

Electronic Biomedical Nanosensors (電子式生醫奈米感測器)

Instructor : Yu-Lin Wang/王玉麟 (ylwang@mx.nthu.edu.tw)

Course level : Undergraduate or graduate students

Course goals : The first goal is to learn the knowledge of biological systems, important biomolecules, and biological recognition. The second goal is to learn different electronic transducers and the incorporation of sensing elements and nano-materials for chemical or biological molecule detection.

Prerequisite : general chemistry and general physics

Text Book/ Reference book:

Part I & Part II

“Biochemistry”, by R. H. Garrett and C. M. Grisham, Brooks/Cole, 4th Ed. 2010 (ISBN-13: 978-0-495-11464-2; ISBN-10:0-495-11464-2)

Part III

“Semiconductor Devices-Based Sensors for Gas, Chemical, and Biomedical Applications” by Fan Ren & Stephen J. Pearton, CRC Press, 2011 (ISBN : 978-1-4398-1387-4)

“Chemical Sensors and Biosensors,” by Brian R. Eggins, John Wiley & Sons 2002.

And handouts

Course Outline

1. Introduction : Biomedical sensor architectures, types, and applications (2/23)

Part I: Biochemistry and biomolecules

2. Biological system and Buffer solutions; Amino acid and Proteins : structures and functions (3/1)

Part II: Chemical and biological recognition

3. Enzymes kinetics and specificity (3/8)

4. DNA structures and characteristics (3/15)

5. Antibody, Receptors, and Chemicals (3/22)

Part III : Transducers and Sensors

6. Surface Immobilization and Characterization (3/29)

7. Exam 1 (4/5)

8. Semiconductor and nanomaterials-based Sensors : Principle, devices, and

applications (4/12, 4/19, 4/26)

Sensor made of ISFETs, MOSFETs, HEMTs, Schottky diodes, and conductors.

Detection of Biomolecules, chemicals, ions, and gases.

Materials applicable of Compound and Si semiconductors, CNTs, and graphenes..etc.

9. Electrochemical Sensors : principle, devices and applications (5/3, 5/10)
10. Piezoelectric materials-based Sensors: Principle, devices, and applications (5/17)
11. Other type sensors (5/24)
12. Exam 2 (5/31)
13. Presentation (6/7)
14. Report (6/14)

Grading : Exam 1: 30%

Exam 2: 30%

Report : 20%

Presentation : 20% (from the class)

Office hours : make an appointment

For the report :

Submit the title of the topic and the abstract describing what you want to study to the instructor via e-mail by the 2nd midterm exam for approval. After approved, you can start your work. The title has to be relevant to the course. Early submission is highly recommended. The maximum page number is 15, not including references. The title of the topic cannot be exactly the same with any other paper. The topic is assumed to be generated from studying several papers or books. It is suggested that students start from review papers. Turn in the paper at the date that your group gives presentation in class. Sentences or paragraphs are exactly same with any other person's work no matter with or without citations, including public or non-public papers, will be regarded as plagiarism. Once a term paper is regarded as plagiarism, the student will fail to get any score with that paper. English is required for this term paper.

For the presentation :

Each group is allowed to give a talk in 25 mins and the Q & A in 5 mins. The topic is exactly the same with that of the term paper. The grade for the presentation (20%) will be assessed by the whole class. English is required for the presentation. Language fluency will not be considered in grading. Instead, whether the speech is well

organized, the topic is significant, the review is in depth, the coverage of the content is adequate, and the answers for questions are satisfied, will be the factors for evaluation. However, clear expression by the speaker will help the audience to learn easily which may lead to a positive evaluation.