Class meetings Monday-Wednesday 10:00-11:20 in DP B-227

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 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-Wednesday 9-10 AM, and 11:30-12:00 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
• Lectures, exercises, homework, quizzes
• Labs: computer based and field webinars
• Software: R and package renpow
• Online resources: Canvas https://unt.instructure.com/

Grade
• Midterm exam 25%: Closed book.
• Final exam 25%: not comprehensive. Closed book.
• Bi-weekly quizzes: 20%. Closed book. In-class online. The lowest score of all quizzes will be dropped when calculating your final grade.
• Bi-weekly homework assignments: 20%. The lowest score of all homework assignments will be dropped when calculating your final grade.
• Attendance 10%. Roll is called at 10 am, please be in class on time. A tardy of more than 5 minutes counts as an absence. You are required to be in class until the end of the lecture period.

Schedules of exams
• Midterm: October 16, 2017 at class time.
• Final: According to UNT exam schedule: December 7th 8:00-10:00 am
  http://registrar.unt.edu/exams/final-exam-schedule/fall

Textbooks
Recommended:

**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**
Course Learning Outcomes (CLOs), that is, the areas for student learning in this course are:

- **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, supercapacitors.
- **CLO-5** Understand the role of thermodynamics in electric power systems: Carnot cycle, heat engine, entropy, and enthalpy. Understanding fuel cells.
- **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.

**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 (Hw=Homework; Qz= Quiz, Appx= Appendix)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Assessment</th>
<th>Topics- Activities</th>
<th>Chapter</th>
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<tbody>
<tr>
<td>1</td>
<td>8/26</td>
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<td>Energy and Power, conversion, electricity production</td>
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<td>8/28</td>
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<td>Computer Exercises Lab1 Intro to R and renpow</td>
<td>Appx</td>
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<td>2</td>
<td>9/2</td>
<td>Hw1 due 9/3</td>
<td>Labor Day – University closed</td>
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<td>9/4</td>
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<td>Solution Hw – Combustion, Fossil fuels</td>
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<td>3</td>
<td>9/9</td>
<td>Qz1</td>
<td>Quiz and Solution Quiz</td>
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<td>9/11</td>
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<td>Fossil fuels and CO2, terminology, Carbon Cycle, CO2 emissions Lab 2 More skills in R, CO2 Assign HW2</td>
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<tr>
<td>4</td>
<td>9/16</td>
<td>Hw2 due 9/17</td>
<td>Videoconference class – DC circuits, sources, batteries AC circuits. Solar PV</td>
<td>3-5</td>
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<td></td>
<td>9/18</td>
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<td>Videoconference Lab 3 - Field Webinar, Circuits, Batteries, Solar PV</td>
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<td>5</td>
<td>9/23</td>
<td>Qz2</td>
<td>Solution Quiz - Thermodynamics, 1st law, paths, states,</td>
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<td>9/25</td>
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<td>Lab 4 Heat Engines, cycles, Carnot limit</td>
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<td>6</td>
<td>9/30</td>
<td>Hw3 due 10/1</td>
<td>Solution Hw, Entropy 2nd law, T-s plane Fuel cells</td>
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<td>Coal fired power plants, Steam based, nuclear, geothermal</td>
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<td>7</td>
<td>10/7</td>
<td>Qz3</td>
<td>Solution Quiz, Review for midterm exam</td>
<td>1-7, Appx</td>
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<td>10/9</td>
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<td>Midterm Exam</td>
<td>1-7, Appx</td>
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<td>8</td>
<td>10/14</td>
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<td>AC power, RMS AC Power, PF</td>
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<td>10/16</td>
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<td>Lab 5 Field Webinar Wind, Solar, grid tie</td>
<td>11,14</td>
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<td>9</td>
<td>10/21</td>
<td>Hw4 due</td>
<td>Solution Hw -Gas and oil, gas turbine, combustion engines</td>
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<td>10/23</td>
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<td>Lab 6 Landfill gas, microturbines, Stirling engines</td>
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<td>10/28</td>
<td>Qz4</td>
<td>Videoconference class Solution Quiz AC power</td>
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<td>10/30</td>
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<td>Videoconference class Lab 7 Three phase</td>
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<td>11/4</td>
<td>Hw5 due</td>
<td>Solution Hw, Transformers, Three phase, Harmonics</td>
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<td>11/6</td>
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<td>Lab 8 Electric power systems, the Grid, power flow, demand</td>
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<tr>
<td>12</td>
<td>11/11</td>
<td>Qz5</td>
<td>Solution Qz, Electric power systems, the Grid, power flow, demand</td>
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<td>11/13</td>
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<td>Lab 9 Hydroelectric,</td>
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<td>11/18</td>
<td>Hw6 due</td>
<td>Online class -Solution Hw – Solar resources</td>
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<td>11/20</td>
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<td>Lab 10 Solar CSP - Wind</td>
<td>13, 14</td>
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<td>Qz6</td>
<td>Solution Qz Tidal and wave energy</td>
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<td>11/27</td>
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<td>Lab 11 Wind resources, power, statistics</td>
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<td>Wind stats, turbines – ABET survey</td>
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<td>Review for Final</td>
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<td>Finals</td>
<td>12/7</td>
<td>Final exam</td>
<td>Final Exam</td>
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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.