

## **EEE 598B ST: Molecular Electronics**

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*Instructor: Nongjian Tao, Prof. of Electrical Engineering & Affiliated Prof. of  
Chemistry and Biochemistry  
Email: Nongjian.tao@asu.edu*

### **Description and Objectives:**

It is widely believed that the emerging field of nanotechnology will lead to the next industrial revolution. A central theme of nanotechnology is to build electronic and sensor devices using individual molecules. This course is to introduce the student to the frontiers in molecular electronics. Because most progress in nanoscale science and technology results from research involving various combinations of Engineering, Chemistry, Physics, Biology, and Computer Science, this is an interdisciplinary course and tailored for both engineering and science students. The course will cover fundamental aspects of molecular electronics, including electron transport in molecules, molecular self-assembly and nanofabrication, single molecule detection and manipulation. It will also discuss the most recent advances in the field using selective examples from the research literature, including molecular wires, quantum dots, switches and motors, DNA computing, nanosensors and organic transistors.

### **Textbooks:**

There is no prescribed textbook for the course, but reference books and materials will be provided.

### **Prerequisites:**

The course is intended for graduate students and undergraduate seniors from Engineering, Chemistry and Physics. Background in basic quantum physics, chemistry, and solid state electronics (e.g., ECE 352, EEE 434, or equivalent courses) is expected.

## Term Paper Instructions

You are required to write a critical/comprehensive term paper. While you have freedom to choose a topic of your own interest, the topic must be relevant to molecular electronics. A reprint of your qualify exam or a summary of your own research will not be acceptable. A list of suggested topics is given below, but you are encouraged to come up with your own topic and discuss the topic with me.

In addition to term paper, you are required to give a 15 mins oral presentation (power point slides) in class. We will discuss the presentation schedule in class. The final grade of the term paper is based on the following criteria: 1) Relevance (the topic has to be relevant to the class, and the materials have to be relevant to the chosen topic). 2) Completeness (the paper needs to cover all the works published to date. Simply focusing on one or two papers will not be considered being complete.) 3) Critical (the significance and weak points of each work needs to be discussed). 4) Clarity (this applies to both the written paper and oral presentation. 5) Creativity (You have some original ideas that you want to present? That is great! You will get bonus points).

A list of suggested topics:

- 1) Molecular rectifiers
- 2) Molecular switches and transistors
- 3) Molecular motors or electromechanical devices
- 4) Magnetic or spintronic properties of molecules
- 5) Molecular thermoelectric devices
- 6) Piezoelectric & piezoresistive properties of molecules.
- 7) DNA computation
- 8) Charge transport in DNA
- 9) Molecular memory devices
- 10) Experimental techniques for probing electron transport in molecules
- 11) Theoretical methods for calculating electron transport in molecules
- 12) Molecular sensors
- 13) Optoelectronic properties/devices of single molecules
- 14) Assembly of molecular electronic devices
- 15) Architecture of molecular electronic devices
- 16) Molecular energy harvesting devices
- 17) Many more....