EE - 4221
Power Systems Analysis 1

Curricular Designation: EE: elective        CpE: N/A

Catalog Description:
EE 4221 – Power systems analysis 1 Complex Power flow in circuits and the effects of real and reactive power flow on a system; transformer and load representations in power systems; power transmission line parameters and steady-state operation of transmission lines; the per unit system; development of the bus admittance matrix; power flow.
Credits: 3.0  Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall Prerequisites: EE3120

Textbooks(s) and/or Other Required Materials:

Prerequisites by Topic:
1. Mastery of DC and AC circuit analysis.
2. Familiarity with three-phase circuits and the power triangle.
3. Familiarity with basic electric machine theory.
5. Mastery of manipulation of complex numbers and phasors.

Course Objectives:
1. Become Familiar with the history and recent restructuring and reregulation of the power industry and its effect on engineering decisions.
2. Master the development and application of power system models of transformers, transmission lines, machines, and loads, including their per unit representations.
3. Study transmission line design, to;
   a. Master the principles relating physical representation of a line to the steady-state parameters of resistance, inductance and capacitance.
   b. Become familiar with the problems associated with loading lines and methods of compensation to mitigate these problems.
4. Become familiar with the steady-state admittance matrix system model of a power system.

Topics Covered:
1. History and present and future trends in the electric utility industry.
2. Power transformer circuit models, including:
   a. 3-phase and 3-phase, 3-winding transformers, including the auto-transformer
   b. per unit representations, including off-nominal turns ratios
   c. phase shift in three-phase transformers
3. Electric Power Transmission lines, including:
   a. design considerations
   b. from the physical representation, determine the steady-state impedance and admittance parameters.
   c. develop steady-state two-port models of short, medium and long lines.
d. solve the receiving end power flow problem; maximum power, voltage regulation, and line compensation methods.

4. The methods for developing the bus admittance matrix representation of the power system.

Relationship of the Course Content to Program Outcomes:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Topics and Level of Coverage</th>
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<tbody>
<tr>
<td>a</td>
<td>an ability to apply knowledge of mathematics, science and engineering</td>
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<td>b</td>
<td>an ability to design and conduct experiments, as well as to analyze and interpret data</td>
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<tr>
<td>c</td>
<td>an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability and sustainability</td>
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<tr>
<td>d</td>
<td>an ability to function on multi-disciplinary teams</td>
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<tr>
<td>e</td>
<td>an ability to identify, formulate and solve engineering problems</td>
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<td>f</td>
<td>an understanding of professional and ethical responsibility</td>
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<td>g</td>
<td>an ability to communicate effectively</td>
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<td>h</td>
<td>the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context</td>
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<tr>
<td>i</td>
<td>a recognition of the need for, and an ability to engage in life-long learning</td>
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<td>j</td>
<td>a knowledge of contemporary issues</td>
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<td>k</td>
<td>the ability to use the techniques, skills, and modern engineering tools necessary for the practice of electrical engineering</td>
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Contribution of Course to Meeting Degree Requirements:

3 Credit Hours – Engineering Topics

Class/Laboratory Schedule (note: 1 hour = 50 minutes):
Lecture: 42 hours = 3 hours/week for 14 weeks

Prepared by:
John Lukowski, Associate Professor, December 10, 2016