First Semester 2016-2017

Date: 02.08.2016

Course No.: PHY F424

Course Title: Advanced Electrodynamics

Instructor-in-Charge: Amol Holkundkar

Scope and Objective:

This course offers an advanced and application oriented overview of the field of electrodynamics.

Text Books:

1. Classical Electrodynamics, J D Jackson, 3rd Edition, Wiley Student Edition

Reference Books:

1. Introduction to Electrodynamics, D J Griffith.

2. Electrodynamis, F Melia.

3. Computational Electrodynamics, A Taflov and S C Hagness

Course Plan:

Lect. No.	Topics to be covered
1 - 2	Review of the Maxwell's equations, Vector and Scalar Potential, Gauge Transformation. Some problems on these topics.
3-5	Need for relativity in electrodynamics, its genesis and quick recap of STR. Lorentz Transformation for length, time, velocity. Concept of proper time, four vector, four velocity, possible four acceleration, metric tensor, four potential, Doppler shift.
6-8	Manifestly covariant form of Maxwell's equations, concept of dual tensor, covariance of Maxwell's equations, transformation of electric and magnetic field under LT using covariant form, without using EM field tensor.
9-12	Lorentz force using covariant form, Relativistic Lagrangian and Hamiltonian of the charge particle in EM fields and derivation of Lorentz force from that, Lagrangian for EM fields.
13-16	Solving for electron dynamics in external EM fields, phase-space plots, etc. Solving wave propagation equation using Covariant form and Green's identity (should give notes) and derivation of LW potentials, using the same obtain the expression for the spectral information of the emitted radiation.

17-20	Application of HHG in ASP generation, Syncroton Radiation, bremsstralung, undulators, wigglers etc..
21-23	Nonlinear Thomson Scattering, theory and current perspectives.
24-26	Radiation Reaction, theory and perspective.
27-29	Single Particle Dynamics, RR as logistic Approach, Interaction of Laser with Plasma, 1D formulation and its applications to RSIT, LWFA etc.
30-32	Future Directions, and possible areas of active research, when Classical ED fails and QED is important.

Evaluation Scheme:

No.	Evaluation Component	Duration	Weightage	Date & Time
1	Tutorials/Assignments (some open book will be there)	30 mins	30%	6/10 10:00 - 11:30 AM
2	Mid-Term (Close book)	90 Mins	30%	
3	Compre. Exam. (Close/Open book*)	3 Hrs	40%	8/12 FN

*Open Book: Only the books listed in the handout and handwritten notes allowed. **Chamber Consultation Hours**: To be announced in the class.

Notices: Will be uploaded on Intrabits site only.

Make-up Policy: Make-up will be given only in genuine cases, that is, illness leading to hospitalization or going out of station with prior permission. No make-ups for the tutorials.

Instructor-in-charge