

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Hyderabad Campus
SECOND SEMESTER 2023-2024
Course Handout

Date: 09/01/2024

Course Number :**PHY F413**
Course Title : **Particle Physics**
Instructor-in-Charge :**Rahul Nigam**

Scope and Objective of the Course: During the course we study the elementary particles and the fundamental forces of interaction between them. We will start from the history of the subject and follow as the subject evolved to its present state. We will also discuss the various breakthroughs and discoveries made in the field which completely changed the way we view our universe.

Text Book:

1. Quarks and Leptons: An Introductory Course in Modern Particle Physics by Francis Halzen & Alan D. Martin (H-M)

Reference Book:

1. Introduction to Elementary Particles by David Griffiths (G)

Course Plan:

Lecture	Content	Reference
1-2	History of particle physics; Motivation; Natural Units and its use; Classification of Particles; Fermions and bosons; constituents of matter; The four fundamental interactions	H.M. – 1 G – 1
3-7	Symmetry & Groups -- Quark Model; Spin, Isospin & strangeness, Quark content of hadrons; SU(2), SU(3) groups and their role in particle physics; Evidence in support of quark model	H.M. – 2
8-14	Relativistic Kinematics, Energy-momentum relationship, 4-vectors notation, Klein-Gordon Equation and Dirac Equation, Concept of Antiparticle, Dirac and Weyl Spinor	H.M. – 3,5
15-20	Symmetries and Conservation Laws, Noether's Theorem, symmetries, properties of space-time, Conservation of Momentum, Energy etc; Charge conjugation (C), parity (P) and Time-reversal (T) symmetries; CP-violation and CPT theorem.	H.M. – 5 G – 4
21-28	Electrodynamics of spineless and spin 1/2 particles; Decay rate Scattering Crosssection, Mandelstam Variables Massless and Massive Propagators; Feynman Rules, Matrix Amplitude; Bhaba Scattering, Compton Scattering etc	H.M. – 4,6
29-30	Introduction to Loop correction and renormalization; Hadrons & Partons; Quantum Chromodynamics (Qualitative discussion)	H.M. – 7
31-38	Weak Interactions, Parity Violation -- V-A interaction; Nuclear beta decay, Interpretation of the Fermi constants, Muon and Pion Decay processes, Charged and Neutral Currents, Cabibo angles, Weak Mixing angles; CP violation in nature?	H.M. – 12 G – 9
39-43	Electroweak Interactions, Basic of E-W interaction; Concept of weak isospin and hypercharge;	H.M. – 13

Evaluation Scheme:

No.	Components	Duration	Weightage	Nature of Component	Date and Time
1	Test I	50 mins	15%	Open Book	
2	Test II	50 mins	15%	Open Book	
3	MidSem	90 mins	30%	Close Book	11/03 - 4.00 - 5.30PM
3	Comprehensive	180 mins	40%	Close Book	07/05 AN

Chamber Consultation Hour: Weekdays 5 – 6pm

Make-up Policy: Make up will be given only to for sickness leading to ***hospitalisation***,

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.