EE 3940 – Global Seminar: Nano-Bio Circuits and Systems in London and Paris
Prof. Jerry Sobelman – May Intersession 2010
(Updated 4/18/10)

Goals and Objectives of the Course

The purpose of this class is to obtain an understanding of current research and development work in the areas of nano-bio circuits and systems. The specific technologies to be studied include nanodevices, nanoelectronics, systems biology, bioinformatics, and nano-related applications in biology, medicine and communications. Students will gain an understanding of the current state-of-the-art in these areas and learn how engineering advances occur in today's global technology environment. Site visits will be made to universities, R&D laboratories and high-tech companies. We will also attend the premier conference in the circuits and system area, the IEEE International Symposium on Circuits and Systems.

Required Pre-Departure Meetings (during Spring Semester, 2010)

Monday, April 19: 7:00 – 9:00 PM, Walter Library 101:
Guest presentation by Prof. Stephen Campbell (ECE Dept.) on nanotechnology. Also, course orientation and logistics – part I (with Adam Pagel).

Thursday, April 22: 7:00 – 9:00 PM, EE/CS 2-260:
Guest presentations by Prof. Chad Myers (CSE Dept.) and Prof. Marc Riedel (ECE Dept.) on bio-related topics. Also, introduction to the technical sites to be visited.

Tuesday, May 4: 12:30 – 2:00 PM, ME 1130:
Course orientation and logistics – part II (with Adam Pagel).

Technical Site Visit Schedule

Wed. May 19	Imperial College, London http://www3.imperial.ac.uk/electricalengineering
Thurs. May 20	London Centre for Nanotechnology http://www.london-nano.com/
Fri. May 21	University of Cambridge - Nanoscience Centre, Cambridge http://www.nanoscience.cam.ac.uk/
Fri. May 21	Wellcome Trust Sanger Institute, Cambridge http://www.sanger.ac.uk/
Tue. May 25	University of Oxford http://webnix.physics.ox.ac.uk/biophysics/, http://www.physics.ox.ac.uk/cm/cmt/research.htm

Fri. May 28	France Telecom, Paris http://www.francetelecom.com/en EN/
Mon. May 31	IEEE International Symposium on Circuits and Systems, Paris http://www.iscas2010.org/
Thurs. June 3	Ecole Centrale Paris http://www.ecp.fr/index html en
Fri. June 4	University of Pierre and Marie Curie, Paris http://www.upmc.fr/en/index.html

Required Reading (to be completed during Spring Semester, 2010)
(materials available at the WebVista course site)

1. "The Future of Integrated Circuits: A Survey of Nanoelectronics," Michael Haselman and Scott Hauck, *Proceedings of the IEEE*, Vol. 98, No. 1, pp. 11-38, January 2010.

2. "Molecular Biology for Computer Scientists,"Lawrence Hunter, Chapter 1 of *Artificial Intelligence and Molecular Biology*, AAAI Press, 1993.

Supplementary References
(materials available at the WebVista course site)

1. "Genomics and Proteomics: A Signal Processor's Tour," P. P. Vaidyanathan, *IEEE Circuits and Systems Magazine*, pp. 6-29, Fourth Quarter 2004.

2. "Nanotechnology for Genomic Signal Processing in Cancer Research," Jie Chen and Stephen T.C. Wong, *IEEE Signal Processing Magazine*, pp. 111-121, January 2007.

3. "Analysis and Design of Biological Circuits and Systems," Heinz Koeppl and Gianluca Setti, *IEEE International Symposium on Circuits and Systems,* pp. 297-300, May, 2009.

4. "Reverse engineering of gene regulatory networks," K.-H. Cho, S.-M. Choo, S.H. Jung, J.-R. Kim, H.-S. Choi and J. Kim, *IET Systems Biology*, Vol. 1, No. 3, pp. 149 – 163, May, 2007.

5. "Stochastic Simulation of Chemical Kinetics," Daniel T. Gillespie, *Annual Review of Physical Chemistry*, Vol. 58, pp. 35–55, May 2007.

6. "Network Motifs: Theory and Experimental Approaches," Uri Alon, *Nature Reviews Genetics*, 8, pp. 450–461, June 2007.

7. "Foundations for Engineering Biology," Drew Endy, *Nature Review* 438, pp. 449 - 453, Nov. 2005.

8. "Writing and Compiling Code into Biochemistry," Adam Shea, Brian Fett, Marc Riedel, Keshab Parhi, *Proceedings of PSB*, 2010.

<u>Other Course Requirements – Before the Seminar</u>

- Write a two-page introduction to one of the sites that we will visit. (You will also give a presentation about this site to the rest of the class on the day of our visit to that site).

<u>Other Course Requirements – During the Seminar</u>

- <u>Maintain a daily journal</u>. Record your thoughts, reactions and impressions of each of the sites that we visit. At the technical sites, be sure to carefully and completely record details about the technologies, designs, research directions, key people involved, etc.

- <u>Participate</u>: Listen carefully and ask relevant and thoughtful questions. Compare what you are hearing and seeing with what you have already learned in your previous courses and/or past work experience. Share your thoughts and ideas with the group.

<u>Other Course Requirements – After the Seminar</u>

- <u>Write a Final Report</u>: The written report is due by **4:00 PM, Monday, June 28**. Note that clarity, grammar, spelling, etc. are important so be sure to carefully proof-read your report. <u>Important</u>: The report must be written entirely in your own words. Be sure to use the following organization:

  o <u>Summary of Technologies</u>: Based on what we have learned, select 2 specific topics (1 nano-related topic and 1 bio-related topic) which are of most interest to you. Explain how each of these topics were being investigated at one or more of the sites that we visited. If appropriate, explain the different approaches taken by universities, companies and research labs. This section should be 4 double-spaced pages in length, including figures and tables.

  o <u>Detailed Technical Analysis</u>: Select one of the topics you described in the previous section for further analysis. Explain the engineering, scientific and/or mathematical basis for the technology. If appropriate, state and explain the fundamental equations which govern the field. What are the key parameters that should be optimized? What fundamental or practical constraints limit the current state of progress in the area? What will the state of this technology be like 5 years from now? Apply concepts and knowledge gained from the site visits, your previous technical courses, the required reading and supplementary references, and other references to provide additional insights and explanations. This section should be 8 double-spaced pages in length, including figures and tables.

<u>Grading System</u>
Site Report/Presentation 10%, Homework 10%, Journal 20%,
Participation 30%, Final Report 30%