Course syllabus

Basic Information:

Course title (中文): 有機光電：物理・材料和元件

Course title (English): Organic optoelectronics: physics, materials and devices

Instructor: **大江昌人 (Oh-e, Masahito)** (oh-e@ee.nthu.edu.tw) @台達館#838

Language for teaching: English

Class time: M7M8W6 *Location:* DELTA 台達 212

Course Description:

This course is constructively prepared for graduate and senior undergraduate students. Organic optoelectronic devices such as liquid crystal displays (LCDs) and organic light-emitting diodes (OLEDs) consist of interdisciplinary technologies. This course offers physics, materials science, and device applications about liquid crystals and organic semiconductors. Device physics is also included. If time permits, we will also learn other optoelectronic devices such as quantum dot displays and μ-light emitting diode (μ-LED) displays. This course is oriented to material physics and science, however, the course "有機光電材料科學" (in the Fall semester) is not necessarily a prerequisite for this course.

* The course is offered in English.

Course materials:

Available on https://eeclass.nthu.edu.tw/

References:

"Concepts of Modern Physics", sixth edition, by Arthur Beiser (Mc Graw Hill);

"Modern Quantum Mechanics", by J.J. Sakurai (Addison-Wesley Publishing Company);

"Organic Electro-Optics and Photonics: Molecules, Polymers and Crystals" by L. R. Dalton (Cambridge Univ. Press);

"Optics and nonlinear optics of liquid crystals", by Iam-Choon Khoo (World Scientific);

"Introduction to liquid crystals–Chemistry and Physics–", by Peter J. Collings and Michael Hird (Taylor&Francis);

"Liquid crystal displays", by Ernst Lueder (Wiley-SID series in display technologies);

"OLED Displays and Lighting", by Mitsuhiro Koden (IEEE Press, John Wiley & Sons, 2017); …, etc.

Teaching Method:

Combining blackboard teaching with power point viewgraphs.

Report presentation by students.

Syllabus:

Session 1–2: Overview of liquid crystal display (LCD)

- Various flat panel display (FPD), • Operating principles of LCD and driving schemes,
- Manufacturing process, • Peripheral technology supporting liquid crystal industry, … etc.
- Overview of in-plane switching (IPS)-LCD

Session 3–10: Fundamentals of LC

- What is LC? • Classification of LC, • Discovery of LC and history,
- Why LC molecules tend to align? • Order parameter and director, • Phase transition,
- Frank's elastic free energy, • Interaction with electric and magnetic field,
- Frederik's transition, • Hydrodynamics, • Scattering, • Optics of LC,
- Topological defects of LC, • LC display modes, …etc.

Session 11–12: Overview of organic light-emitting diode (OLED)

- History of OLEDs, • Operation principles of OLED, • OLED device structures,
- Fabrication process, • Driving technologies of OLED display, • OLED Lighting,
- Flexible OLEDs, • Other technologies, …etc.

Session 13–15: Fundamentals of OLED

- Electroluminescence mechanism, • Elementary processes, • Unit of light,
- Efficiency, • Light extraction, • OLED materials, • Energy transfer, • Marcus theory, …etc.

Session 16: Final

** The contents and plans will be appropriately changed and adjusted during the course.

Grading:

Homework, quiz, and performance in the class (The midterm will be replaced with a report work in the final or other methods.) (30%), Final report including presentation (40%), Class attendance and participation (30%)

*** This may be adjusted in the end of the semester.