

Class Time: MWF 11:10am-12:00noon

Location: WSU FSHN 103

470 Instructor: Frank Younce, PE, CFS

Office: FSHN G20E (Pilot Plant)

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570 Instructor: Dr. Barbara Rasco

Office: FSHN 106H

Phone:

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Office Hours:

**Course Description:** FS 470/570 Advanced Food Technology 3 credit Spring. Fundamentals of industrial instrumentation, control, automation and data management systems as applied to novel food processing technologies. Cooperative course taught jointly by WSU and UI. Prerequisites: WSU student: FS 432/433, FS 404 or c//; MATH 140 or 171; STAT 212, UI student: FS 432/433, FS 404 or c//; MATH 160 or 170; STAT 250.

**Course Overview:** In this course we will study the function and validation of control systems used to safely manufacture food with consistent quality utilizing novel processing technologies.

### Learning Outcomes (for IFT Food Science Degree Core Competencies):

The student will:

1. Become familiar with industrial control systems terminology.
2. Draw a variety of piping and instrumentation diagrams (P&IDs) using ISA standards.
3. Calibrate and perform error analysis on a transducer.
4. Formulate the logic necessary to control equipment for batch and continuous food processes.
5. Tune a PID controller.
6. Perform a risk analysis on a system to select an appropriate safety integrity level for an industrial manufacturing situation.
7. Select appropriate operating and safety alarm levels for a process.
8. Validate an industrial control system for a food process.

### Required Texts:

1. Battikha, N. E. 2007. The Condensed Handbook of Measurement and Control, Third Edition. ISA, (ISBN 978-1-55617-995-2 paperback).
2. Singh R. P. and D. R. Heldman. 2013. Introduction to Food Engineering 5<sup>th</sup> ed. Academic Press. (this is the required text for FS 432/433)
3. Course handouts

### Recommended Texts (optional, but good for your personal library):

4. NFPA, 2002, Validation Guidelines for Automated Controls, NFPA Bulletin 43-L, Second Edition, available from the Grocery Manufactures Association [www.gmaonline.org](http://www.gmaonline.org). (This will be used for the validation project and will be available for group checkout mid-semester.)
5. Trevathan, V. L., 2006, A Guide to the Automation Body of Knowledge, Second Edition, ISA (ISBN 978-1-55617-984-6 hardcover).

### Course Grading:

Midterm Exam 1	20%	100-93 = A, 92.9-90 = A-, 89.9-87 = B+, 86.9-83 = B,
Midterm Exam 2	20%	82.9-80 = B-, 79.9-77 = C+, 76.9-73 = C, 72.9-70 = C-,
Validation Project Report	25%	69.9-67 = D+, 66.9-60 = D, 59.9 or less = F
Validation Project Presentation	5%	It is acceptable and desirable for the entire class to
Homework	20%	receive As, if you earn them.
Participation	10%	(in class activities and presentation attendance)
Graduate Research Paper	+25%	(additional FS 570 requirement, see addendum)

### Reading Assignments and In-Class Participation

Reading is an important part of learning. The reading assignments listed for each lecture in the schedule should be completed before class. Students will be chosen at random for in class questions, explaining concepts, reporting on group discussions, etc. (e.g. stick points). Student responses will be recorded for the "participation" score. Attendance and participation in the final group presentations is required.

**Late Assignment Policy**

Assignments lose 20% of total possible score for each university business day late (5:00 pm cutoff). So if you turn in a homework (which was due 1/22) on 1/27, three business days late, it will be docked 60% of its total possible score (i.e. a three day late report that is scored a 93% will only get a 33% grade after being docked 60%). Assignments received five or more business days late will be recorded as a zero. No reports will be accepted after 5:00 pm Friday April 29, 2016. They will be recorded as a zero.

**Attendance**

Attendance and participation is expected and will contribute your learning which will reflect on your performance which influences to your final grade. Please provide the instructor notice of any planned absences (such as a required field trip for another class) so arrangements can be made for you to complete the requirements for this course.

**Learning Goals and Assessment**

At the end of this course, students should be able to:		Course topics (&dates) that advance these learning goals:	This objective will be assessed
LG1	Use Critical and Creative thinking to integrate and synthesize knowledge from multiple sources. And to combine and synthesize existing ideas, images, or expertise in original ways.	Lectures on classical and novel control strategies and safety analysis. Discussions on the validation of novel food processing technologies.	Exams, validation project, homework (graduate research paper)
LG2	Use Quantitative Reasoning to convert relevant information into various mathematical forms. And to understand and apply quantitative principles and methods in the analysis of data.	Lectures with in class examples on instrumentation, programming, finite state logic, control system analysis, system tuning and safety analysis.	Homework assignments, exams
LG3	Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.	Lectures on safety integrity analysis. Discussions on the validation of novel food processing technologies.	Validation project, in-class participation
LG4	Effectively identify, locate, evaluate, use responsibly and share information for the problem at hand.	Readings and lectures on codes and regulations.	Validation project, (graduate research paper)
LG5	Use communication skills to tailor message to audience, express concepts, propositions, and beliefs in coherent, concise and technically correct form.	Lecture and handouts on the validation process.	Validation project presentation, in class participation questions
LG7	Develop depth, breadth, and integration of learning in Food Science / Food Engineering.	Readings and lectures on control systems throughout the semester.	Exams, validation project, in-class participation

## Lecture Schedule

Class:	Topic: (chapter reading)
Jan. 9	Introduction: software for control InduSoft {assignment of 570 projects}
Jan. 11	Measurement, control, identification, symbols, P&IDs (Battikha 1, 2)
Jan. 13	Signals and transmission (Battikha 2)
Jan. 16	MLK Holiday (no class)
Jan. 18	Flow and level measurement (Battikha 4, 5) {assignment of validation teams}
Jan. 20	Temperature and pressure measurement (Battikha 6, 7) [HW #1 due]
Jan. 23	Lab activity – Script programming with InduSoft (FSHN 102)
Jan. 25	Analyzers (Battikha 3)
Jan. 27	Final control elements, valves (Battikha 13)
Jan. 30	Lab activity – Calibration (Battikha 17) (FSHN 102 and Pilot Plant G20F)
Feb. 1	Valve trim and variable frequency drives (handouts) (Battikha 13)
Feb. 3	Pressure relief devices (handouts) [HW #2 due]
Feb. 6	Lab activity - Transmitters and wiring (FSHN Pilot Plant G20F)
Feb. 8	Case study (or guest speaker) and review
Feb. 10	<b>EXAM 1</b>
Feb. 13	Exam review, flowcharts and transfer functions (handouts)
Feb. 15	Control concepts (Battikha 8)
Feb. 17	Lab activity – finite state machines (FSHN 102)
Feb. 20	Presidents Day Holiday (no class)
Feb. 22	Off/On control (handouts)
Feb. 24	PID control (Battikha 8) [HW #3 due]
Feb. 27	Lab activity – process dynamics and simulation (FSHN 102 and Pilot Plant G20F)
Mar. 1	Loop tuning strategies (handouts)
Mar. 3	Cascade and ratio loops (Battikha 8)
Mar. 6	Lab activity – loop tuning (FSHN 102 and Pilot Plant G20F)
Mar. 8	Feed forward and fuzzy logic (handouts and online reading)
Mar. 10	Model predictive control (handouts) [HW #4 due]
Mar. 13-17	Spring Break
Mar. 20	Selecting control strategies for processes
Mar. 22	Case study (or guest speaker) and review
Mar. 24	<b>EXAM 2</b>
Mar. 27	Validation, documentation (NFPA-43L pages 1-30, Battikha 14)
Mar. 29	Exam review, validation example MATS (NFPA-43L pages 1-30)
Mar. 31	Data management, trending, records, history
Apr. 3	Lab activity –trending, history (FSHN 102)
Apr. 5	HMI design, controller programming (Battikha 9, handouts)
Apr. 7	Batch processing, recipe control [term project draft due]
Apr. 10	Lab activity – batch processing and recipe control (FSHN 102)
Apr. 12	Safety and alarms management (Battikha 10)
Apr. 14	Failure, SIS and SIL (Battikha 10)
Apr. 17	Lab activity – Alarms, thin clients and OPC (FSHN 102) [HW #5 due]
Apr. 19	Guest speaker, Manufacturing Execution Systems software (Battikha 19)

Apr. 21	Validation Project Presentations
Apr. 24	Validation Project Presentations
Apr. 26	Validation Project Presentations
Apr. 28	Validation Project Presentations [term project final due] [HW #6 due]
May 1-5	WSU Finals Week (no final exam for this course)

**Note: This schedule may change due to unforeseen events such as the availability of guest speakers. Watch for class announcements on the lecture slides and emails.**

### Homework Assignments and Lab Activities

The Lab Activities are designed to reinforce the lecture material with hands on experience. Although there are no formal lab reports, the homework assignments will include computer simulations and analysis of data collected during the Lab Activities. Additional access to software packages will be provided outside of class.

1. Systems, P&IDs and HMIs – tray dryer control
2. Calibration and control – thermostat controller
3. Finite state machines, flowcharting - vending simulation
4. PID loop tuning – control simulation
5. Batch and recipe programming – bread machine simulation
6. HMI programming – HMI for validation project

### Reading Assignments

You are expected to complete the assigned reading prior to the class period in which it is to be discussed. This practice will permit the instructor to expand on and clarify the topics. Reading ahead is encouraged.

### Validation Project

Each student will be assigned to group to perform the validation of a food processing control system for a novel food processing technology (similar to the methods of NFPA Bulletin 43-L). The validation of the system will be documented in a report. Each group will turn in a draft report which the instructor will mark for improvement and return to the group (similar to WSU Writing in Major [M] classes). Then the group will make revisions and turn in a final copy. Each group will make a presentation of their project during the last week of class. A handout with additional details on scope, content and format will be provided.

### Students with Disabilities

UI students: Reasonable accommodations are available for students who have documented temporary or permanent disabilities. All accommodations must be approved through Disability Support Services located in the Idaho Commons Building, Room 306 in order to notify your instructor(s) as soon as possible regarding accommodation(s) needed for the course. 208-885-6307, email at [dss@uidaho.edu](mailto:dss@uidaho.edu), website at <[www.access.uidaho.edu](http://www.access.uidaho.edu)>

WSU student: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.

### Academic Regulations & Student Affairs Policy Regarding Absences

It is the policy of the Office of Student Affairs to assist students during crisis situations where they are unable to notify their instructors prior to a hurried emergency departure. The Office of Student Affairs will send professors an "Emergency Notification" in those instances where the student will be away for more than two days. The Office of Student Affairs will not issue notifications retroactively or for "one-day emergencies."

### Academic Etiquette

Do not carry on side conversations or read during class. Please mute cellular phones during class.

**Academic Integrity**

You are encouraged to work with classmates on assignments. However, each student must turn in original work. No copying will be accepted. Students who violate the UI *Student Code of Conduct* or the WSU *Standards of Conduct for Students* will receive an F as a final grade in this course, will not have the option to withdraw from the course and will be reported to the UI Dean of Students or WSU Office Student Standards and Accountability. Cheating is defined in the UI *Student Code of Conduct* and the WSU *Standards for Student Conduct* (WAC 504-26-010 (3)). It is strongly suggested that you read and understand these definitions.

**Plagiarism**

Plagiarism is defined by Webster's Dictionary as, "to steal and pass off the ideas or words of another as one's own." There are two general forms of plagiarism:

- (a) Unintentional: the use of other writers' words, phrases, sentences, paragraphs as though they were your own *without understanding* the need to cite the original source. Unintentional plagiarism normally occurs when the individual does not understand the conventions of scientific writing and the need to cite sources of information.
- (b) Intentional: the use of other writers' work and claiming it as your own. Intentional plagiarism includes *knowingly copying* or incorporating sections of books, articles, or other sources into your work without citation.

To evade plagiarism, you must acknowledge the source of information. In scientific writing, this can be performed in the text of your work through the use of surnames of authors and the year of publication or by using numbers enclosed by parentheses which correspond to specific citations in the reference section. In addition to employing citations in the text, plagiarism can be avoided by applying special techniques when writing about information obtained from a source:

- (a) Paraphrase: rewording information in which you accurately present the main ideas from the source but do so using your own organization, words, and sentence structures.
- (b) Summary: a concise statement of the main idea from a section within a source.
- (c) Direct quotation: use of quotes surrounding the passage written by another author.

In general, paraphrasing (a) and the use of summary statements (b) are very common techniques used in scientific writing. Use of quotations (c) in scientific writing is rare and should be avoided.

Plagiarism is dishonest and is **not** tolerated. If caught using all or portions of a current or former classmate's writing or other sources of information, a grade of "zero" will be given for the exercise. Additional penalties for plagiarism are possible as outlined in the University of Idaho *Student Code of Conduct* and the Washington State University *Student Handbook*.

**Safety**

Washington State University is committed to enhancing the safety of the students, faculty, staff, and visitors. It is highly recommended that you review the Campus Safety Plan (<http://safetyplan.wsu.edu/>) and visit the Office of Emergency Management web site (<http://oem.wsu.edu/>) for a comprehensive listing of university policies, procedures, statistics, and information related to campus safety, emergency management, and the health and welfare of the campus community.

**Access to the FSHN G20 Pilot Plant**

Your Cougar card will be activated to open the Pilot Plant entrance lock (or you will be given keypad access) so you can visit the instructor's office. Your code will be active during regular 8am – 5pm business hours. The lock keeps date/time records so please do not share your personal code.