

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

Operational Controls - FALL 2024 (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

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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 BR-201 (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%
<u>Final (2 hour Comprehensive)</u>	<u>30%</u>
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

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Instrumentation and Process Control

Textbook

Workbook



Tweet

Instrumentation and Process Control ATP eTextbook

6th Edition
ISBN: 978-0-8269-3442-0
By: Franklyn W. Kirk, Thomas A. Weedon, Philip Kirk

Textbook: 691 pages, 557 illustrations
Download Size: 26.5 MB
eReader: Adobe Digital Editions

Instrumentation and Process Control is a comprehensive resource that provides a technician-level approach to instrumentation used in process control. With an emphasis on common industrial applications, this textbook covers the four fundamental instrumentation measurements of temperature, pressure, level, and flow, in addition to position, humidity, moisture, and typical liquid and gas measuring instruments. Fundamental scientific principles, detailed illustrations, descriptive photographs, and concise text are used to present the following instrumentation topics:

- Process control and factory automation measurement instruments and applications
- Control valves and other final elements
- Digital communication systems and controllers
- Overview of control strategies for process control
- Safety systems and installation in hazardous locations
- Systems approach to integration of instruments in process control

Instructor Resources are available for this title. [Click here](#) to learn more.

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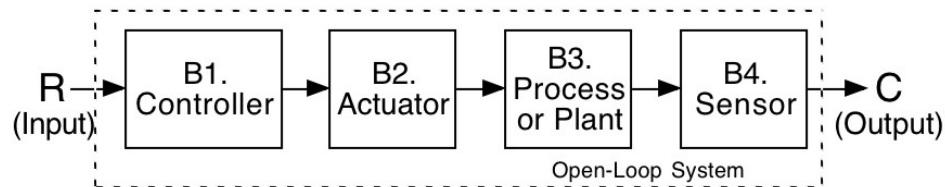
Instructional Guide

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:

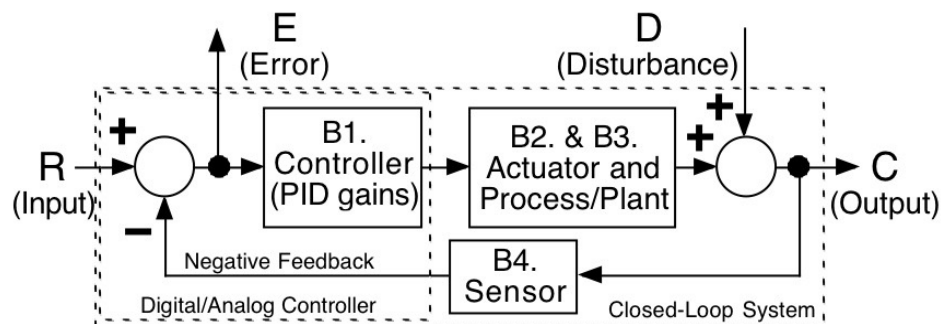
1) a Controller, 2) an Actuator, or 3) a Sensor, as related to a Process, Plant or system.



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.

Section One – Introduction to Instrumentation

Chapter 1: Instrumentation Overview

Chapter 2: Fundamentals of Process Control

Chapter 3: Piping and Instrumentation Diagrams

Section Two – Temperature Measurement

Chapter 4: Temperature, Heat, and Energy

Chapter 5: Thermal Expansion Thermometers

Chapter 6: Electrical Thermometers

Chapter 7: Infrared Radiation Thermometers

Chapter 8: Practical Temperature Measurement and Calibration

Section Three – Pressure Measurement

Chapter 9: Pressure

Chapter 10: Mechanical Pressure Instruments

Chapter 11: Electrical Pressure Instruments

Chapter 12: Practical Pressure Measurement and Calibration

Section Four – Level Measurement

Chapter 13: Mechanical Level Instruments

Chapter 14: Electrical Level Instruments

Chapter 15: Ultrasonic, Radar, and Laser Level Instruments

Chapter 16: Nuclear Level Instruments and Weigh Systems

Chapter 17: Practical Level Measurement and Calibration

Section Five – Flow Measurement

Chapter 18: Fluid Flow

Chapter 19: Differential Pressure Flowmeters

Chapter 20: Mechanical Flowmeters

Chapter 21: Magnetic, Ultrasonic, and Mass Flowmeters

Chapter 22: Practical Flow Measurement

Section Six – Analyzers

Chapter 23: Gas Analyzers

Chapter 24: Humidity and Solids Moisture Analyzers

Chapter 25: Liquid Analyzers

Chapter 26: Electrochemical and Composition Analyzers

Section Seven – Position Measurement

Chapter 27: Mechanical and Proximity Switches

Chapter 28: Practical Position Measurement

Section Eight – Transmission and Communication

Chapter 29: Transmission Signals

Chapter 30: Digital Numbering Systems and Codes

Chapter 31: Digital Communications

Chapter 32: Industrial Networks

Chapter 33: Wireless Systems

Chapter 34: Practical Transmission and Communication

Section Nine – Automatic Control

Chapter 35: Automatic Control and Process Dynamics

Chapter 36: Control Strategies

Chapter 37: Controller Tuning

Chapter 38: Digital and Electric Controllers

Section Ten – Final Elements

Chapter 39: Control Valves

Chapter 40: Regulators and Dampers

Chapter 41: Actuators and Positioners

Chapter 42: Variable-Speed Drives and Electric Power Controllers

Section Eleven – Safety Systems

Chapter 43: Safety Devices and Equipment

Chapter 44: Electrical Safety Standards

Chapter 45: Safety Instrumented Systems

Section Twelve – Instrumentation and Control Applications

Chapter 46: General Control Techniques

Chapter 47: Temperature Control

Chapter 48: Pressure and Level Control

Chapter 49: Flow Control

Chapter 50: Analysis and Multivariable

Control Answers - Appendix - Glossary - Index - Supplemental topics

ONLINE Chapter 51: Pneumatic Transmission

ONLINE Chapter 52: Control Principles of Electricity