ECE 5321 – Electric Power Systems CUSP Curriculum
Spring 2020, Online

Educational Goals & Philosophy: This course is the first course on Power Systems, covering Electric Power Generation, Transmission, and Distribution with an integrated focus on a set of courses on Electric Energy Systems with an emphasis on sustainability as part of the CUSP™ (Consortium of Universities for Sustainable Power) curriculum. The CUSP™ courses have been developed under the vision and leadership of Prof. Ned Mohan at the University of Minnesota by the nation’s leading experts including 7 members of the National Academy of Engineering (NAE) and are the most comprehensive collection of courses in the country in the field of Power/Energy Systems with an emphasis on sustainability. No single University program covers the breadth and depth of the content in the CUSP™ courses. This course will qualify for graduate credit at Texas Tech University for degree as well as certificate programs.

Prerequisites: Bachelor's Degree in Engineering or a closely related field or consent of Instructor.

Delivery Type: This course is delivered 100% online with prepared educational modules and instructor managed additional lectures, discussions, quizzes, tests and exams to determine a final grade


Instructor: Dr. Michael Giesselmann, P.E., Professor & Chair of ECE.

Goals: This course is designed to acquaint senior undergraduate and first year graduate students of electrical engineering with the electric utility industry and to provide them with good examples of how the fundamentals they have learned in previous courses can be applied to real world problems.

Support Files: Lectures & supplementary materials will be placed online with full access for local and Distance Ed students on the COE Distance Education Server, http://aln.coe.ttu.edu/ecw/.

Topics:
1. Electric Power Systems Overview, Power Computation (5h)
2. Polyphase Systems & Transformers (4h)
3. The “Per-Unit” System (4h)
4. Symmetrical Components (3h)
5. Transmission Lines, Determination of Parameters (4h)
6. Transmission Line Loadability and Operation (4h)
7. Power System load flow theory (1h)
8. Synchro-Phasors (2h)
9. Power System load flow modeling (Power-World) (3h)
10. Power System Operation and Stability (3h)
11. Power System Faults & Protection Systems (4h)
12. Renewable Energy Systems (3h)
13. Reviews, Tests, and Excursion (3h)

Excursion: Site visit in the field of electrical power generation or distribution.

Grading: Homework: 20%.
3 Tests, 15% each: 45%.
Final Project (Paper): 35%.
**Disability Policy:** Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as possible to make necessary arrangements. Students must present appropriate verification from Student Disability Services during the instructor's office hours. Please note that instructors are not allowed to provide classroom accommodation to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services office in 335 West Hall or call 806-742-2405. Further details are provided by Texas Tech Operating Policy 10.08.

**Religious Holidays:** Any student absent for a religious holiday should make that intention known in writing to the instructor prior to the absence and will be permitted to make up missed exams in accordance with Texas Tech Operating Policy 34.19.

**Academic integrity:** It is the aim of the faculty Texas Tech to foster a spirit of complete honesty and a high standard of integrity. The attempt of students to present as their own any work that they have not honestly performed is regarded by the faculty and administration as a serious offense and renders the offenders liable to serious consequences, possibly suspension.

**Detailed Schedule:** “Topics and/or dates may be changed during the semester at the instructor’s discretion because of scheduling issues, developments in the discipline, or other contingencies.”

- **January 16, 2020:** Overview of the Class Content & Format, History of Power Systems, AC vs. DC.
- **January 21, 2020:** Power Systems, 3-Phase Power Systems, AC Generator Overview.
- **January 23, 2020:** MathCAD intro, RMS Value, Real, reactive, & apparent Power.
- **January 28, 2020:** Power Factor of Linear & Non-linear Loads, PF-Correction., Utility Rules
- **January 30, 2020:** 3-Phase Power, Y – Delta, 3-Phase Generation.
- **February 04, 2020:** Transformer Basics, 3-Phase Power advantages.
- **February 06, 2020:** 3-Phase Power Calculation, Y-D, coupled circuits, Transformer Construction.
- **February 11, 2020:** Transformer design, Transformer eq. circuit, BH-Curve, inrush current
- **February 13, 2020:** Intro to the per-unit system, Example for one line diagram with p.u. values
- **February 18, 2020:** Test 1, (tentative)
- **February 20, 2020:** Intro to Symmetrical Components, Visualization, Details, Examples.
- **February 25, 2020:** Detailed Examples of solving circuits with symmetrical components.
- **February 27, 2020:** Intro to Transmission lines (TL). R & L Inductance calculations, Amp. law, GFI.
- **March 03, 2020:** Inductance calculations for Transmission lines with mutual coupling, GMR.
- **March 05, 2020:** Capacitance Calculations for Transm. Lines, use of symmetrical components.
- **March 10, 2020:** Test 2 (tentative).
- **March 12, 2020:** Comprehensive example for 765 kV TL. Work practices on TL.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>March 14, 2020</td>
<td>Spring Break</td>
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<tr>
<td>March 22, 2020</td>
<td>Spring Break</td>
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<tr>
<td>March 24, 2020</td>
<td>Short, medium, long lines. Power transmission in DC &amp; AC systems.</td>
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<td>March 26, 2020</td>
<td>Stability of Power Transfer over long lines, Line Loadability. max. power trans.</td>
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<td>April 02, 2020</td>
<td>Equivalent circuit for TL with Equivalent lumped param., voltage profiles.</td>
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<td>April 07, 2020</td>
<td>Introduction to load flow and load flow modeling &amp; visualization.</td>
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<td>April 09, 2020</td>
<td>Derivation of detailed Theory of load flow analysis.</td>
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<td>April 16, 2020</td>
<td>System operation, power flow control, modeling of large systems in Powerworld.</td>
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<td>April 21, 2020</td>
<td>Transient phasor monitoring, Synchro-Phasor technology for system stability.</td>
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<td>April 23, 2020</td>
<td>Introduction to system faults and system protection. Transient impedances. Assignment of take home test Test 3.</td>
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<td>April 28, 2020</td>
<td>Detailed discussion of System faults, monitoring, modeling and example.</td>
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<td>April 30, 2020</td>
<td>Introduction to Renewable Energy generation &amp; potential, Examples</td>
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<tr>
<td>May 05, 2020</td>
<td>Excursion, visit Power System Installation.</td>
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<td>May 11, 2020</td>
<td>Final Papers (constituting the Final Exam) due at 5:00 p.m.</td>
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<td>May 15, 2020</td>
<td>Graduate Commencement</td>
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<tr>
<td>May 16, 2020</td>
<td>Undergraduate Commencement</td>
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