BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

January 6, 2016

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

Course No. : PHY F412
Course Title : Introduction to Quantum Field Theory
Instructor Incharge : Rishikesh Vaidya

Scope and Objective of the course:

This course aims to teach the bare bones of canonical quantization program for a system of fields, focusing (for the most part) on a system of scalar fields. It will introduce Quantum Field Theory as an inevitable consequence of the union of our most prized gems of knowledge -- quantum mechanics and relativity. The example of harmonic oscillator would be used to illustrate how particles and wave aspects of reality emerge from the underlying foundations of quantized fields. Notions of symmetries – both, space-time and internal, would be exploited to "build Lagrangians and interactions from scratch". Time permitting; machinery of S-matrix would be developed within perturbative framework that would help us see how the violence of creation and destruction of elementary particle is as mundane and dirty as much it is pretty. It is mundane, because that is all that particles can do and actually do, all the time. It is pretty because it is a science that we have perfected to predict to extra-ordinary levels of accuracy. The dirty part is what you would know, when you get there (the S-matrix machinery).

Text Book: Quantum Field Theory for the Gifted Amateur by Lancaster and Blundell (Oxford University Press)

Reference Books:

1. Quantum Field Theory of Point Particles and Strings by Brian Hatfield (Addison Wesley Pub.)
2. Quantum Field Theory by Lewis Ryder (Cambridge University Press)
3. Quantum Field Theory (2nd edition) by Mandl and Shaw (John Wiley)

Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference Section
1-3	Motivation	Roads to Quantum Field Theory	Class Notes
4-5	Lagrangians and Least Action	Relativistic Notations and Functional Methods	Ch.0,1
6-7	SHO at the heart of everything	A linear chain of uncoupled and coupled Simple Harmonic Oscillator and phonon modes	Ch. 2
8-10	Treating bosons and fermions right	Occupation Number Representation	Ch. 3

11-14	Quantization of a field as an operator	Elements of Second Quantization	Ch. 4
15-16	Classical Fields	Lagrangians for Continuous Systems	Ch. 5
17-19	Writing down Lagrangians	Relativistic (Klein Gordan) Quantum Mechanics and example Lagrangians	Ch. 6,7
20-22	Temporal evolution	Schrodinger and Heisenberg Pictures of Evolution	Ch. 8
23-25	Quantum space time transformations	First stab at the Rotation and Lorentz Group	Ch. 9
26-27	Symmetries	Continuous symmetries and Noether's theorem	Ch. 10
29-31	Cannonical Quantization of Fields	Examples from Complex Scalar Field theory	Ch. 11, 12
32-35	Greens Function	Propagators and Green Functions as Amplitudes	Ch. 16,17
36-40	The S-matrix	The S-matrix calculations	Ch. 18, 19

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Remarks
1.	Mid-Sem Test	90 Min.	35	6/3 2:00 -3:30 PM	Closed Book
2.	4 Tutorial Tests/Assignment	TBA	25	To be announced in class	Closed/open Book
4.	Comp. Exam	3Hours	40	3/5 AN	Closed/Open Book

Chamber Consultation Hour: To be announced in class.

Notices: Notices will be displayed only on **Physics** notice board.

Make-up Policy: To genuine cases only, for either sickness leading to hospitalization or Out of station with prior intimation & permission.

Instructor-in-Charge, PHY F215