Introduction

Fundamental Accelerator Theory, Simulations, and Measurement Lab

Sarah Cousineau, Jeffrey Holmes, Robert Potts, Yan Zhang,
USPAS, University of Tennessee
January, 2014

Schedule

Schedule Week 1

	Monday	Tuesday	Wednesday	Thursday	Friday
9 :00 am - 12:00 pm	Lecture 1	Lecture 3	Lecture 4	Lecture 5	Lecture 6
12:00 pm - 2:00 pm	Lunch	Lunch	Lunch	Lunch	Lunch
2:00 pm - 5:00 pm	Lecture 2	Labs	Labs	Labs	Labs
6:00 pm - 7:00 pm	Dinner	Dinner	Dinner	Dinner	Dinner
7:00 pm – 12:00 am	Homework	Homework	Homework	Homework	Homework

Schedule Week 2

	Monday	Tuesday	Wednesday	Thursday	Friday
9 :00 am - 12:00 pm	Lecture 7	Lecture 8	Lecture 9	Labs	Final Exam
12:00 pm - 2:00 pm	Lunch	Lunch	Lunch	Lunch	
2:00 pm - 5:00 pm	Labs	Labs	Labs	Labs	
6:00 pm - 7:00 pm	Dinner	Dinner	Dinner	Dinner	
7:00 pm – 12:00 am	Homework	Homework	Homework	Homework	

Course Grades

The final course grades will be based on:

1. Problem Sets – 35%
2. Lab Reports – 35%
3. Final Exam – 30%

- The problem sets are due at 9am on the stated due date– they will be graded promptly.
- Laboratory write-ups will be due on the second Monday morning for week 1 labs, and on the second Friday morning for week 2 labs.

Syllabus

Day	Subject	Topics	Wiedemann Reference
		Monday Morning	
Lecture 1a	Introduction to Accelerators	Historical overview	
		Types of accelerators	
Lecture 1b	Basic Principles	Units	Appendix B
		Special relativity	1.2
		Electrodynamics/Maxwell's Equations	1.1
		Accelerator coordinate systems	1.3
		Monday Afternoon	
Lecture 2	Particle Acceleration	Forces on charged particles	1.1
		Electrostatic Accelerators	
		RF Accelerators	Most of the book
		Waveguides	15.2,
		RF Cavities	15.2, 15.4
		Tuesday	
Lecture 3	RF Acceleration in Linaces Part I	Transit-time factor	15.4
		Linac RF power parameters	15.3 – 15.5
		Coupled cavities and acceleration schemes	Wangler Chapter 2-3
		Some linear accelerator structures	Wangler Chapter 2-3
		Wednesday	
Lecture 4	RF Acceleration in Linaces Part II	Travelling wave structures	Wangler Chapter 2-3
		Synchronicity conditions for acceleration	Wangler Chapter 2-3
		Longitudinal dynamics	6
		Thursday	
Lecture 5	Transverse Beam Optics Part I	Particle beam guidance	2.2
		Magnet current to field equations	2.2, 3.1.3
		Multipole expansion of fields, design concepts	3.1

Syllabus

Day	Subject	Topics	Reference (Wiedemann unless otherwise noted)
		Friday	
Lecture 6	Transverse Beam Optics Part II		
		Single Particle Equation of Motion	2.2
		Piecewise Constant Solutions	2.5, 4.2-4.3
		Periodic Focusing	4.2-4.3
		Twiss Parameterization of Beam Distribution	5.1
		Monday	
Lecture 7	Transverse Beam Optics Part III	Analytic (Twiss Parameter) Solution of Hill's Equation	5.2-5.3
		FODO Lattice in terms of Twiss Parameters	7.1
		General Periodic Lattice	7.2
		Betatron Tune	7.2
		Lattice Errors and Resonances	12.1
		Tuesday	
Lecture 8	Off Momentum Effects and Longitudinal Motion in Rings	Dispersion	2.5.4, 5.4
		Momentum Compaction	5.4
		Chromaticity	12.2
		Longitudinal motion in rings	6
		Wednesday	
Lecture 9	Misc Topics	Collective Effects	Class Notes
		Synchrotron Radiation	3.6, 20.1-20.2, 21.1
		Thursday	

Some Tips

- In the evening during the "homework time", instructors will be available for further discussion on course related topics.

- There will be daily homework. You are allowed, and even encouraged, to work in groups. Don't "stew" over problems too long…ask for help

- Everyone will perform 8 laboratory experiments and computer simulations. These will be done in groups, with each group submitting a lab report.

- Final exam on the morning of Friday, January 26 (three hours) and no lab in the afternoon.

Introductions

- You sheet:
  - Email address
  - Role / Title
  - Simple picture that represents some part of your life.
  - A one word reminder of something you will tell us about yourself which nobody here knows (nothing too personal)
- Take 3 minutes to prepare, less than 1 minute to present:
  - Explain your sheet
  - We will applaud
  - Post it on the wall