INSTRUCTOR NAME: Bobby (Robert) Yost

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OFFICE: DMC 125

DEPT/COURSE #:INST 143

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QTR/YEAR: Spring 2018

MEETING TIMES/DAYS:Monday through Friday 9:00 to 2:00

CREDITS: 4

Theory Hours: 22 Guided Practice Hours: 44 Field Based Experience Hours: 00

## COURSE TITLE:

PLC Systems

## COURSE DESCRIPTION:

In this course you will learn how to program data-handling functions in programmable logic controllers (PLCs) including comparison, arithmetic, and data transfer instructions. You will also learn to connect and program human-machine interface (HMI) panels to PLCs.

## COURSE PREREQUISITE:

INST 142 (PLC Programming) with a minimum grade of “C-”

## LEARNING OUTCOMES

At the end of this course, the student should be able to:

| Learning Outcomes | Methods of Assessment |
| --- | --- |
| Calculate voltages and currents in an ideal AC transformer circuit. [Ref: Program Learning Outcome #4] | Written “mastery” exam question requiring quantitative predictions, at Bloom’s “Application” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Sketch proper wire connections for sourcing or sinking PLC I/O points given schematic or pictorial diagrams of the components. [Ref: Program Learning Outcome #5] | Written “mastery” exam question requiring a correct diagram drawn, at Bloom’s “Application” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Determine status of a PLC discrete output given input states and a RLL program. [Ref: Program Learning Outcome #4] | Written “mastery” exam question requiring qualitative predictions, at Bloom’s “Application” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Calculate voltages and currents within balanced three-phase electrical circuits. [Ref: Program Learning Outcome #4] | Written “mastery” exam question requiring quantitative predictions, at Bloom’s “Comprehension” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Solve for specified variables in an algebraic formula. [Ref: Program Learning Outcome #4] | Written “mastery” exam question requiring correct manipulation and re-writing of an algebraic equation, at Bloom’s “Application” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Determine the possibility of suggested faults in a simple PLC circuit given a wiring diagram, RLL program listing, meter measurements, and/or reported symptoms. [Ref: Program Learning Outcome #4] | Written “mastery” exam question requiring qualitative assessments of fault probability, at Bloom’s “Application” level. Mastery (100% competence) required to pass this exam. Multiple opportunities to re-try (different exam version each time) prior to deadline. |
| Program an HMI panel to fulfill a specified control system function. [Ref: Program Learning Outcome #5] | Team demonstration and explanation of all PLC control functions as delineated in INST143 (INST232) worksheet. Mastery (100% competence) required, with no limit on re-tries prior to deadline. |
| Demonstrate proper use of safety equipment and application of safe procedures while using power tools, and working on live systems. [Ref: Program Learning Outcome #3] | Direct observation of work habits in lab, followed up by lab team meetings. No score given, but willful safety violations will result in a failing (F) grade for the course. |
| Communicate effectively with teammates to plan work, arrange for absences, and share responsibilities in completing all labwork. [Ref: Program Learning Outcomes #1 and #2] | Records of late arrivals and attendance on roster. Direct observation of work habits in lab, followed up by lab team meetings. No score given, but failure to remedy unprofessional behavior may result in expulsion from the lab team. |
| Augment a PLC-controlled motor start/stop system with an HMI panel providing operator access to operating parameters. [Ref: Program Learning Outcome #5] | Team demonstration and explanation of all motor control functions as delineated in INST143 (INST232) worksheet. Mastery (100% competence) required, with no limit on re-tries prior to deadline. |
| Generate an accurate wiring diagram compliant with industry standards documenting your team’s motor control system. [Ref: Program Learning Outcome #8] | Individual inspection of wiring diagram simultaneous with close inspection of all wiring and installation, minimum standards delineated in INST143 (INST232) worksheets. Mastery (100% competence) required, with no limit on re-tries prior to deadline. |
| Research equipment manuals to sketch a complete circuit connecting a PLC to either a discrete sensing device or a discrete control element (e.g. VFD), with all components randomly selected by the instructor. [Ref: Program Learning Outcomes #5 and #9] | Individual design inspection, checked against parameters delineated in equipment manuals. Mastery (100% competence) required, with no limit on re-tries prior to deadline. |
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## COURSE OUTLINE:

INST143 Section 1 (HMI programming, PLC comparison and arithmetic programming, PLC data transfer programming): 6 days theory and labwork

INST143 Section 2 (PLC analog programming and project completion): 4 days theory and labwork + 1 day for mastery/proportional Exams + 1 day lab clean-up

## COURSE SCHEDULE:

A course calendar in electronic format (Excel spreadsheet) resides on the Y: network drive, and also in printed paper format in classroom DMC143, for convenient student access. This calendar is updated to reflect schedule changes resulting from employer recruiting visits, interviews, and other impromptu events. Course worksheets provide comprehensive lists of all course assignments and activities, with the first page outlining the schedule and sequencing of topics and assignment due dates. These worksheets are available in PDF format at http://www.ibiblio.org/kuphaldt/socratic/sinst

METHODS OF INSTRUCTION: **(check all that apply)**

Lecture

Lab

Discussion

Small Group Work

Workplace Experience

Independent Study

Instructor Demonstrations

## REQUIRED STUDENT TEXT(S), SUPPLIES, AND MATERIALS:

• Course worksheet (Currently under former name: INST232\_sec1 and INST232\_sec2) available for download in PDF format (http://www.ibiblio.org/kuphaldt/socratic/sinst)  
• “Lessons in Industrial Instrumentation” textbook, available for download in PDF format (http://www.ibiblio.org/kuphaldt/socratic/sinst)  
• Spiral-bound notebook for reading annotation, homework documentation, and note-taking.  
• Instrumentation reference (provided by instructor). This USB drive contains many tutorials and  
datasheets in PDF format.  
• Tool kit (see detailed list in course worksheet)  
• Simple scientific calculator (non-programmable, non-graphing, no unit conversions, no numeration  
system conversions), TI-30Xa or TI-30XIIS recommended.  
• Portable personal computer with Ethernet port and wireless. Windows OS strongly preferred, tablets  
discouraged

•Small monolithic PLC and HMI panel.

## STUDENT REQUIREMENTS/EXPECTATIONS:

There are no lecture sessions in this course – all theory is taught in an “inverted” format where students first encounter new concepts and techniques through independent reading and outline what they have learned, then challenge and enhance their learning in subsequent Socratic dialogue sessions with the instructor. Labwork takes the form of practical projects managed by student teams with instructor oversight, with a great deal of reliance on manufacturer documentation for specifications and procedures. Critically important learning objectives are assessed at a “mastery” level which means students must demonstrate 100% competence, with opportunities to re-try if necessary. Failure to meet each and every course mastery standard by the published deadline will result in a failing grade for the course.

## ASSIGNMENTS, EVALUATION, AND GRADING STANDARDS:

• Mastery lab objectives = 50% of course grade   
• Lab questions = 25%  
• Daily quizzes = 25%  
• Tardiness penalty = -1% per incident (1 “free” tardy per course)  
• Absence penalty = -1% per hour (12 hours “sick time” per quarter)  
• Extra credit = +5% per project (assigned by instructor based on individual learning needs)  
  
All grades are criterion-referenced (i.e. no grading on a “curve”)  
100% ≥ A ≥ 95% 95% > A- ≥ 90%  
90% > B+ ≥ 86% 86% > B ≥ 83% 83% > B- ≥ 80%  
80% > C+ ≥ 76% 76% > C ≥ 73% 73% > C- ≥ 70% (minimum passing course grade)  
70% > D+ ≥ 66% 66% > D ≥ 63% 63% > D- ≥ 60% 60% > F  
  
Absence on a scheduled exam day will result in a 0% score for the proportional exam unless you provide  
documented evidence of an unavoidable emergency.  
If you fail a mastery exam, you must re-take a different version of that mastery exam on a different day.  
Multiple re-tries are allowed, on a different version of the exam each re-try. There is no penalty levied on your course grade for re-taking mastery exams, but failure to successfully pass a mastery exam by the due date will result in a failing grade (F) for the course.  
  
If any other “mastery” objectives are not completed by their specified deadlines, your overall grade  
for the course will be capped at 70% (C- grade), and you will have one more school day to complete the  
unfinished objectives. Failure to complete those mastery objectives by the end of that extra day (except in the case of documented, unavoidable emergencies) will result in a failing grade (F) for the course.  
  
“Lab questions” are assessed in a written exam format, typically on the last scheduled day of the lab  
project. Grading is as follows: full credit for thorough, correct answers; half credit for partially correct  
answers; and zero credit for major conceptual errors.  
  
Individual preparation for Socratic dialogue sessions is measured by a “prep quiz” and/or personal  
inspection of your work by the instructor. A second (“summary”) quiz score for every Socratic session marks your participatory dialogue and ability to give reasoned answers to challenge questions on that session’s topic(s). In the event of absence, these scores may be credited by having your preparatory work and demonstration of understanding reviewed at any time before the end of the quarter in a one-on-one dialogue with the instructor.  
  
Extra credit opportunities exist for each course, and may be assigned to students upon request. The  
student and the instructor will first review the student’s performance on feedback questions, homework, exams, and any other relevant indicators in order to identify areas of conceptual or practical weakness. Then, both will work together to select an appropriate extra credit activity focusing on those identified weaknesses, for the purpose of strengthening the student’s competence. A due date will be assigned (typically two weeks following the request), which must be honored in order for any credit to be earned from the activity. Extra credit may be denied at the instructor’s discretion if the student has not invested the necessary preparatory effort to perform well (e.g. lack of preparation for daily class sessions, poor attendance, no feedback questions submitted, etc.).

## ADDITIONAL STUDENT RESOURCES:

Accessibility: BTC and your instructor are committed to the principle of universal learning. This means that our classroom, our virtual spaces, our practices, and our interactions be as inclusive as possible. Mutual respect, civility, and the ability to listen and observe others carefully are crucial to universal learning.

If you have difficulty reading, hearing or seeing content, or any other difficulties that might negatively impact your potential to succeed in this course, you may be eligible to receive help from our Accessibility Resources Office. If you feel you may benefit from an accommodation, contact Accessibility Resources ideally at the start of the quarter. (You may contact them at any time during the quarter.) This office is located in the **Admissions and Student Resource Center, Room 106. Call 360-752-8450 or email** [**ar@btc.edu**](mailto:ar@btc.edu). If you qualify for academic accommodations, the Accessibility Resources Office will forward a letter of accommodation to your instructor, who will, with you, work out the details of any accommodations needed for this course.

Campus Emergencies: If an emergency arises, your instructor may inform you of actions to follow. You are responsible for knowing emergency evacuation routes from your classroom. If police or university officials order you to evacuate, do so calmly and assist those needing help. You may receive emergency information alerts via the building enunciation system, text message, email, or BTC’s webpage, Facebook and Twitter. Refer to the emergency flipchart in your room for more information on specific types of emergencies.

Tutoring:Drop-in tutoring is available at no cost to students when classes are in session. Tutors are recruited in all subjects where tutoring assistance is requested. The Tutoring Center is located in Building H, Rooms 9 and 15. To request tutoring or to apply to be a tutor, please contact the Tutoring Center at 360.752.8499 or visit [www.btc.edu/tutoring](http://www.btc.edu/CurrentStudents/TutoringCenter/indexTutoringCenter.aspx)for additional information and to access the Tutoring Request Form and the current drop-in tutoring schedule.

Advising & Career Services:Academic & Career Advisors are available to assist with: Exploring and choosing the career that fits you best; Developing an educational plan and selecting the courses to get you started and progress toward your goals; Assistance with academic success strategies; Job and internship searching resources including resume and cover letter development, mock interviews and more; Connecting with employers to explore job opportunities. This office is located in the Admissions and Student Resource Center, Room 106. Call 360-752-8345 or email [advising@btc.edu](mailto:advising@btc.edu).

Financial Aid: Students seeking Financial Aid should begin by completing a FAFSA at [FAFSA.ed.gov](file:///\\btc-nas1.bellingham-tech.edu\sleibrant\Syllabi%20Project\Syllabus%20Template%2016-17\FAFSA.ed.gov). Students who have completed a FAFSA can check their status by logging in to their student Financial Aid Portal on the BTC website. Visit the Financial Aid office in CSB 101, call at 360-752-8351, or email at [finaid@btc.edu](mailto:finaid@btc.edu) for assistance or additional resources. You may also qualify for additional funding support through Workforce Funding & Student Support. Apply at [http://www.btc.edu/workforcefunding](http://www.btc.edu/CurrentStudents/FinancialResources/WorkForceFunding.aspx)or stop by Campus Services, Room 102 for more information.

Library:The BTC Library is located on the third floor of the Campus Center Building with an inviting atmosphere that includes a view of Bellingham Bay. The Library offers a variety of services and technology to meet the educational needs of students by providing professional, high-quality service and assistance.

The Library houses a physical collection of 12,000 books and media as well as online resources that include access to 120,000 eBooks and 20+ databases (8,000 full-text online journals) to use for research in prerequisite classes and specific programs; one-on-one assistance is offered for reference and research needs. The Library also is the open computer lab on campus and consists of 80 computers with 40+ software programs. A variety of equipment is available for check out that includes laptops and iPads. Assistance is offered with hardware and software questions, online learning and any technology-related question during all open hours; there is also a HelpDesk with specific hours to help with technology needs. Media-enhanced rooms are available for group study.

Contact the Library by phone at 360.752.8383 or via email at [Library@btc.edu](mailto:Library@btc.edu), or visit the website: [www.btc.edu/library](http://www.btc.edu/CurrentStudents/Library/indexLibrary.aspx).