PHYS5320 Photonics: Materials and Devices

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Tutor:  Cui, Ximin (崔熹旻)
xmcui@phy.cuhk.edu.hk
Tel: 5933 3659
Consultation time: Tu 2:30 pm – 4:15 pm
Room LG220, Run Run Shaw Science Building
(Please enter Room LG220 and reach the hallway close to the windows on the other side, where Mr. Ximin Cui sits.)
PHYS5320 Photonics: Materials and Devices

**Time & Location:**
- Mon, 4:30 pm – 6:15 pm, SC_L2
- Wed, 4:30 pm – 6:15 pm, SC_L5

**Score weight**
- Homeworks: 10×, 15%
- Exams: 3×, equally weighted, 85%

Course information (contents, homework, and lecture slides) is available at:
http://www.phy.cuhk.edu.hk/~jfwang/
Why do we want to study OPTICS and PHOTONICS?

Some key advanced technologies are based on OPTICS and PHOTONICS.
lasers

light-emitting diodes

laser surgery

laser surgery
Photonic chip – *Photonic integrated circuit*
https://www.submarinecablemap.com/
How are signals transmitted through optical fibers?
Light sources (LEDs and LDs) are needed!
Electronic signals have to be somehow converted into optical signals (modulators).

Photodetectors are needed to convert optical signals back into electronic signals.
WLAN (Wireless Local Area Network): does not require costly wiring. Easier, cheaper, and faster to set up.

WLAN operates using radio frequency (RF) technology (2.4, 3.6, 4.9, 5.0 and 5.9 GHz). A key device is known as an access point (AP). It is usually connected to a wired network. It sends out wireless signals. Computers and cellular phones are equipped with wireless network adapters, which receive wireless signals.
Course Contents

Nature of light
Waves
Photons

Dielectric waveguides and optical fibers
Refractive index
Snell’s law and total internal reflection
Slab waveguides
Step index fibers
Dispersion in single mode fibers
Bit-rate, dispersion, electrical, and optical bandwidth
Graded index optical fibers
Attenuation in optical fibers

Semiconductor physics
Crystal structures of solids
Semiconductor concepts
Charge carriers in semiconductors
Carrier transport

Light emitting diodes
PN junction principles
Forward and reverse applied bias
Light emitting diodes

Lasers
Stimulated emission and photon amplification
Laser gain
Population inversion
Threshold gain coefficient
Laser resonators
Beam irradiation and divergence
Examples of important laser systems
Examples of applications

Photodetectors
Photoconductor
PN Photodiode
PIN photodiode
Avalanche photodiode
Phototransistors
Course Contents – Continued

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<td>Polarization</td>
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Some groups (Daniel H. C. Ong, Dajun Wang, Sen Yang and my group) are carrying out research relying on optics and photonics. You can try to visit their groups to have a look at various optical components.


Highly Recommended Preliminary Knowledge

1. Electromagnetism
2. Introduction to solid state physics
Some Notes

1. **Tutoring** classes will be used for lecturing.

2. **State-of-the-art related research works** will be selectively introduced briefly.

3. Welcome to ask questions about the course in the classes, by email, or stopping at my office.

4. **Homeworks**: Answers will be provided. The questions will be incorporated in the exams.

5. The **final grades** are based on the overall scores.

6. Please try to **attend the exams**. If someone misses one exam, no points will be given for that exam.

7. Why are there **3 exams** and homeworks?
2017 – 2018 second term

Teaching period: 08 Jan 2018 (Mon) – 21 Apr 2018 (Sat)

Class make-up: 23 Apr 2018 (Mon) & 24 Apr 2018 (Tue)

Exam period: 25 Apr 2018 (Wed) – 12 May 2018 (Sat)

Holidays: 15 Feb 2018 (Thu) – 21 Feb 2018 (Wed), Lunar New Year
30 Mar 2018 (Fri) – 02 Apr 2018 (Mon), Easter
5 Apr 2018 (Thu), Ching Ming Festival

Reading week: 29 Mar 2018 (Thu) – 04 Apr 2018 (Wed)

Does not apply for postgraduate students

Approximate exam dates: First, 12 Feb 2018 (Mon)
Second, 26 Mar 2018 (Mon)
Third, 25 Apr 2018 (Wed)