EENG 4350.001 & EENG 5350.001 Renewable Electrical Power Systems
Fall 2023 – Syllabus

Tentative Syllabus – Subject to change according to circumstances

Contents

Course Description
Fundamental course on efficient and renewable electrical power systems with relationships to environmental systems. Integration of renewable and alternative energy generation to the electric power system grid. Environmental challenges for the harnessing of renewable and alternative energy sources for electrical power systems. Credit hours: 3.

Course Prerequisites
Senior standing or Master standing. Students are expected to have knowledge of physics, chemistry, and mathematics (up to linear algebra and differential equations). In addition, students are expected to have basic skills using computers such as managing files, using spreadsheets, bibliography search, and elements of programming.

Class Schedule
Monday and Wednesday 10:00-11:20 am at DP B227

Instructor
- Miguel F. Acevedo, Regents Professor Electrical Engineering (EE), and Advanced Environmental Research Institute (AERI). Office Discovery Park B-260 or E245M, Phone 940-891-6701, acevedo@unt.edu. Office hours: Monday-Wednesday 9-10 AM, and 11:30- 12:00 or by appointment.
- The preferred means of communication with the instructor is by Email using Canvas or alternatively Email to acevedo@unt.edu by using your UNT student Email account. Please do not use other Email systems.

Course Structure
- Online resources: Canvas https://unt.instructure.com/
- Lectures in person at DP at fixed times per schedule and attendance is required. When needed, lectures will be delivered online by Zoom (links will be given in Canvas).
- Lecture time will include taking examinations (quizzes and exams), examples of problem solving, going over answers to questions in problem sets and quizzes, and reviews prior to quizzes and exams.
- Problem sets developed individually and submitted via Canvas per course calendar.
- Examinations (quizzes and exams) taken in class individually online via Canvas at fixed times per schedule and using Respondus LockDown Browser. Examinations (quizzes and exams) will be on a timer.
- Computer based labs using R and package renpow
- Remote field webinars using Zoom as needed.

Assessments and Grading

Assessment	Modality	Late/makeup policy	Points possible	Percent of final grade
Weekly problem sets	Submitted via Canvas Due Mondays 11:59 pm	No late submittal accepted	25 Average of all PS	25%
Weekly quizzes	Taken in-class via Canvas on Wednesdays 11 am	No makeup given	25 Average of all quizzes	25%
Midterm exam	Taken in-class via Canvas per schedule	No makeup given	25	25%
Final exam (not comprehensive)	Taken in-class via Canvas per schedule	No makeup given	25	25%
Total possible			*100*	*100%*

Grading scale to obtain final letter grade from percentage
A = 90.0-100.0
B = 80.0-89.9
C = 70.0-79.9
D = 60.0-69.9
F = 0.0-59.9

Schedules of exams

- Midterm: October 11, at class time 10:00 -11:20 AM.
- Final: According to UNT exam schedule: December 9, 8:00-10:00 am http://registrar.unt.edu/exams/final-exam-schedule/fall

Textbooks

Recommended: Acevedo M.F. 2018. *Introduction to renewable power systems and the environment with R*. CRC Press, 439 pp, ISBN 978-1138197343.

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.

Course Learning Outcomes

The Course Learning Outcomes (CLOs) are listed below and are evaluated by surveys of self-assessment from students at the beginning and end of the semester. The results become part of ABET accreditation reports of the EE department.

CLO-1 Working grasp of various forms of energy and power and their relation to electricity production. Understanding what makes an energy- conversion process renewable.

CLO-2 Awareness of the importance of understanding environmental systems, Carbon cycle, fossil fuel resources, global climate change, air pollution, and sustainability

CLO-3 Review and extend prior knowledge of DC circuits and power. Electrical storage. Batteries, super-capacitors.

CLO-4 Review and extend prior knowledge of AC circuits and power. Electromagnetic devices. Three-phase circuits, transformers, generators. Power quality: harmonics, power factor.

CLO-5 Understand the role of thermodynamics in electric power systems: Carnot cycle, heat engine, entropy, and enthalpy. Understanding fuel cells.
CLO-6 Basic knowledge of coal and steam combustion generation. Rankine cycles. Coal-fired power plants. Alternative: geothermal, nuclear and biomass.
CLO-7 Basic knowledge of gas turbines and combustion engines. Brayton and Otto cycles. Distributed generation: Microturbines, Stirling engines, co-generation.
CLO-8 Acquire an overall view of electric power industry. Generation, transmission, distribution. Baseload, intermediate and peaking power plants, load–duration curves.
CLO-9 Working grasp of hydropower. Watersheds, Reservoirs, dams. Turbines. Reservoir and power management. Micro hydropower. Wave and tidal power
CLO-10 Working grasp of wind power generation. Environmental conditions. Technologies, generators. Efficiencies, economics. Small-scale. Utility scale
CLO-11 Working grasp of solar power: Sun-Earth relations, sun path, insolation, radiation, and tracking. Photovoltaic systems. Small scale. Utility scale. Environmental conditions, efficiencies.

Required Technology and Skills

Students will need access to a set of minimum technological resources and skills to succeed in this class. This course has digital components. To fully participate in this class, students will need internet access to reference content on the Canvas Learning Management System and other requirements as described below. If circumstances change, you will be informed of other technical needs to access course content. Information on how to be successful in a digital learning environment can be found at Learn Anywhere (https://online.unt.edu/learn).

Minimum Technology Requirements

The students are required to have:

- Computer
- Reliable internet access and web browser
- Canvas Technical Requirements (https://clear.unt.edu/supported-technologies/canvas/requirements)
- Install Respondus LockDown Browser (available from Canvas)

Computer Skills and Digital Literacy

Course-specific technical skills learners must have to succeed in the course:

- Using Canvas for accessing materials and grades, as well as submitting files and taking examinations.
- Converting files to PDF
- Using email with attachments
- Downloading and installing software
- Using spreadsheet programs
- Using presentation and graphics programs
- Using R and package renpow
- Performing online library searches

Technical Assistance

Here at UNT we have a Student Help Desk that you can contact for help with Canvas or other technology issues.

UIT Help Desk: UIT Student Help Desk site (http://www.unt.edu/helpdesk/index.htm)
Email: helpdesk@unt.edu
Phone: 940-565-2324
In Person: Sage Hall, Room 130

Walk-In Availability: 8am-9pm
Telephone Availability:

- Sunday: noon-midnight
- Monday-Thursday: 8am-midnight
- Friday: 8am-8pm
- Saturday: 9am-5pm

Laptop Checkout: 8am-7pm
For additional support, visit Canvas Technical Help (https://community.canvaslms.com/docs/DOC-10554-4212710328)

Course Topics

- Introduction
  - Energy and Power
  - Potential and kinetic energy; EM energy, thermal energy, chemical energy
  - Carbon-based power systems
  - Terminology: Clean, Alternative, Renewable, Green, or Sustainable
  - Electric power systems
- Environmental Systems, the Carbon Cycle, and Fossil Fuels
  - Ecosystems and the Carbon Cycle
  - Carbon Dioxide in the Atmosphere and Global Temperature
  - Geologic History and Age of Fossil Fuels
  - Shortening the Cycle and Sequestering Carbon
- Fundamentals of Direct Current Electric Circuits
  - Basics of Electric Circuits, Current and Voltage, Circuit Analysis Methods
  - Modeling Voltage and Current Sources
  - Resistivity, Wires, and Power Loss in the Wire
  - Batteries and Electrochemical Cells
- Thermodynamics
  - First Law of Thermodynamics
  - PV Paths and States
  - Heat Engine, Cycles, and Carnot Limit
- Electrical Storage Elements, Basics of AC Circuits, and AC-DC Conversion
  - Principles of Circuits with Energy Storage Elements
  - Electromechanical Devices
  - Basics of AC Systems
  - AC to DC and DC to DC Conversion
- More Thermodynamics State Functions: Entropy, Enthalpy, and Free Energy
  - Entropy and the Second Law of Thermodynamics, The T-s Plane
  - Enthalpy and Free Energy
  - Thermochemical Processes
  - Fuel Cells
- Coal- and Steam-Based Processes
  - Coal Characteristics and Types, World Coal Consumption and Reserves
  - Coal-Fired Power Plants
  - Earth's Atmosphere, Environmental Impacts of Coal-Fired Power Plants
  - Other Steam-Based Systems, Nuclear, Geothermal
- Alternating Current (AC) Circuits and Power

    - Impedance
    - Instantaneous and Average Power, Root Mean Square (RMS)
    - Complex Power, Power Factor, Complex Power Loss in the Line
    - Inverters and Back-to-Back Converters
- Gas and Liquid Fuels: Gas Turbines and Combustion Engines
    - Natural Gas, Gas-Based Conversion
    - Internal Combustion Engines, Oil as Fuel for Power Generation
    - Alternative or Substitute Gas and Liquid Fuels, Alternative Turbines and Combustion Engines
    - Combined Heat and Power (CHP)
- Transformers and Three-Phase Circuits
    - Transformers
    - Three-Phase Power Systems
    - Power Quality: Harmonic Distortion
    - AC-DC and DC-AC Converters in Three-Phase Systems
- Power Systems and the Electric Power Grid
    - Electric Power Systems: Major Components, Distribution Bus
    - Transmission Line Models, Bus Admittance Matrix
    - Basics of Per Unit (P.U.) System, Power Flow
    - Demand, Daily Regime, Weekly Regime, Load–Duration Curve
    - Power Delivery: Environmental Relationships
- Hydroelectric Power Generation
    - Hydroelectric Power: Calculating Power
    - Types of Turbines
    - Hydro Power Design and Management, Environmental Interaction
    - Coastal Hydroelectric: Tidal and Wave Power
- Wind Resources and Wind Power
    - Wind: Driving Forces and Circulation Patterns
    - Wind Power, Statistics of Wind Speed
    - Wind Turbines, Wind Farms
    - Off-Grid and Microgrids, Distributed Generation
    - Environmental Considerations of Wind Power Generation
- Solar Power
    - Solar Resource
    - Photovoltaic (PV) Basics, PV Performance, Tilting the Panel and Sun Tracking
    - Solar Farms, Grid-Tie, Off-Grid, and Microgrids
    - Concentrating Solar Power (CSP)
    - Environmental Considerations of Solar Power Generation

Tentative Course Calendar

(PS=Problem Set)

Week	Date	Assessment	Topics- Activities	Chapter
1	8/21	ABET Survey	Energy and Power, conversion, electricity production	1
1	8/23		Intro to R and renpow, combustion, Fossil fuels	1, Appendix
2	8/28	PS due	Carbon Cycle, CO_2 emissions, Global temperature	2
2	8/30	Quiz	Continued Carbon and energy	2
3	9/4	PS due 9/5	Labor Day – University closed	
3	9/6	Quiz	DC circuits, sources, batteries	3,5
4	9/11	PS due	DC transients Thermodynamics, 1st law, paths, states	5,4
4	9/13	Quiz	Heat Engines, cycles, Carnot limit	4
5	9/18	PS due	Entropy 2nd law	6
5	9/20	Quiz	T-s plane, Fuel cells	6
6	9/25	PS due	AC Circuits, phasors, analysis, AC power	5
6	9/27	Quiz	RMS AC Power, Power Factor	8
7	10/2	PS due	Coal fired power plants, Steam based	7
7	10/4	Quiz	Nuclear, geothermal	7
8	10/9	PS due	Review for midterm exam Nongraded Quiz	1-8, Appendix
8	10/11		Midterm Exam	1-8, Appendix
9	10/16		Gas and oil, gas turbine, combustion engine	9
9	10/18		Landfill gas, microturbines, Stirling engines	9
10	10/23	PS due	Transformers	10
10	10/25	Quiz	Three phase, Harmonics	10
11	10/30	PS due	Electric power systems, the Grid	11
11	11/1	Quiz	Power flow, demand statistics	11
12	11/6	PS due	Water resources, Hydroelectric power, hydrology	12
12	11/8	Quiz	Tidal and wave energy	12
13	11/13	PS due	Wind resources, power, statistics	13
13	11/15	Quiz	Wind turbines	13
	11/20		Thanksgiving week- No class	
	11/22		Thanksgiving week No class	
14	11/27	PS due	Solar resources	14
14	11/29	Quiz	Photovoltaics Solar CSP	14
15	12/4	PS due	Integration of renewables	14
15	12/6	ABET Survey	Review for Final Non-graded Quiz	9-14
Finals	12/9	Final exam	Final Exam 8:00 -10:00 am	9-14

Course Policies

Syllabus Change Policy

Information provided in the syllabus is subject to change according to circumstances.

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.

Attendance

Attendance to class is required. Please arrive on time and do not leave the classroom early unless you request my authorization to do so before the class starts. Being punctual and staying for the full period indicates our respect for others. Being late to class is sometimes inevitable. If you are late, know that you are welcome to join the class, but please do so without distracting others. More than two instances of tardiness will result in an absence from class.

Class Participation

Students are encouraged to participate during lectures.

Late Work

Problem sets are to be submitted by the due date and time. Late work is not accepted.

Examination Policy

Examinations (quizzes and exams) require Respondus LockDown Browser. Make sure you are logged on to Canvas and Respondus LockDown Browers at least 5 minutes before the examination start time to avoid last minute technical difficulties. Students will take the examinations individually but at the same time (per schedule) and are not allowed to work together or in teams while taking the examinations. No make-up examinations will be given.

Assignment Policy

Instructions, due dates, submittal format for each assignment will be given in Canvas. Consider submitting assignments ahead of the due date to avoid potential last minute technical difficulties, including server unavailability. If you experience technical difficulties at the due date and time, you should immediately contact the instructor and the Student Helpdesk helpdesk@unt.edu or 940.565.2324.

Instructor Responsibilities and Feedback

As an instructor I strive to help students learn, providing clear instructions for assessments, answering questions about assignments, identifying additional resources as necessary, providing grading information, reviewing and updating course content. I aim to return graded work to you within one week after the due date. Normally, I do my best to respond to Email questions within a 24-hour timeframe.

UNT policies

Rules of Engagement

Rules of engagement refer to the way students are expected to interact with each other and with their instructors. Here are some general guidelines:

- While the freedom to express yourself is a fundamental human right, any communication that utilizes cruel and derogatory language based on race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law will not be tolerated.
- Treat your instructor and classmates with respect in any communication, even when their opinion differs from your own.

- Speak from personal experiences. Use "I" statements to share thoughts and feelings. Try not to speak on behalf of groups or other individual's experiences.
- Use your critical thinking skills to challenge other people's ideas, instead of attacking individuals.
- Avoid using all caps while communicating digitally. This may be interpreted as "YELLING!"
- Be cautious when using humor or sarcasm in emails or discussion posts as tone can be difficult to interpret digitally.
- Avoid using "text-talk".
- Proofread and fact-check your sources.
- Keep in mind that online posts can be permanent, so think first before you type.

See these Engagement Guidelines (https://clear.unt.edu/online-communication-tips) for more information.

Academic Integrity Policy

Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. Examples of 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.

ADA Policy

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable

accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website (http://www.unt.edu/oda). You may also contact ODA by phone at (940) 565-4323.

Prohibition of Discrimination, Harassment, and Retaliation (Policy 16.004)

The University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law in its application and admission processes; educational programs and activities; employment policies, procedures, and processes; and university facilities. The University takes active measures to prevent and investigate such conductand takes remedial action when appropriate.

Emergency Notification & Procedures

UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

Acceptable Student Behavior

Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom or Zoom meeting and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. Visit UNT's Code of Student Conduct (https://deanofstudents.unt.edu/conduct) to learn more.

Access to Information - Eagle Connect

Students' access point for business and academic services at UNT is located at: my.unt.edu. All official communication from the University will be delivered to a student's Eagle Connect account. For more information, please visit the website that explains Eagle Connect and how to forward e-mail Eagle Connect (https://it.unt.edu/eagleconnect).

Student Evaluation Administration Dates

Student feedback is important and an essential part of participation in this course. The student evaluation of instruction is a requirement for all organized classes at UNT. The survey will be made available during weeks 13, 14 and 15 of the long semesters to provide students with an opportunity to evaluate how this course is taught. Students will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-reply@iasystem.org) with the survey link. Students should look for the email in their UNT email inbox. Simply click on the link and complete the survey. Once students complete the survey they will receive a confirmation email that the survey has been submitted. For additional information, please visit the SPOT website (http://spot.unt.edu/) or email spot@unt.edu.

Sexual Assault Prevention

UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination on the basis of sex, and therefore prohibit sexual misconduct. If you or someone you know is experiencing sexual harassment, relationship violence, stalking, and/or sexual assault, there are campus resources available to provide support and assistance. UNT's Survivor Advocates can assist a student who has been impacted by violence by filing protective orders, completing crime victim's compensation applications, contacting professors for absences related to an assault, working with housing to facilitate a room change where appropriate, and connecting students to other resources available both on and off campus. The Survivor Advocates can be reached at SurvivorAdvocate@unt.edu or by calling the Dean of Students Office at 940-565- 2648. Additionally, alleged sexual misconduct can be non-confidentially reported to the Title IX Coordinator at oeo@unt.edu or at (940) 565 2759.