<u>Course: M.Sc (Physics)</u>

Semester	3
Paper Number	12 (MPHC4303)
Paper Title	Relativistic Quantum Mechanics
No. of Credits	3
Course description/objective	The Objective of this course is to introduce students to elementsof high energy physics. Starting from particle creation and annihilation, students are led through single particle equations into the principles of QFT. Feynman-Stuckelberg interpretetion for antiparticles is used to introduce students to deal with the physics of elementary particle interactions using Feynman diagram technique.
Course Outcome	CO1: Understand how relativity changes the nature of quantum mechanics: particle production and spin-specific wave equations CO2: Understand Spinor algebra and apply it to understand relativistic electrons CO3: Learn functional calculus to extend the variational principle to continuum systems, CO4: Understand the basic notions of QFT and related symmetry principles. CO5: Understand how the Feynman diagram formalism is employed to learn about relativistic particle interactions.
Syllabus	**<u>Relativistic Quantum Mechanics</u>[36 Lectures]** Relativistic Quantum Mechanics: Klein-Gordon equation, Feynman-Stuckelberg interpretation of negative energy states and concept of antiparticles, Dirac equation, covariant form, adjoint equation, plane wave solution and momentum space spinors, spin and magnetic moment of the electron, non-relativistic reduction, helicity and chirality, properties of gamma matrices, charge conjugation, normalization and completeness of spinors, Lorentz transformation of the Dirac equation, bilinear covariants and their transformations under parity and infinitesimal Lorentz transformation, Weyl representation and chirality projection operators. [16 lectures] Field quantization: Basic ideas, construction of conjugate momentum from Lagrange density, commutation relations for bosonic and anti-commutation relations for fermionic fields in terms of field and momentum or creation and annihilation operators, quantization of scalar and complex scalar fields. [12 lectures] Introduction to Feynman diagrams by way of spinless electron - electron scattering, calculation of the matrix element and scattering cross section. [8 lectures]
References	1. Bjorken, J.D.; Drell, S.D. (1965). Relativistic Quantum Fields (Pure &

	Applied Physics). McGraw-Hill. 2. Greiner, W. (2000). Relativistic Quantum Mechanics. Wave Equations (3rd ed.). Springer. 3. Gauge Theories in Particle Physics, Volume -1, From Relativistic Quantum Mechanics to QED (2013), by Aitchison and Hey. CRC Press 4. F. Halzen and A.D. Martin: Quarks and Leptons: John Wiley and Sons. 5. http://epx.phys.tohoku.ac.jp/~yhitoshi/particleweb/particle.html : Quantum Field theory for Non Specialists Lecture Notes.
Evaluation	Total: 50 CIA: 10 marks End Semester Examination: 40 marks