

CCRI
Department of Engineering and Technology
INST 1010-001 and 103
Introduction to Instrumentation Technology
Spring Semester 2016

Instructor: Basile Panoutsopoulos, Ph.D.
Office: Room 2210
Telephone: 401-825-2398
Office hours: M. 6:00-6:50, T. 1:30-2:50, W. 11:00-11:50, T. 4:00-4:50 and by appointment.
e-mail: BPanoutsopoulos@ccri.edu
Classroom: Room 2034
Laboratory: Room: 2028
Communication: (All e-mail must be sent with the subject: INST-1010-xxx, where xxx is the section number.)

Course Description: INST-1010: Introduction to Instrumentation Technology (3 credits)
This course stresses the theory and practical application of mechanical and electrical sensing devices and control systems. Topics covered include sensing and control devices for temperature, humidity, pressure, level and flow. In addition, calibration procedures are covered.

Course Duration: 15 weeks.
Lecture: 2 hours per week.
Laboratory: 2 hours per week.

Prerequisites: None
Corequisites: None

Textbook: Terry L.M. Bartelt Instrumentation and Process Control. Delmar Cengage Learning.

Additional References: DOE Fundamentals Handbook, Instrumentation and Control, Volume 1 of 2
<http://energy.gov/ehss/downloads/doe-hdbk-10131-92>

DOE Fundamentals Handbook Instrumentation and Control Volume 2 of 2
<http://energy.gov/ehss/downloads/doe-hdbk-10132-92>

Department of Energy Technical Standards Program
<http://energy.gov/ehss/services/nuclear-safety/department-energy-technical-standards-program>

DOE Fundamentals Handbook, Classical Physics
<http://energy.gov/ehss/downloads/doe-hdbk-1010-92>

DOE Fundamentals Handbook Mathematics Volume 1 of 2
<http://energy.gov/ehss/downloads/doe-hdbk-10141-92>

DOE Fundamentals Handbook, Mathematics Volume 2 of 2
<http://energy.gov/ehss/downloads/doe-hdbk-10142-92>

DOE-HDBK-1015/1-92, DOE Fundamentals Handbook Chemistry Volume 1 of 2
<http://energy.gov/ehss/downloads/doi-hdbk-10151-93>

DOE-HDBK-1015/2-92, DOE Fundamentals Handbook Chemistry Volume 2 of 2
<http://energy.gov/ehss/downloads/doi-hdbk-10152-93>

DOE-HDBK-1016/1-93, DOE Fundamentals Handbook Engineering Symbology, Prints, and Drawings Volume 1 of 2
<http://energy.gov/ehss/downloads/doi-hdbk-10161-93>

DOE-HDBK-1016/2-93, DOE Fundamentals Handbook Engineering Symbology, Prints, and Drawings Volume 2 of 2
<http://energy.gov/ehss/downloads/doi-hdbk-10162-93>

Tony R. Kuphaldt. *Lessons in Industrial Instrumentation*. 2014.
<http://www.ibiblio.org/kuphaldt/socratic/sinst/>

Franklyn Kirk, Weedon Thomas, Kirk Philip. *Instrumentation*. Fifth Edition. 2010. American Technical Publications.

NJAATC. *Fundamentals of Instrumentation*. Thomson Learning.

Process Instrumentation, Volume 1, SCP 114, Schoolcraft Publishing.
Process Instrumentation, Volume 2, SCP 114, Schoolcraft Publishing.

Materials: Laboratory Notebook.
Scientific Calculator approved by NCECS only (<http://nces.org/exams/calculator-policy/>)

Course Objectives: Upon completion of this course, students will be able to:

- Understand the operation of fundamental instrumentation.
- Understand fundamental process control theory.
- Explain basic control system concepts.
- Understand principles of instrumentation communications protocols.
- Set up and run basic laboratory experiments using a variety of instrumentation.
- Use instruments to measure quantities such as pressure, temperature, flow, and level.
- Perform basic instrumentation calibration.
- Collect and analyze data from experiments.
- Prepare a well-organized laboratory report.
- Present information in equation, table, and graph form.

Course Methodology:

- Classroom lectures and discussions (Socratic approach).
- Classroom computer applications and laboratory activities.
- Notes and assignments.
- Homework.
- Internet and library based assignments.

Grading:

- Laboratory Reports: 30%
- Short Examinations: (To be announced in class) 30% (6 examinations 5% each)
- Final Examination: 30%

- Attendance and participation 10%

The final grade is calculated according to the following table:

Grade		Cumulative Grade Index / Number of Points
A	Superior	4.0
A-		3.7
B+		3.3
B	Above Average	3.0
B-		2.7
C+		2.3
C	Average	2.0
D+		1.3
D	Below Average	1.0
F	Failure	0

- Administrative:**
- Final grade will be lowered one full grade for each weekly session missed beyond one session.
 - No food or drink allowed in the Laboratory room or Lecture/Laboratory combination rooms.
 - As a matter of professional conduct and courtesy to your colleagues and the instructor, please show up on time.
 - As a matter of professional conduct and courtesy to your colleagues and the instructor, please do not be destructive.
 - Telecommunication devices of any kind are strictly prohibited. (Turn them off and put them in your carry on.)
 - Electronic recording devices are strictly prohibited.

Reference

Books	http://bookboon.com/
Computer Algebra System	http://maxima.sourceforge.net/
Drawing:	http://www.inkscape.org/en/
Electric circuit simulation	http://qucs.sourceforge.net/
Encyclopedia	http://www.wikipedia.org/
Equation editor (fonts)	http://www.dessci.com/en/products/MathType/
Graphing	http://scidavis.sourceforge.net/
Mathematical	http://www.scilab.org/
Mathematical	http://www.geogebra.org/cms/en/
Mathematical Notepad	http://en.smath.info/forum/
Notepad	http://notepad-plus-plus.org/
Photo-editing	https://inkscape.org/en/
Office suite	http://www.openoffice.org/
Office suite:	http://www.libreoffice.org/
Recording:	http://infrarecorder.org/
Sketching - Drafting	https://wiki.gnome.org/Apps/Dia
Sketching - Drafting	http://www.freecadweb.org/
Signal processing:	http://audacity.sourceforge.net/
Viewer:	http://djvu.org/
Viewer:	http://get.adobe.com/reader/

Laboratory Reports:

- Laboratory reports are due within a week, at the beginning of the next laboratory session.
- No late laboratory reports will be accepted.
- Laboratory reports must be submitted as professionally prepared documents:

- Following the Departmental guidelines,
- Typed,
- Stapled,
- Printed double sided,
- Professionally organized.

**Homework
Reports:**

- Homework reports must be submitted as professionally prepared documents:
 - Following the Departmental guidelines (Must include a Title page!),
 - Typed (Exception: Mathematical homework may be written neatly),
 - Printed double sided,
 - Be stapled,
 - Professionally organized.
- Within one week (At the beginning of the next lecture session.).
- No late homework report will be accepted.

		<u>LECTURE</u>		LABORATORY
Week #	Date	Topic	Textbook And References.	Topic
1		Prolegomena: Introduction of the course. Syllabus; Class policies; Administrative matters. Instrumentation Process measurements Process Control Process Control Signals Basic Process Measurement Systems Position Indicators	IPC Chapter 1 Homework: Chapter 1. ----- DOE IC V2 Module 7 1-6 DOE IC V2 Module 07 8-16 LII Chapter 6.	Introduction to Instrumentation. Laboratory equipment. Safety in the Laboratory. Report preparation. Word processing. Data analysis. Spreadsheets. Communication. Report presentation. Data: Equations, Tables, Graphs Laboratory assignments. Mathematical notebooks, Interpolation Accuracy Hysteresis Repeatability
2		Instruments and Instrumentation Symbology. Control Loop Diagrams	IPC Chapter 10. Homework: Chapter 10. ----- DOE-HDBK- 1016/1-93. Vol. I	Process components and symbology. Instrumentation diagrams.
3		Fundamentals of Instrument Calibration. Calibration procedures. Note 1: Homework is due.	IPC Chapter 12 Homework: Chapter 12. ----- LII Chapter 18	Pressure gage calibration Note 1: Laboratory Report is due.
4		Electrical and Electronic measurements Note 1: Homework is due.	Handouts	Electrical and Electronic measurements: The Electrical Bridge Note 1: Laboratory Report is due.
5		Fundamentals of Pressure and Measurements. Force - Pressure Pressure scales	IPC Chapter 4. Homework:	Electronic pressure transducer calibration Note 1: Laboratory Report is due.

		<p>Pressure sensors Pressure measuring instrumentation: Pressure gages Pressure Transducers Dead weight testers</p> <p>Note 1: Homework is due.</p>	<p>Chapter 4. ----- DOE IC V1 Module 2</p>	
6		<p>Fundamentals of Temperature and Measurements Heat - Temperature Temperature scales Temperature measuring Instrumentation Filed thermal systems Thermocouples Resistance temperature detectors</p> <p>Note 1: Homework is due.</p>	<p>IPC Chapter 5. Homework: Chapter 5. ----- DOE IC V1 Module 1</p>	<p>Thermocouple calibration RTD calibration Thermistor temperature measurements and data logging Note 1: Laboratory Report is due.</p>
7		<p>Fundamentals of Level and Measurements Float and displacers Pressure methods Ultrasonic Conductivity Capacitance</p> <p>Note 1: Homework is due.</p>	<p>IPC Chapter 7. Homework: Chapter 7. ----- DOE IC V1 Module 3</p>	<p>Level measurement Water Filled Manometer Note 1: Laboratory Report is due.</p>
8		<p>Fundamentals of Flow and Measurements Types of flow measurements Flow measuring Instrumentation Differential pressure devices Variable area meter (Rotameters) Magnetic flow meters</p>	<p>IPC Chapter 6. Homework: Chapter 6. ----- DOE IC V1 Module 4</p>	<p>Flow measurement Orifice plate Note 1: Laboratory Report is due.</p>
9		<p>Fundamentals of Analytical Measurements. pH Conductivity Humidity</p> <p>Note 1: Homework is due.</p>	<p>IPC Chapter 8. Homework: Chapter 8. -----</p>	<p>Analytical measurement pH Measurements Note 1: Laboratory Report is due.</p>
10		<p>Industrial Process Techniques and</p>	<p>IPC</p>	<p>Level measurement</p>

		Instrumentation. Valves Valve bodies Valve actuators Valve sizing Flashing and cavitation Note 1: Homework is due.	Chapter 9. Homework: Chapter 9. -----	Liquid level measurement. Note 1: Laboratory Report is due.
11		Fundamentals of Process Control Methods. Control models: On/Off (two position) Proportional Integral (reset) Derivative (rate) Note 1: Homework is due.	IPC Chapter 11. Homework: Chapter 11. ----- DOE IC V2 Module 8	Note 1: Laboratory Report is due.
12		Fundamentals of Controllers Control signal Type of controllers: Analog Digital Programmable Logic Controller (PLC) Control elements and process control Control Valves Electric Actuators Note 1: Homework is due.	IPC Chapter 3. Homework: Chapter 3. ----- V1 Module 5	Flow measurement Electromagnetic measurement of flow Note 1: Laboratory Report is due.
13		Fundamentals of Smart Instruments Fundamentals of Smart Instrument Calibration Note 1: Homework is due.	Handouts	Transmitter Calibration Pressure gage calibration, in H ₂ O Note 1: Laboratory Report is due.
14		Review Note 1: Homework is due.		Make-up work
15		Review		Make-up work
		Final Examination		Final Examination

NOTICE: The schedule and related topics are tentative and subject to changes by the instructor at any time.