

Course Outline

BE 7250: Advanced Instrumentation and Control for Biological Systems

Instrumentation theory [Weeks 1-2]

Sensing and measurement;
Transducers;
Analog and digital measurement systems.

Control concepts [Weeks 3-4]

Feedback loops;
Measurement;
Laplace transform methods;
Classical (analog) control theory;
Digital control theory.

Relevant properties of biological systems: [Weeks 5-6]

Growth;
Reproduction and death;
Trophic levels;
Environmental and ecological issues and complexity.

Advanced Instrumentation and Control: Integration [Weeks 7-9]

Applications of Modeling and Simulation;
Adaptive Control;
Specific Examples of Design and Control Simulation Languages:
Matlab
Femlab
Applications in Biological Engineering

Project Work [Weeks 9-15]

Final Project Suggested Application Areas:

Environmental Applications: [Review Weeks 9]

Environmental monitoring: automated systems for environmental monitoring

Precision or Prescription Farming: (Barbosa, Smith) GPS and GIS applications in agriculture and related areas.

Control Systems Applications: (Hall, M)
systems.

Autonomous Vehicles: [Week 11] (Hall)

Improvements in autonomy of land, air and water based vehicles,

Control systems (e.g. what drives vehicle, batteries, AC/DC power supplies)

Control mechanisms (e.g. servos); control processors (e.g. BASIC Stamp)

Biosensors/Biomedical: [Week 12] (Monroe, Haven, possible contributors)

Applications of mass spectrometry and in biosystems.

Protein interactions "proteomics".

Biomedical applications (Greatbatch and biomedical history)

Food and Process Engineering Automation: [Week 13] (Gallie, Daldor, possible contributors)

Automated equipment in the food processing industry;

Control systems;

Rice Mill operations.

Final Projects and Presentation Due: [Weeks 14-15]

Reference Reading List
Steven G. Hall, Assoc. Professor, 578-1049 cell 281-9454.

Dally, James W., William F. Riley and Kenneth G. McConnell, 1993. Instrumentation Measurements. Second Edition. John Wiley and Sons, New York, 504 pp.

Doebelin, Ernest O., 1990. Measurement Systems, Application and Design, Fourth Edition. McGraw Hill: New York, 960 pp.

Franklin, G. F., J. D. Powell, J. M. Lathi, 1990. Digital Control of Dynamic Systems. Second Edition. John Wiley and Sons, New York, 514 pp.

Karnopp, Dean C., Donald L. Margolis and Ronald C. Rosenberg, 1990. System Dynamics, A Unified Approach, Second Edition. John Wiley and Sons, New York, 514 pp.

Mohsenin, Nuri N., 1986. Physical properties of plant and animal materials : structure, physical characteristics, and mechanical properties. New York : Gordon and Breach, 801 pp.

557 pp.

Costa, Katsuhiko, 1990. Modern Control Engineering, Second Edition. Prentice Hall, Englewood Cliffs, NJ, 963 pp.

Omega Catalogs: www.omega.com.

Park, Leon B., Biomaterials : an introduction, 1979. New York : Plenum Press, 251 pp.

Parallax website: www.parallaxinc.com

Shahian, B. and Michael Hassul, 1993. Control System Design Using MATLAB. Prentice Hall: Englewood Cliffs NJ, 503 pp.

Stark, G. B. and P. Horch, 1998. Biological matrices and tissue reconstruction. New York : Springer-Verlag.

BE 7350 Spring 2012 Course Outline

Date	Topic
1/17	Introduction, instrumentation review (Omega materials)
1/24a	Control concepts; digital mathematics
1/24b	Biological applications introduction*
1/31a	Differential Equations
1/31b	Differential Equations; Project Discussion*
2/7a	Analog Control Theory (P.L.D.) Review*
2/7b	Digital Control Theory Review; Preliminary Project Proposals Due
2/14	Mini-Lecture: Process/Block Diagrams; ADP Math*
2/14b	Microcontroller theory and introduction (Smith) Project Proposals Due
2/21	(ward/Chris) independent work on projects
2/28a	Discussion Class: Autonomy (Smith et al) Independent work on Projects
2/28b	Control system simulation: MATLAB, SIMULINK *
3/6	Midterm; Project Update Due
3/13	Final Lecture: Introduction Applications FDA
3/20	Discussion: Environmental and Human Issues (Student Led)*
3/27	Discussion: Biological and Environmental Issues (Student Led)*
4/3	Discussion: Diagnosis Applications (Guests TDA)
4/10	Discussion: Measurement and Control in the Biosphere (Guests TDA)
4/17	Student Presentations, Ag, Env, Biomed (Students)
4/24	Student Presentations: Biosensors; Bioprocess; Biotech (Students)**
5/1	Conclusion, Party! (under control?) Final Reports due 5/1/09

* Student presentation/facilitation of peer reviewed articles.

** Student presentations of final research reports