken Scaling, Quarks within Patrons, Gluons
- QCD: QCD Lagrangian, Gluon Emission CrossSection, QCD and e^+ e^- annihilation
- Weak Interactions: Parity Violation, Interpretation of Coupling, Beta Decay, Muon Decay, Pion Decay, Neutrino-Electron Scattering, Neutrino-Quark Scattering, Cabibbo Angle, Weak Mixing Angles, CP Invariance, CP Violation.
- Electro weak Interactions: Weak Isospin and Hypercharge, Basic Electroweak Interaction, Effective Current-Current Interaction, Feynman Rules for Electroweak Interaction, Electroweak Interference of electron-electron Annihilation.
- Standard Model and Beyond: Higgs Field, Masses of the Gauge Bosons, Masses of the Fermions, Lagrangian of the Standard Model, Grand Unification, Dark matter.

ASSESSMENT CRITERIA

- Mid-Term exams : 20 %
- Assignments and classroom activities: 30 %
- Final Exam: 50%

COURSE TEACHING STRATEGIES

- Lectures, Discussions, Seminar, Group discussions.

TEXT BOOK

- F.Halzen and A.D.Martin ,Quarks and Leptons: An Introductory Course in Modern Particle Physics, Wiley,1984.

REFERENCE BOOKS

- D. Griffiths, Introduction to Elementary Particles, 2nd edition, Wiley-VCH, 2008.
- I. Aitchison and A. Hey, Gauge Theories in Particle Physics V1,IOP, 2003.
- I. Aitchison and A. Hey, Gauge Theories in Particle Physics V2,IOP, 2004.
- B. R. Martin and G. Shaw, Particle Physics, Manchester, 2008.