# ECI (EN-3212)- Electronics (& Computer Integration)

# Electronics - Fall 2012

ECI provides a broad overview of the modern electronics used by the marine and power industries for automation, system monitoring and control. Electronic components and circuits are categorized by function (sensor, transmitter, actuator or controller), signal type (analog or digital), and technology (i.e., computer, micro-electronic, solid-state).

## Learning Outcomes:

1. Understand the relationship of component blocks and signals in electronic systems.
2. Define primary circuits and components used for analog signals and conditioning.
3. Define primary circuits and components used for digital signals and conditioning.
4. Read analog and digital circuit diagrams, and identify basic electronic components.
5. Understand the use of solid-state devices for amplification and switching applications.
6. Read and understand PLC and ladder logic circuits used in discrete-state applications.

**Text:** **Process Control Instrumentation Technology**
Curtis D. Johnson, 8th Edition (© 2006), Prentice Hall

**Instructor:** Dr. John J. Bausch Phone: (508) 830-5000 (x-2029)
Email: jbausch@maritime.edu Room: HA 222
Home Office (Thurs): use email (or Skype if needed)

**Calendar:** Subscribe within Calendar Software (iCal on Macs, Outlook, and Google): (check you email for setup inst

**Class:** Monday, Wednesday, and Friday
Section 11- 0800 to 0850 Hours (1st period)
Room: BR 222 (see my ELab Hours for extra help)

**Grading:** Grades are based on homework, quizzes, and exams. The 2-hour final is comprehensive. Assignments are made via email. **Late work will NOT be accepted.**

**Evaluation:** Exam problems are based primarily on homework and quizzes.

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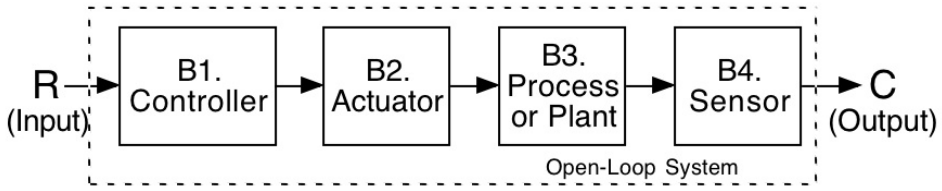
| Homework (~weekly) | 10% |
| Quizzes (any time) | 20% |
| Exam1 | 20% |
| Exam2 | 20% |
| Final (2 hour Comprehensive) | 30% |
| Total Grade | 100% |

# ECI (EN-3212)- Electronics & Computer Integration

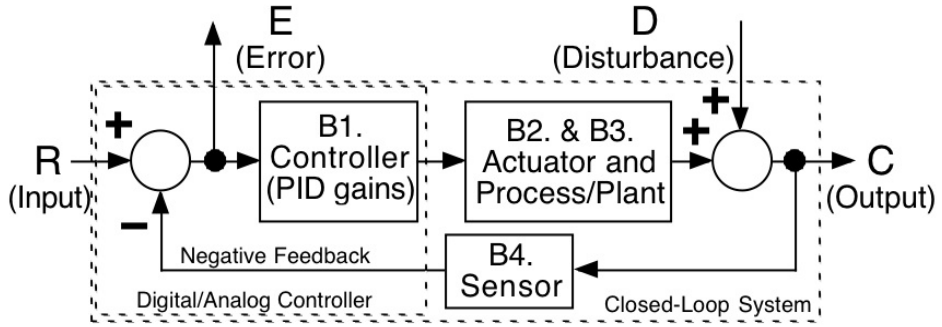
ECI now uses the textbook previously used for Instrumentation & Control: Curtis Johnson's "Process Control Instrumentation Technology". Using the first eight chapters, students are exposed to most of the electronic hardware components and systems in use in both analog and digital worlds. The open-loop diagram below is used to introduce students to the concept of a system, and the input/ output relationships of most industrial electronic components. Electronic hardware components are then defined as part of a 1) Controller, 2) an Actuator, or 3) a Sensor, and related to a process or application.




**ECI-Electronics:** The Open-Loop Block Diagram defines the major components of Electronic Hardware studied, and the relationship of signals and signal processing.

# INC (EN-4223)- Instrumentation & Controls

Modern digital controllers require more advanced models and systems; real-time signals are integrated through programs like Matlab/Simulink (introduced in INC) using C-language-like .m files. The INC class takes the component block diagram from ECI (shown above), and adds the complexity of a closed-loop, multi-input, multi-output, PID controller (shown below). In this case, the system dynamics are essential to design, and the INC class introduces controller performance parameters based on 1) Stability, 2) Speed of Response, and 3) Dynamic Accuracy.




**INC-Controls:** The Closed-loop Block Diagram for Instrumentation & Controls. INC uses transfer functions to study the more advanced concepts of dynamic modeling and multi-input, multi-output, proportional-integral-derivative (PID) control systems.

# ECI-SAMPLE- See the iCal Link (class email)

NOTE: This is Not the ACTUAL Syllabus. Check your email for the iCal Link to the online schedule. The online schedule is regularly updated for this Semester.

L1: Welcome to ECI
L2: Intro to Marine Electronics
L3: Electronic Control Applications
L4: Intro to Control Systems
L5: Control System Performance
L6: Digital & Analog Systems
L7: Levels of Control Electronics
L8: Measurement Units & Error
L9: Error, Accuracy & Uncertainty
L10: Sensors & System Dynamics
L11: Intro to Analog Signal Processing
L12: Filtering & Impedance
L13: Voltage Dividers & Bridges
L14: RC (Analog) Filters
L15: RC Filter Design
L16: Exam1 Review
L17: 1st Order & 2nd Order Hi-Pass Filters
L18: Advanced RC Filter Design
L19: Filter Design with Op-Amps
L20: Intro to Operational Amplifiers
L21: Op-Amp Electronic Circuits
L22: Intro to Digital Signal Processing
L23: Boolean Algebra & Logic Gates
L24: Digital PLCs (Programmable Logic Controllers)
L25: Digital Electronics & Devices
L26: Digital to Analog Converters (DACs)
L27: Analog to Digital Converters (ADCs)
L28: Exam2 Review
L29: Guest Lecture: Mr. Tom Quinn from Rolls Royce Marine
L30: Intro to Ladder Logic & PLC Systems
L31: Switching Theory & Boolean Logic
L32: Ladder Logic System Design
L33: E-M Relay Timer Design
L34: Cargo Elevator Application Case Study
L35: Intro to Industrial PLCs
L36: PLC Programming
L37: Transistors & Solid-State Relays
L38: ECI Course Review
L39: Final Exam

**Problem Set #1:**
ECI- PSet1 Due Friday, 14Sep12

Reading: Chapter 1 in Johnson (Sections 1.1-1.4)

Problems:
1.1- A/C System, Block Diagram

1.2- Auto Driving Control
Is this open-loop or closed-loop?
What are the sensors?

1.3- Refer Madness. Chill out with another Block Diagram.

1.4- Control Performance Criteria: Max Error and Settling Time

1.5- System Tuning

1.6- Quarter Amplitude Criterion

1.7- Quarter Amplitude Criterion again

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