CS & ECE J444/544: Supervisory Control & Critical Infrastructure Systems

Spring 2024

DESCRIPTION	Principles of network-based distributed real-time control and critical infrastructure systems. Integration of dedicated control protocols with wide area networks (e.g. the Internet). Issues of reliability, cost, and security. Application to selected industries, such as electric power distribution and waste and water management.
PREREQUISITES	Recommended preparation: ECE 340, CS 240, ME 313, CE 330, or CE 372.
OBJECTIVES	1. Demonstrate an understanding of the evolution of supervisory control systems and their roles in various industries. 2. Describe the different components and communication systems of a modern supervisory control system. 3. Differentiate supervisory control system communication protocols and demonstrate an understanding of their strengths & weakness. 4. Understand design of a modern supervisory control system.
INSTRUCTOR	Brian K. Johnson
CONTACT INFO	GJL 201 208-885-6902 bjohnson@uidaho.edu
CLASS TIME	11:00 am-12:15 pm Pacific time, TR, JEB 21 (Moscow section)
RECITATION	Zoom recitation once/week, TBD, most likely at 5:00pm on scheduled day. Questions relevant to the class will be recorded.
OFFICE HOURS	M, W, F: 1:30-2:30pm Pacific time T: 2:00-3:00pm or anytime my door is open
COURSE WEB SITE	https://webpages.uidaho.edu/ece/ee/power/ECE444544/
TEXT	• Mini S. Thomas & John D. McDonald, *Power System SCADA and Smart Grids*, 1st Edition. CRC Press, 2015. • Various papers and other publications presented in class.
REFERENCES	Notes to be provided during the course and linked on course web page.

GRADING:

Item	Percent of Grade	
Homework	13%	A: 90-100
Labs	15%	B: 80-89
Projects	22%	C: 70-79
Exam 1	25%	D: 60-69
Final Exam	25%	F: < 60

COURSE OUTLINE

Lecture Topic	Chapter
• Introduction/Welcome	
• Overview of distributed monitoring and control networks	1
• Components used in industrial control networks	
o Types of controllers	Notes
o Real-time computing	Notes
o Control network nodes: RTUs, IEDs, Relays	2
o Modeling, simulation and validation	Notes
• Introduction to Control Systems	Notes
• Communication Networks for Operational Technology (OT)	
o Interconnections	3
o Topologies and design	3
o Differences from enterprise networks	Notes
o Power Grid Cases: protection, EMS, DA/DMS/ADMS	5 & 6
o Network Reliability and survivability	Notes
o Susceptibility, vulnerability assessment	Notes
o Security	Notes
o Resilience	Notes
• Standard Communication Protocols	
o Vendor specific versus industry standard	Notes
o MODBUS, IEC 60870 and DNP3	3.9.1-3.9.3
o IEC 61850 family of protocols	3.9.6, notes
o IEEE C37.118	3.9.3, 3.9.7
o ICCP, IEEE 2030 standards, and others	Notes
• Industry case studies	
o Microgrids/DER	Notes
o Integrate a wind farm	Notes
o Electric power grid digital transformation concepts	Notes
o Application in other industries	Notes
o Digital twins	Notes
• Student Project Presentations	
• Review	

1. Exams may be given as "take homes"
2. Note: homework assignments and projects may require software tools.

LECTURE DATES:

Monday Date	Tuesday	Thursday
January 8	X	1
15	2	3
22	4	5
29	6	7
February 5	8	9
12	10	11
19	12	13
26	14	15
March 4	16	17
11	H	H
18	18	19
25	20	21
April 1	22	23
8	24	25
15	26	27
22	28	29
29	30	31

Final Exam: Thursday May 9, 10:15am-12:15pm Pacific Time (likely take home exam/project).

GENERAL GUIDELINES:

On-Campus Students:
1. Please include either "CS 444," "ECE 444," "CS 544" or "ECE 544" in the subject line of e-mail correspondence related to this course
2. When submitting homework assignments, please send copies to Brian Johnson (bjohnson@uidaho.edu) and Derrick Agbenya (e-mail address will be sent to class).
3. Assignments handed in after the due date will be worth a maximum of 50%. However, I will allow extensions if you consult with me in advance, and have a major timing conflict.
4. Feel free to contact me by phone or e-mail if you have questions and can't make it to our offices easily. I have a link to my Google calendar posted on the course web page. Please refer to that to check my availability, especially if you want to schedule a meeting.
5. We will be scheduling lab sessions using outside of the normal class time. We will try to set times that don't cause problems with your work schedules or the schedules for your other classes.

Outreach Students:
1. This is not a self-paced class. Engineering Outreach students are expected to finish the course at the same time as the on campus students.

2. Please include either "CS 444," "ECE 444," "CS 544" or "ECE 544" in the subject line of e-mail correspondence related to this course.

3. The lab sessions are set up for remote access. We will contact you for scheduling and access.

4. Due dates for homework and projects will generally be specified the same as the due date for on-campus students. This is the date when your assignment reaches Moscow. Assignments will be worth a maximum of 50% after the due date. However, I will allow extensions if you consult with me in advance and if you have a major schedule conflict.

5. Please put your name and the course number on top of the first page of each exam and homework, especially if submitting by FAX or e-mail. It would be best if your name was in the header of each page. E-mail submission of assignments is ok, as long as compatible file formats are used. Allowable formats for electronic submission are Adobe Portable Document Format (PDF), Microsoft Word (*.doc or *.docx), Rich Text Format (*.rtf) or MathCAD 15 (or earlier) or Prime 9.0 (or earlier). Limit to one or two attached files. We don't want a large number of files with no documentation on what order to use them. Make sure you number your pages as: 1/4, 2/4, etc., so we know whether or not we have a complete set. Also make sure writing is dark and clear on for scanned documents.

6. When submitting homework assignments, please send copies to Brian Johnson (bjohnson@uidaho.edu) and Derrick Agbenya (e-mail address will be sent to class).

7. Phone calls, Zoom, Teams or the use of e-mail for asking questions is encouraged. You are welcome to call outside of office hours. I have a link to my Google calendar posted on the course web page. Please refer to that to check my availability, especially if you want to schedule a meeting.

8. Library Resources: As a UI student, you not only have access to valuable print and electronic resources from the university's library, such as access to IEEEXplore, but you also have the access to personalized assistance from the librarians. If you have assignments or research questions and aren't sure how to make the most of library resources from off campus, you do one of the following:
   a. As a UI student you can also download a VPN client from the ITS Help Desk: https://support.uidaho.edu/TDClient/KB/ArticleDet?ID=231   You will need to log in using your UI student account.
   b. You can visit the Off-Campus Access information page on the library's website at: https://libanswers.uidaho.edu/faq/227988
      i. For IEEEXplore papers, it appears that you may now need to go to the UI library web page (https://www.lib.uidaho.edu/) if you aren't coming from a UI IP address, put the paper title in the search box.

9. University of Idaho is committed to creating a safe learning environment for all students. Consistent with this, UI policy and Title IX prohibit sexual misconduct, which includes sex or gender-based harassment, sexual assault, intimate partner violence, stalking, and retaliation. If you have experienced any form of sexual misconduct, know that help and support are available. Please be aware that all University of Idaho employees are mandatory reporters and are required to report any information they receive about sexual misconduct to the university's Title IX Coordinator within 24 hours (Idaho State Board Policy, Section I, I.T.). Visit http://www.uidaho.edu/ocri/title-nine/resources to learn more about which resources on campus and within our community are confidential. If you would like to report an incident, you may do so anonymously by visiting www.uidaho.edu/vandalcare or you can directly contact the Office of Civil Rights and Investigations at 208-885-4285 or ocri@uidaho.edu.