PHY-915 Particle Physics-II

Credit Hours: 3-0
Prerequisite: PHY-914

Objectives and Goals: The purpose of this course is to give an overview neutrino physics and neutrino oscillation. It also provides a brief introduction to the Electroweak unification, Higgs mechanism, Parton model and CP- Violation in Standard as well as in K-decays. This course will help student to tackle research problems in depth.

Core Contents: Neutrino and Neutrino oscillations, Electroweak Unification, Spontaneous symmetry breaking and Higgs mechanism, GIM mechanism, CKM matrix, Deep inelastic scattering, Parton model, Particle Mixing and CP-Violation in Standard Model.

Detailed Course Contents: Intrinsic properties of neutrinos, Neutrino Mass and constraint on neutrino mass, Dirac and Majorana masses, Fermion masses in the Standard Model and see-saw mechanism, Fermion masses in the Standard Model and see-saw mechanism, Neutrino Oscillation, Neutrino oscillations in matter: Mikheyev-Smirnov-Wolfenstein (MSW) effect, Evolution of flavor eigenstates in matter, Neutrino mass models and mixing matrix and symmetries, Neutrino magnetic moment, Eectroweak Unification: Introduction, Spontaneous symmetry breaking and Higgs mechanism, Gauge symmetry breaking for chiral group, Renormalizability of a gauge theory, Decay width of W and Z bosons, Higgs boson mass, GIM mechanism, CKM matrix, Deep inelastic scattering, Lepton-nucleon scattering, Parton model, Deep inelastic neutrino-nucleon scattering, Particle Mixing and CP-Violation in Standard Model and in K-decays

Course Outcomes: At the end of the course, the students will be able to

- understand the Neutrino physics and constraint on neutrino mass as well neutrino oscillations
- understand the Electroweak unification, Spontaneous symmetry breaking and Higgs mechanism
- understand the Deep inelastic scattering, Parton model and CP- Violation in Standard Model and in K-decays
- understand research problems in this field

TextBook: Fayyazuddin and Riazuddin, Modern Introduction to Particle Physics, 3rd ed. World Scientific 2011. (Referred as FR)

Reference Books:

1. Mark Thomson, Modern Particle Physics, Cambridge University Press 2013.
2. I J R Aitchison and A J G Hey, Gauge Theories in Particle Physics: A Practical Introduction, Volume I: From Relativistic Quantum Mechanics to QED, IOP 2013.
3. David J. Griffith's, Introduction to elementary Particle Physics, John Wiley & Sons 1987.

Weekly Breakdown		
Week	***Section***	***Topics***
1	FR 12.1, 12.2, 12.3.1	Neutrino: Introduction, Intrinsic properties of neutrinos, Neutrino Mass: Constraints on neutrino mass
2	FR 12.2.3, 12.3.3	Dirac and Majorana masses, Fermion masses in the Standard Model and see-saw mechanism
3	FR 12.3.3, 12.4	Fermion masses in the Standard Model and see-saw mechanism, Neutrino Oscillation
4	FR 12.4.1, 12.4.2	Neutrino oscillations in matter: Mikheyev-Smirnov-Wolfenstein (MSW) effect, Evolution of flavor eigenstates in matter
5	FR 12.6, 12.7	Neutrino mass models and mixing matrix and symmetries, Neutrino magnetic moment
6	FR 13.1, FR 13.2, 13.2.1	Electroweak Unification: Introduction, Spontaneous symmetry breaking and Higgs mechanism.
7	FR 13.2.2, FR 13.3	Gauge symmetry breaking for chiral group, Renormalizability of a gauge theory.
8	FR 13.4	Electroweak unification
9	FR 13.5, 13.7, 13.8	Decay width of W and Z bosons, Higgs boson mass
10	FR 13.11, 13.12	GIM mechanism, CKM matrix
11	FR 14.1, 14.2	Deep inelastic scattering: Introduction, Lepton-nucleon scattering
12	FR 14.3, 14.4	Parton model, Deep inelastic neutrino-nucleon scattering
13	FR 16.1, 16.2	Particle Mixing and CP-Violation: Introduction, CPT and CP invariance
14	FR 16.3, 16.4	CP- Violation in the Standard model, Particle mixing
15	16.5	CP- Violation in K-decay