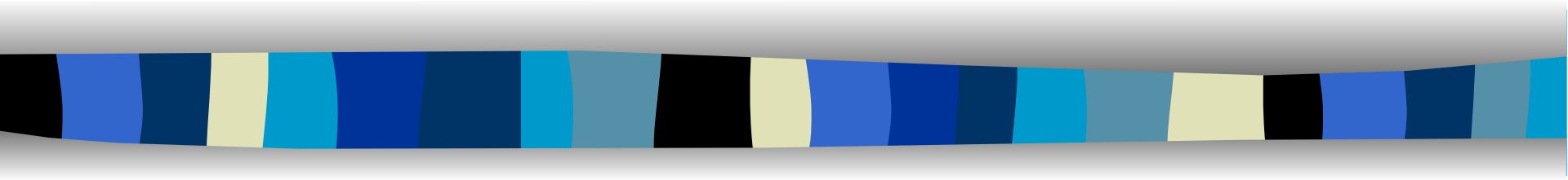
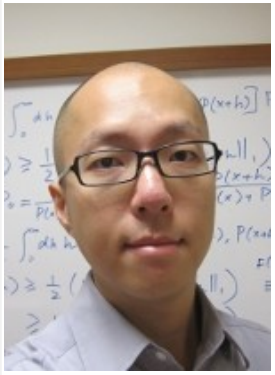
PC2232 Physics for Electrical Engineers



Lecture 0: Introduction

Our Team : Lecturer & Tutors



Lecturer: Mankei Tsang

Assistant Prof. in ECE and Physics
BSc in EE and Physics (UCLA), MSc and PhD in EE (Caltech), postdoc research at MIT and Univ. New Mexico
Office: E4-05-29
Tel: 6601 2340
mankei@nus.edu.sg
Research interest: Theoretical Optics, Quantum Measurement Theory
Website: http://www.ece.nus.edu.sg/stfpage/tmk/

Tutors:

Angeline Shu
S13-04-08
6516-2617
physhua@nus.edu.sg

Lim Yen Kheng
S12-02-12
6516-2625
phylyk@nus.edu.sg

Approximate Coverage

Prerequisite: EE2011 Engineering Electromagnetics

Basic concepts of modern optics (Weeks 1 – 3)

- Maxwell's equations, wave equations, plane EM waves, standing EM waves, Poynting vector, power, polarization, reflection, refraction, interference, diffraction; EE related applications (optical waveguides, optical data storage systems)

Introduction to quantum mechanics (Weeks 3 – 4)

- Classical versus quantum physics, probability versus probability amplitudes, Born's rule, Stern-Gerlach experiments

Approximate Coverage

Wave function and quantization (Weeks 5 – 7)

- Schrödinger equation (wave function, probability, charge density, current density), free particle, quantum confinement (harmonic oscillator, 1D, 2D, 3D potential wells), quantization of energy, ground state and tunneling; EE related applications (semiconductor quantum wells, quantum wires and quantum dots).

Hydrogen atoms, atomic bonding, solids (Weeks 8 – 10)

- Particle in central potential, hydrogen atom, angular momentum, electron spin, atomic states, atomic bonding, solid, periodic potentials, energy band, metal, insulator and semiconductor

Approximate Coverage

Optical transition in atoms and solids (Week 11 – 13)

- Optical transitions between atomic levels, spontaneous emission, absorption, stimulated emission, laser; EE related applications (LEDs, LDs, optical communications, DVDs, and display technologies)

This is only a very rough guide. The timing is only approximate, and the order which some of the topics will be taught may also be switched to enhance your understanding.

Organization of module

Lecture	Tue 12 – 2pm (LT7A), Fri 10 – 12 noon (LT7A)
Tutorial	Once a week – starts 3rd week.
Practical	2 experiments for whole semester – in Physics Dept See your lab schedule.
Term Test	1 h 30 m: 20 MCQs. On Week 7 (March 6, 10-12pm)
Exams	Final closed book written examination. 2 hours duration. April 29, 9am

Events in this semester that affect us –

Chinese New Year: 20 Feb (Friday)

Good Friday: 3 April (Friday)

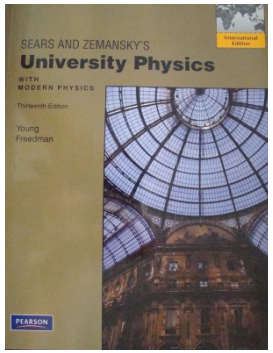
Module Workload

Activities	Hours / week
Lectures	3.0
Tutorials	1
Labs	0.5
Preparation for class	**5.5**
Total	***10***

- * Approximate - excludes public holidays and term test.

Recommended Textbooks

No single textbook covers the topics adequately. You can obtain all the fundamental ideas from any introductory University Physics textbook, e.g.,



University Physics

Young & Freedman (13th Ed, 2011)

Pearson – Addison Wesley

- **Feynman's Lectures on Physics**
  http://www.feynmanlectures.caltech.edu/
- **Physics for Scientists and Engineers** – Serway & Jewett, Thomson – Brooks/Cole
- **Fundamentals of Physics** – Halliday, Resnick and Walker, John Wiley
- **University Physics –** Bauer & Westfall, McGraw Hill

Supplementary textbooks

- More advanced examples and applications will be taken from other sources and we will indicate them in the lectures, e.g.,
  - **Optics**
    - Hecht, Addison Wesley
    - Pedrotti, Pearson Addison Wesley
  - **Modern Physics** –
    - Randy Harris, Pearson Addison Wesley
    - Bernstein, Fishbane & Gasiorozicz, Pearson Prentice Hall
  - **Quantum Mechanics** –
    - Bransden & Joachain, Pearson Prentice Hall
- There are also textbooks meant for engineers which you may also refer to, e.g.,
  - **Engineering Physics – Fundamentals & Modern Applications** – Khare & Swarup, Infinity Science Press

Assessment

	%	Components
1	10	Practical – discussion / viva & report,
2	10	Tutorials (attendance, participation, etc.)
3	20	Term Test
4	60	Final written examination

Lectures

- Strongly encouraged to attend all lectures.
- PDF slides to be uploaded into IVLE (before lectures if possible).
- Download Lecture slides from

  IVLE – PC2232 – Workbin – Lectures

Group Tutorial

Conducted in every week starting from Week 3.

10 tutorials in total.

Problems will be given in advance, you are strongly encouraged to attempt them before coming to the discussion.

Attendance will be taken and tutors will organize tutorials in a way that encourages discussion and teamwork – it's also about learning and collaboration.

Some questions may be set as assignments to be handed in during tutorials.

May also use classroom feedback systems (clickers) for interactive learning.

Practical (10%)

- In total, 2 laboratory sessions (each 3 hours):
  - *Diffraction (Weeks 4 – 7)*
  - *Scanning Tunneling Microscope (STM) (Weeks 8 – 13)*
- Venue: Physics-E Lab, S11 03-02 (in Physics Dept.)
- If absent, please arrange another session with Ms Foo Eng Tin: phyfooet@nus.edu.sg or at above venue as soon as possible.
- Each session consists:
  - *Short Group Briefing*
  - *Carry Out Experiment in Pair (1st expt) / group of 3 (2nd Expt)*
  - *Viva (Oral Examination) – Individual*
  - *Individual report (to be submitted within 24 hours after the experiment)*

Term Test (20%)

- **Format:** 20 Multiple Choice Questions
- **Duration:** 1 hour 30 min
- **Date:** March 6 (Friday)
- **Time: 10am to 12pm**
- **Venue**: To be finalized
- **Coverage:** Optics and Quantum Physics (first half)

Still subjected to change – please treat as tentative.

Written Examination (60%)

Format:
5 Short Qns (10% each), **2** Long Qns (25% each)
- (all compulsory)

Duration: 2 hours

Date: 29 April Wednesday

Time: 9am

Venue: To be announced

Coverage: Everything (but slightly more emphasis on those not covered in test)

Still subjected to change – please treat as tentative.