Spring 2020 – Syllabus
EENG 4340.001 & EENG 5340.001 Environmental Monitoring

Description:

Fundamental course on sensors, instruments, and real- time systems to monitor environmental systems. Applications to atmospheric and radiation, weather, air quality, hydrological, water quality, terrestrial ecosystems, and aquatic ecosystems. Sensors: technology, operation principles, calibration, and maintenance. Data acquisition systems and telemetry: data loggers, sensor networks, wireless communications, and networks. Informatics: database, metadata, standards, data sharing, and preservation. Environmental observatories. Credit hours: 3 hrs.

Prerequisites:

Senior standing or Master standing

Instructor

Miguel F. Acevedo, Regents Professor Electrical Engineering (EE), and Advanced Environmental Research Institute (AERI). Office Discovery Park B-260, Phone 940-891-6701, acevedo@unt.edu, Office hours: Monday 9:00-10:00 am, Wednesday 10:00-11:30 am, or by appointment.

Grader

Akash Raj Ayyagari, Graduate Student, Electrical Engineering Department, Office B-245, Email AkashRajAyyagari@my.unt.edu. Office hours: Monday and Wednesday 12pm-2 pm or by appointment.

Format:

- Online components using the Canvas Learning Management System https://unt.instructure.com/
    - Resources: readings, summary power point presentations, lab guides.
- Your grade will be based on problem sets, quizzes, and exams.
- Lectures: Monday 10:00-11:20 am each week in Discovery Park B-227. Lectures will also be available by Zoom.
    - This lecture time will include examples of problem solving, going over answers to questions in problem sets and quizzes, and reviews prior to quizzes and exams.
- Labs: computer-based and hands-on. You will complete these on your own.
    - Hands-on: Students will use a kit for sensors and instruments. The kit can be checked out from the EE Department and returned at the end of the semester
    - Computer-based: using software listed below
- Communication with the instructor:
    - Email to acevedo@unt.edu is the preferred way of communication. Please use your UNT student Email account to communicate with me.
- Software:
    - Word (MS or equivalent), Excel (MS or equivalent), PDF maker and reader (Adobe or equivalent), and Browser (Chrome or equivalent).
    - R, Arduino libraries, SQLiteStudio, RealTerm, RadioMobile (All this software is available free for download from the internet)

Grade:

- Bi-Weekly problem set assignments: 25%
- Bi-Weekly quizzes: 25%
- Midterm exam 25%
- Final exam 25%: not comprehensive

Exams:

- Exam 1 (Midterm) March 5
- Exam 2 (non-comprehensive Final) Designated final day: Exam 2 (Final) My 2, 8:00-10:00 am according to UNT schedule http://registrar.unt.edu/exams/final-exam-schedule

Textbooks Recommended:

- RTEM: Acevedo, M.F. 2015. Real-Time Environmental Monitoring: Sensors and Systems. CRC Press. ISBN: 978-1-4822-4020-7.
- DASE: Acevedo M.F. 2013. Data Analysis and Statistics for Geography, Environmental Science, and Engineering. CRC press. ISBN: 978-1-4398-8501-7

Class Evaluation by Students:

The SPOT (Student Perceptions of Teaching) evaluation is a requirement for all organized classes at UNT and is available for your input at the end of the semester.

Topics:

1. Principles of Monitoring: definition and motivation, Earth systems, ecosystems, environmental systems, and applications.
2. Sensors and transducers: Principles of circuits and electronics, principles of sensors, examples.
3. Sensors and transducers: Bridge circuits, sensor technology, operation principles, calibration, and maintenance.
4. Signal Conditioning and A/D converters: Amplifiers, noise, isolation, A/D converters.
5. Data acquisition systems: Data loggers, Real-time clock. Communication: serial, standards.
6. Single board computers and microcontrollers.
7. Wireless technology and telemetry: Radio waves, transmission, reception, antennas, WiFi
8. Wireless sensor networks: Examples, protocols.
9. Power sources and storage for remote stations: Solar cells, batteries, chargers.
10. Informatics: Database design and implementation, metadata, standards, data interoperability, data preservation, web services.
11. Atmosphere monitoring: Solar radiation, UV and ozone, weather, fiber optics, spectrometers, air quality (gases, aerosols and particulate matter).
12. Hydrosphere monitoring: Hydrology and hydrodynamics (water velocity, flow, and depth), water quality and aquatic ecosystems (dissolved oxygen, pH, conductivity, and other parameters).
13. Monitoring terrestrial ecosystems: Soil moisture, evapotranspiration, vegetation, productivity, Gas exchange.
14. Wildlife monitoring: Biomonitoring, organism response to stress, radio tags, acoustic tags, GPS trackers, camera and video.

Course Learning Outcomes (CLOs):

[CLO-1] Grasp the motivation for monitoring environmental systems and ecosystems, along with their applications.

[CLO-2] Have working knowledge of how to design and use sensors, signal conditioning systems, and conversion from analog to digital.

[CLO-3] Have working knowledge of data acquisition systems, data loggers, and single board computers.

[CLO-4] Have working knowledge of wireless technology, wireless sensor networks, telemetry, and application to automated stations.

[CLO-5] Have working knowledge of models, data analysis and software, informatics, databases, database management, and web services.

[CLO-6] Have a general concept of monitoring the atmosphere: weather, gases, solar radiation, and air quality.

[CLO-7] Have a general concept of monitoring the hydrosphere: streams, rivers, lakes, sea, and water quality.

[CLO-8] Have a general concept of monitoring the biosphere: terrestrial ecosystems, vegetation, soils, bio-monitoring and wildlife tracking.

Policies:

Grades: All grades for the course will be final. No extra credit assignments or work will be considered after the final grade has been recorded.

Accommodations: The EE Department in cooperation with the Office of Disability Accommodation complies with the Americans with Disabilities Act in making reasonable accommodations for qualified students with disabilities. Please present your written accommodation request before the 12th class day.

Academic Dishonesty: Students caught cheating, plagiarizing, or any other academic dishonesty will be subject to penalty according to the new Policy on Students Standards on Academic Integrity. See full policy at http://www.unt.edu/policy/UNT_Policy/volume3/18_1_16.pdf

According to this policy the categories of academic dishonesty are:

A. Cheating. The use of unauthorized assistance in an academic exercise, including but not limited to:
    a. use of any unauthorized assistance to take exams, tests, quizzes or other assessments;
    b. dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems or carrying out other assignments;
    c. acquisition, without permission, of tests, notes or other academic materials belonging to a faculty or staff member of the University;
    d. dual submission of a paper or project, or re-submission of a paper or project to a different class without express permission from the instructor;
    e. any other act designed to give a student an unfair advantage on an academic assignment.
B. Plagiarism. Use of another's thoughts or words without proper attribution in any academic exercise, regardless of the student's intent, including but not limited to:
    a. the knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgement or citation.
    b. the knowing or negligent unacknowledged use of materials prepared by another person or by an agency engaged in selling term papers or other academic materials.
C. Forgery. Altering a score, grade or official academic university record or forging the signature of an instructor or other student.
D. Fabrication. Falsifying or inventing any information, data or research as part of an academic exercise.
E. Facilitating Academic Dishonesty. Helping or assisting another in the commission of academic dishonesty.
F. Sabotage. Acting to prevent others from completing their work or willfully disrupting the academic work of others.

Tentative Course Calendar (PS=Problem Set, QZ=Quiz)

Week	Module	Topic	Activity	Reading	Module Completion date	Assess.	Due Date
1	1	Principles of Monitoring Intro to R	Survey ABET - Lab1 Intro to R	RTEM Ch 1 & Appx.	1/20	PS1	1/20
2	2	Review of Probability and Statistics	Lab 2 More skills in R, stats in R	DASE Ch 3,4 RTEM Appx.	1/27	QZ1	1/27
3	3	Sensor and Transducers Voltage Dividers	Lab3 Sensor design	RTEM Ch 2	2/033	PS2	2/03
4	4	Bridge Circuits, Signal Conditioning	Lab4 Bridge circuits, & OpAmp	RTEM Ch 3, 4	2/10	QZ2	2/10
5	5	Signal conditioning, Data acquisition systems and dataloggers	Lab 5 ADC, RTC, data loggers, 4-20 mA	RTEM Ch 4,5	2/17	PS3	2/17
6	6	Single board computers and microcontrollers	Lab 6 Moteino and thermistor	RTEM Ch 6	2/24	QZ3	2/24
7	7	Wireless technology and telemetry	Lab 7 Radio link, term capture, RTC, Moteino and Gateway	RTEM Ch 7	3/2		
8	1-7	Review for midterm exam-	Review	All material			
8		Midterm exam	Midterm exam			Exam	3/05
		Spring Break					
9	8	Wireless sensor networks WSN	Lab 8 WSN	RTEM Ch 8	3/23	PS4	3/23
10	9	Power sources and storage	Lab 9 Power and batteries	RTEM Ch 9	3/30	QZ4	3/30
11	10	Informatics, DBM	Lab 10 DBM	RTEM Ch 10	4/06	PS5	4/06
12	11	Atmospheric monitoring	Lab 11 Weather	RTEM Ch 11	4/13	QZ5	4/13
13	12	Water quantity and quality	Lab 12 Water quality	RTEM Ch 12	4/20	PS6	4/20
14	13	Terrestrial Ecosystems	Lab 13 Soil moisture & canopy	RTEM Ch 13	4/27	QZ6	4/27
15	14	Wildlife monitoring	Survey ABET, - Lab 14 Wildlife monitoring	RTEM Ch 14	4/29		
	8-14	Review for final exam	Review	All material			
Finals		Final Exam	Final Exam			Exam	5/2