

## PPH301: PARTICLE PHYSICS

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<b>3</b>	<b>1</b>	<b>0</b>	<b>3.5</b>

**Course Objectives:** To impart the knowledge of fundamental particles, fundamental interaction and the range and strength of these interactions with the concept of particle antiparticle or matter antimatter.

**Introduction:** Fermions and bosons, Particles and antiparticles, Quarks and leptons, Yukawa picture, Types of fundamental interactions - electromagnetic, weak, strong and gravitational, HEP Units, Bound states of quarks, Hadron, Mesons and Baryons.

**Invariance Principles and Conservation Laws:** Interactions and fields in particle physics, Classical and quantum pictures Invariance in classical mechanics and in quantum mechanics types of symmetries and their breaking, Parity, Pion parity, Charge conjugation, Time reversal invariance, CP violation, CPT theorem.

**Hadron-Hadron Interactions:** Cross section and decay rates, Pion spin, Isospin, Two-nucleon system, Pion-nucleon system, Strangeness and Isospin, and Hypercharge.

**Static Quark model of Hadrons:** The Eightfold way, Meson nonet, Baryon octet, Baryon Decuplet, hypothesis of quarks, SU (3) symmetry, Quark spin and color, Quark-antiquark combinations.

**Weak Interactions:** Classification of weak interactions, Fermi theory, Parity non-conservation in  $\beta$ -decay, Helicity of neutrino, Experimental verification of parity violation..

### Course Learning Outcomes (CLO):

Students will have understanding of:

1. Need of standard model and its limitations and the properties of QCD.
2. Basic rules of Feynman diagrams and the quark model for hadrons
3. Properties of neutrons and protons in terms of a simple quark model.
4. Weak interaction between quarks and how that this is responsible for  $\beta$  decay.
5. Leptons and how the (electron) neutrinos and (electron) antineutrinos are produced during  $\beta^+$  and  $\beta^-$  decays respectively.

### Recommended Books:

1. Perkins, D.H., *Introduction to High Energy Physics*, Cambridge University Press, (2000).
2. Hughes, I.S., *Elementary Particles*, Cambridge University Press, (1991).
3. Close, F.E., *Introduction to Quarks and Partons*, Academic Press, (1979).
4. Segre, E., *Nuclei and Particles*, Benjamin-Cummings, (1977).
5. Khanna, M.P., *Introduction to Particle Physics*, Prentice-Hall of India, (2004).