**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 anddiscoveries 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:**

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| --- | --- | --- |
| 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 Sprinor | 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, Mandelstum 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:**

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| --- | --- | --- | --- | --- | --- |
| 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.