OPC (EN-3216)- OpCons (Electronic & Control Instrumentation)

Operational Controls - FALL 2022 (STCW)

Operational Controls studies the principles of industrial measurement and control with emphasis on practical applications aboard ship and in industry. Topics will include electronic sensing, measurement & transmission of data from industrial processes, closed-loop feedback & automatic control systems, analog & digital control hardware, and control modes & configurations. Mechanical, electronic, analog and digital control mechanisms will be discussed, as will programmable logic controllers. *Co-requisite: EN-3212 STCW: Knowledge*

Learning Outcomes and STCW Demonstrated Knowledge, Understanding & Proficiency:

OICEW-A4.1 Basic construction and operation principles of automatic control systems
OICEW-A5.1 Operational characteristics of control systems
OICEW-B1.1 Basic configuration & operation of sequential control circuits & associated devices
OICEW-B1.2 Flowchart for automatic and control systems
OICEW-B1.2 Functions, characteristics and features of control systems for machinery items
OICEW-B1.3 Various automatic control methodologies and characteristics
OICEW-B1.3 Proportional–Integral–Derivative (PID) control characteristics
OICEW-B1.3 Associated system devices for process control
OICEW-B1.3 Configuration and operation principles of control systems
OICEW-B2.5 Function and performance tests of electrical & electronic monitoring systems
OICEW-B2.5 Function and performance tests of electrical & electronic control devices
OICEW-B2.5 Function and performance tests of electrical and electronic protective devices

Text: **Instrumentation and Process Control**
Franklyn W. Kirk, Thomas A. Weedon, Philip Kirk, 6th Edition, ATP

Instructor: Dr. John J. Bausch Phone: (508) 830-5000 (x-2029)
Email: jbausch@maritime.edu Room: HA 222

Email & Calendar: Check your email **DAILY for electronic assignments**, additional information, and the OpsControl Real-Time Calendar (iCal on Macs, Outlook, and Google):

Class: Monday, Wednesday, and Friday
Section x13 @10:00-10:50 Hours in Room HA-107 (Harrington)
Section x17: @14:00-14:50 Hours in Room: BR-303 (Bresnahan)

FINAL GRADE is based on homework, quizzes, & exams. The 2-hour final is comprehensive. Attendance is noted and graded. **Late work NOT accepted.** No Food or Drink allowed in class.
STCW Requirements: A minimum grade of **C- (70 out of 100)** is needed to **PASS.**
ATTENDANCE is mandatory and will be tracked to satisfy the STCW requirements.

Evaluation: Exams are based primarily on reading assignments and quizzes.

iClicker Quizzes (~Daily)	10%
Exam1	20%
Exam2	20%
Exam3	20%
Final (2 hour Comprehensive)	30%
Total Grade	100%

OpsControl Engineering Course OBJECTIVES

On completion of the course, the student will:
1. Understand the purpose and operation of common automatic control devices that are found aboard ships and in shore side industry.
2. Be familiar with standard C-A-P-S (Controller, Actuator, Process & Sensor) Terminology
3. Be familiar with the hardware and software used in industrial control.
4. Be able to read a variety of standard Electronics and Control System Diagrams
5. Be prepared to troubleshoot and repair basic control system faults.

OpsControl C-A-P-S TOPIC LIST

1. Fundamentals of Automatic Control
2. Automatic Controls Methods
    1. ON-OFF Control
    2. Sequential Control
    3. Proportional-Integral-Derivative (PID) Control
    4. Programmable Logic Control
3. Sensors and Measurement
    1. Temperature
    2. Pressure
    3. Flow Rate
    4. Level
    5. Speed
    6. Flame Sensors
    7. Combustion Properties
    8. Explosive Gases
    9. Relative Humidity
    10. Salinity
    11. Dissolved Oxygen
4. Transmitters and Control Signals
    1. Electrical
    2. Pneumatic
    3. Digital
5. Controller Mechanisms
    1. Pneumatic
    2. Electrical
    3. Digital
6. Final Control Elements (Acuators)
    1. Pneumatic Operators
    2. Hydraulic Servomotors
    3. Electric Servomotor

Extensive Online Textbook Resources from ATP: American Technical Publishers

@

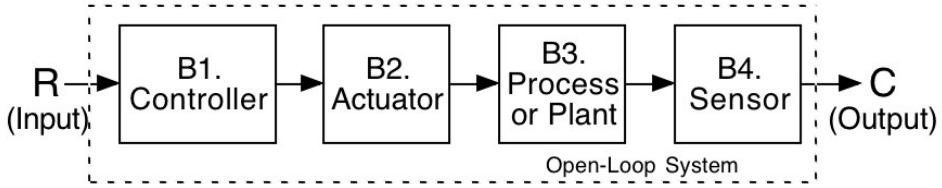
https://www.atplearning.com/product/1670/instrumentation-and-process-control

WEBSITE MATERIALS:

Textbook
Workbook
Answer Key
Online Instructor Resources
Premium Powerpoint ® Presentations
Assessments
Instructional Guide
ATP eTextbook

ECI (EN-3212)- Electronics & Computer Integration

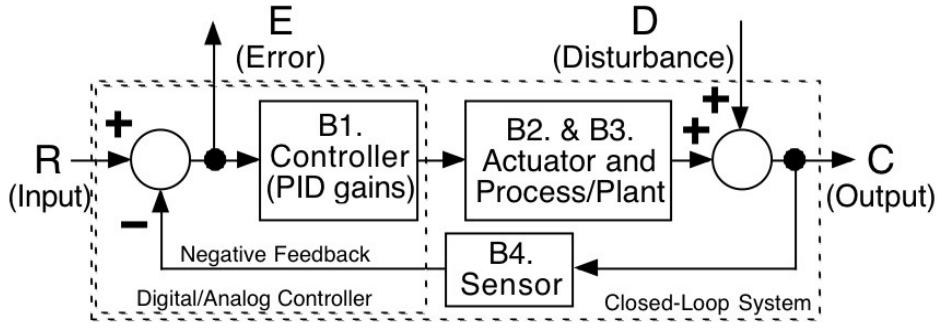
ECI uses the textbook previously used for Instrumentation & Control: Curtis Johnson's "Process Control Instrumentation Technology". Using the first eight chapters, students are exposed to most of the electronic hardware components and systems in use in both analog and digital worlds. The C-A-P-S diagram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



ECI-Electronics: The C-A-P-S Model; the open-loop Block Diagram that defines major components of Electronic Hardware, and the relationship between the electrical signals.

INC (EN-3606)- Instrumentation & Controls

Modern digital controllers are primarily implemented in software and require more advanced dynamic system models; 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.

I&PC Textbook - Table of Contents (page1of2)