EN-3216 Operational Controls Spring 2016

Description: A study of the principles of industrial measurement and control with emphasis on practical applications for gas turbine and industrial control. Methods of sensing, measuring, and transmitting data from industrial processes, feedback, automatic control systems, closed loop systems, controllers, control modes, and control configurations will be investigated. Mechanical, electronic, analog, and digital control mechanisms, including PLC's will be discussed.

Text: Instrumentation (with workbook). Kirk, Weedom, and Kirk. American Technical Publishers, 2010

Grading: Weekly Quizzes – 40%; Exams – 20%; Final Exam – 30%; Homework – 10%

Learning Objectives: To provide the student the understanding of operational controls from an application, rather than the theoretical end. The student, at the completion of the course, shall be able to:

- Define process control and identify key variables, control elements and static & dynamic performance characteristics.
- Understand types of temperature measurement devices including applications and calibration.
- Identify mechanical and electrical pressure measurement devices, including operation and calibration.
- Identify level instrumentation, including applications and calibration.
- Understand considerations in measuring level conditions including boiler and corrosive fluids.
- Identify properties of fluids that affect flow and the selection of flow measurement devices.
- Demonstrate the proper use flow measurement devices.
- Define the terms analysis, analyzer, and analyzer sampling system.
- Identify the proper analyzers for gas, liquid, and solid analysis.
- Apply measurement sensors and switches to liner and rotary applications.
- Discuss transmission methods, requirements, and applications.
- Define automatic control including process dynamics, strategy, tuning, and configuration.
- List and describe types of control valves, actuators, positioners, and dampers.
- Discuss Variable speed drives and power controllers.
- Describe the factors used to establish a safety process.
- Compare continuous and batch processes.
- Explain the use and operation of lead-lag air-fuel ratio control
- Describe common multivariable processes.

STCW Required Learning Objectives:

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 and operation principles of sequential control circuits and 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 and electronic monitoring systems
OICEW-B2.5 Function and performance tests of electrical and electronic automatic control devices
OICEW-B2.5 Function and performance tests of electrical and electronic protective devices

Schedule:

Section	Subject
1 March 1	Introduction to Instrumentation • *Overview of Instrumentation* • *Fundamentals of Process Control* • *P&ID's*
2 March 7	Temperature Measurement • *Temperature, Heat, and Energy (review)* • *Thermometers: Thermal expansion, electrical, infrared.* • *Practical temperature measurement and calibration*
3 March 14	Pressure Measurement • *Pressure, Pascal's Law, pressure scales and units.* • *Mechanical & Electrical Pressure Instruments* • *Practical pressure measurement and calibration.*
4 March 21	Level Measurement • *Mechanical and Electrical Level Instruments* • *Ultrasonic, Radar, and Laser Level Instruments* • *Nuclear Level Instruments* • *Practical Level Measurement and Calibration*
5 March 28	Flow Measurement • *Fluid Flow* • *Differential and Mechanical Flowmeters* • *Magnetic, Ultrasonic, and Mass Flowmeters* • *Practical Flow Measurement*

6 April 4	Analyzers • *Gas Analyzers* • *Humidity and Solids Moisture Analyzers* • *Liquid Analyzers* • *Electrochemical and Composition Analyzers*
7 April 18	Position Measurement • *Mechanical and Proximity Switches* • *Practical Position Measurement* • *Gas Turbine Linear Variable Differential Transformer (LVDT)* o *Liquid Fuel Gas Turbine Valves* o *Gas Turbine Fuel Gas Valves* o *Gas Turbine Inlet Guide Vanes* • *Gas Turbine Rotary Variable Differential Transformer*
8 April 25	Transmission and Communication • *Transmission Systems* • *Digital Communications* • *Industrial and Wireless Networks* • *Practical Transmission and Communication*
9 May 9	Automatic Control • *Automatic Control and Process Dynamics* • *Control Strategies* • *Controller Tuning* • *Digital and Electric Controllers*
10 May 16	Final Elements • *Control Valves* • *Regulators and Dampers* • *Actuators and Positioners* • *Variable Speed Drives and Electric Power Controllers*
11 May 23	Safety Systems • *Safety Devices and Equipment* • *Electrical Safety Standards* • *Safety Instrumented Systems*
12 May 16	I&C Applications • *General Control Techniques* • *Temperature Control* • *Pressure and Level Control* • *Flow Control* • *Analysis and Multivariable Control* •
13 June 6	Gas Turbine Applications • *Emergency Systems – DC Circuits* • *Gas Turbine Trip Circuits* o *Trip Oil: Fuel Gas Valves, Fuel Oil Valves, Inlet Guide Valves* • *Gas Turbine Overspeed Circuits* • *Gas Turbine Start Up Permissives* • *Vibration Measurement* o *Seismic (accelerometer)* o *Vibration Probes (Voltage Gap) – Bentley Nevada System*

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MMA is committed to providing reasonable accommodations to students with documented disabilities. Students who believe they may need accommodations for this class are required to contact Prof. Fran Tishkevich, Director of Disability Compliance, within the first two weeks of class at ext. 2208 or by email at ftishkevich@maritime.edu