SS863 ADVANCED PARTICLE PHYSICS 3-1-0-4

Course Objectives:

The course introduces the different scattering process, symmetries of high energy particles. It also details the standard theoretical models employed in particle physics.

UNIT 1: Scattering Processes

Relativistic kinematics, phase space, Mandelstam variables, Feynman rules, lifetimes and cross-sections, Golden rule; scattering of a spinless charged particle by electromagnetic field, scattering of electrons by electromagnetic field,$e-\mu$ scattering, Moller scattering, electron-proton scattering and form factors, higher order corrections, vacuum polarization, charge renormalization, Lamb shift,$g-2$

UNIT 2: Symmetries and Quarks

Discrete symmetries, isospin-SU(2), G-parity, SU(3)-classification of mesons and baryons, mass formula, magnetic moments, motivation for colour as an internal symmetry.

UNIT 3:Parton Model and QCD

Deep inelastic scattering (DIS) of electrons on nucleons, structure functions and scale invariance, Bjorken scaling, parton model; quantum chromodynamics:Lagrangian, symmetries.

Beta-decay, μ-decay, parity violation,$V-A$ theory of weak interactions, conserved vector current (CVC) hypothesis.

UNIT 4: Standard Model and Neutrino Physics

Glashow-Salam-Weinberg model, neutral current, physics of W, Z and Higgs, CKM mixing, C,P,T transformations, CP violation.

Neutrino Physics: neutrino oscillations.

Reference Books:

1. T. D. Lee, *Particle Physics and Field Theory*, Harwood, 1981.
2. T Cheng and L. Li,Gauge *Theory of Elementary Particles*, Oxford University Press, 1984.
3. I.J.R. Aitchison and A.J.G. Hey, *Gauge Theories in Particle Physics*, Vol. 1: From Relativistic Quantum Mechanics to QED, 3rd Edition, Taylor & Francis,2002.
4. J.D. Bjorken and S.D. Drell, *Relativistic Quantum Fields*, McGraw-Hill, 1965

Course Outcomes:

After the completion of the course student is expected to:

CO1: Be familiar with main theoretical concepts and experimental techniques used in elementary particle physics

CO2: Be able to make quantitative estimates of cross-sections etc. of basic elementary particle processes

CO3: Have a basic understanding of the Standard Model and of theoretical methods employed in particle physics

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