Class Time: MWF 11:10am-12:00noon **Location: WSU Hulbert 23**

470 Instructor: Frank Younce, PE, CFS
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570 Instructor: Dr. Barbara Rasco
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Course Description: FS 470/570 Advanced Food Technology 3 credit Spring. Fundamentals of industrial instrumentation, control, automation and data management systems as applied to food processing. 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 technology and methodology of control systems used to safely manufacture food with consistent quality.

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 processing 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. 2008. Introduction to Food Engineering 4th 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, Bulletin 43-L, Second Edition, National Food Processors Association.
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%	The class is intended to be graded on a straight scale:
Midterm Exam 2	20%	100-90.0 = A, 89.9-80.0 = B, 79.9-70.0 = C,
Validation Project Report	25%	69.9-60.0 = D, 59.9 or less = F.
Validation Project Presentation	5%	
Homework	20%	
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.

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 1/23) on 1/28, 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 May 8, 2015. 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, (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) [assignment]
Jan. 12	Introduction: software for control (ThinknDo)
Jan. 14	Measurement, control, identification, symbols, P&IDs (Battikha 1,2)
Jan. 16	Signals and transmission [*Assignment of the Projects*] (Battikha 2)
Jan. 19	MLK Holiday (no class)
Jan. 21	Flow and level measurement (Battikha 4, 5)
Jan. 23	Temperature and pressure measurement (Battikha 6, 7) [HW #1 due]
Jan. 26	Lab activity - Calibration of sensors (Battikha 17) (FSHN Pilot Plant G20H)
Jan. 28	Analyzers (Battikha 3)
Jan. 30	Final control elements, valves (Battikha 13)
Feb. 2	Lab activity – Calibration of valve actuators (FSHN Pilot Plant G20H)
Feb. 4	Valve trim and variable frequency drives (handouts) (Battikha 13)
Feb. 6	Pressure relief devices (handouts) [HW #2 due]
Feb. 9	Lab activity - Transmitters and wiring (FSHN Pilot Plant G20H)
Feb. 11	Case study (or guest speaker) and review
Feb. 13	**EXAM 1**
Feb. 16	Presidents Day Holiday (no class)
Feb. 18	Transfer functions (handouts)
Feb. 20	Control loops (Battikha 8)
Feb. 23	Lab activity – process dynamics and simulation (Hulbert 23)
Feb. 25	Off/On control (handouts)
Feb. 27	PID control (Battikha 8) [HW #3 due]
Mar. 2	Lab activity – process controllers (FSHN Pilot Plant G20H)
Mar. 4	Loop tuning strategies (handouts)
Mar. 6	Cascade and ratio loops (Battikha 8)
Mar. 9	Lab activity – loop tuning (FSHN Pilot Plant G20H)
Mar. 11	Feed forward and fuzzy logic (handouts and online reading)
Mar. 13	Model predictive control (handouts) [HW #4 due]
Mar. 16-20	Spring Break
Mar. 23	Case study (or guest speaker) and review
Mar. 25	**EXAM 2**
Mar. 27	Validation and data management (Battikha 19, handouts)
Mar. 30	Lab activity – software systems
Apr. 1	Documentation and Management (Battikha 14, 18)
Apr. 3	Logic and flowcharting (handouts)
Apr. 6	Lab activity – flowcharting, trending and data storage
Apr. 8	Finite state machine logic (Battikha 9)
Apr. 10	Controller programming (Battikha 9, handouts)
Apr. 13	Lab activity – finite state programming
Apr. 15	Safety and alarms management (Battikha 10) [HW #5 due]
Apr. 17	HMI design
Apr. 20	Lab activity – HMI programming
Apr. 22	Safety Instrumented Systems and SIL (Battikha 10)

Apr. 24	Control centers and enclosures (Battikha 11, 12) [term project draft due]
Apr. 27	Lab activity – system programming case study
Apr. 29	Codes Standards and Regulations (Handouts)
May 1	Validation Project Presentations [term project final due] [HW #6 due]
May 4	Validation Project Presentations
May 6	Validation Project Presentations
May 8	Validation Project Presentations
May 11-15	WSU Finals Week (no final)

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 analysis of data collected from the Lab Activities. Additional access to software packages will be provided outside of class.

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, website at <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 and complete lab activities. 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.