

## **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](mailto:oh-e@ee.nthu.edu.tw)) @台達館#838

*Language for teaching:* English

*Class time:* W2F3F4      *Location:* DELTA 台達 211

### **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  $\mu$ -light emitting diode ( $\mu$ -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 Kodan (IEEE Press, John Wiley & Sons, 2017);

..., etc.

### **Teaching Method:**

Combination of blackboard teaching with power point viewgraphs.

Report presentation by students.

**Syllabus:**

Session 0: Introduction – Course guide –

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.

Session 3: Overview of in-plane switching (IPS)-LCD

Session 3~11: 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 10: Midterm)

Session 12~13: 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 15~16: Quantum dot display,  $\mu$ -light emitting diode ( $\mu$ -LED) display

Session 17: Final

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

**Grading:**

Homework, quiz and midterm (Report) (30%), Final report including presentation (40%), Class attendance and participation (30%)

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