Syllabus

for
Section 1.01
Section 1.02  Fundamentals of Power Systems
Section 1.03
Section 1.04  EE 3302 Section 001

Spring 2006

Section 1.05 10:30 a.m. - 11:50 a.m., Monday and Wednesday Room 104 GS

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Graduate Teaching Assistants:

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Required Text: Electrical Energy Conversion and Transport
By: George G. Karady and Keith E. Holbert
ISBN 0-471-47652-8

The Text book uses Mathcad software. This software has student version which you may find more information in the following web site:

http://www.campuscomputer.com/subpages/misc_stw.html
CATALOG COURSE DESCRIPTION

FUNDAMENTALS OF POWER SYSTEMS, 3 hours credit. Introduction to power systems, three-phase circuit analysis, symmetrical components, transformer, polyphase induction motors, synchronous generators, synchronous motors, diode and diode circuits, thyristor and thyristor circuits, DC-DC switching converters, and DC-AC switching converters. Prerequisite: EE 2446.

(a) COURSE LEARNING GOALS/OBJECTIVES

The course objectives for EE3302 Fundamentals of Power Systems are the following:

- Demonstrate knowledge of the theory, methods, techniques and applications of conversion of electrical energy to mechanical energy and vice-versa.
- Develop good understanding of electric power systems, particularly electric power generation, transmission, and distribution systems.
- Develop a basic understanding of devices are used in the operation of the electric power systems.
- Develop a professional attitude and approach to the solution of practical problems encountered in the industry.

ATTENDANCE AND DROP POLICY

- Attendance at each class is fully expected in order to achieve satisfactory and timely progress.
- Excessive absences will be noted and the student contacted for an explanation.
- The drop policy for this course is in accordance with University and Department rules and regulations. It is the student's responsibility to be familiar with these policies.

Topics:

The following topics will be covered by lecture.
1. Electrical Power System
2. Application of Single-Phase Circuit Analysis (Load, transmission line operation, power factor correction)
3. Three-Phase Circuits (Per Unit System, Analysis of motor operation in Delta Wye configurations)
4. Transmission Lines and Cables
5. Transformers
6. Synchronous Machines
7. Induction Motors
8. DC Machines
9. Introduction to Motor Control and Power Electronics
10. Electromechanical Energy Conversion
Specific Procedures:

Homework
There will be ten homework assignments. Homework assigned on Monday will be due the following Monday at the beginning of class. Late homework will be accepted, but 25% will be deducted for each class period the assignment is late.

Exams
There will be three (3) major exams and one final for this course. Each midterm exam will be worth twenty (20) points and will cover the most recent material. The final exam will be comprehensive and will worth twenty-five points (25).
All exams are closed book and closed notes. The formula sheet will be provided. You must work alone on all exams. Calculators may be used during exams, but all programmable calculators must be cleared of all programs and/or data before entering the examination room. Discussion and/or communication with anyone, except the instructor, during an exam is forbidden. Any student who willingly provides information to another student during a quiz or exam is as guilty as the student that receives the information.

Course Grading:
Homework (ten) 15 Points
Exam I 20
Exam II 20
Exam III 20
Final 25
Course Total 100 Points

Grade Basis:
Student Course Average Final Letter Grade
90 - 100 A
80 - 90 B
70 - 80 C
60 - 70 D
< 60 F

Course Policies:
Missed examinations
There will be no makeup of missed examinations. In emergency situations (death in family, etc.), if the instructor has been petitioned in writing, and if the instructor agrees another exam may be given.

Academic Dishonesty
Evidence of academic dishonesty will be dealt with severely. Copying homework or examinations will result in administrative dismissal from the course. The grade recorded will be F.
## Article II. Tentative Schedule
EE 3302 Sec 001 Spring 2006

<table>
<thead>
<tr>
<th>Class No.</th>
<th>Date</th>
<th>Day</th>
<th>Lecture, Exams, Etc.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18-Jan-06</td>
<td>Wed</td>
<td>Course and Syllabus description, History of US Electric</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Power Restructuring US Electric Power Industry</td>
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<td></td>
<td></td>
<td></td>
<td>Chapter 1 Electrical Power System</td>
</tr>
<tr>
<td>2</td>
<td>23-Jan-06</td>
<td>Mon</td>
<td>Chapter 1– Electrical Power System</td>
</tr>
<tr>
<td>3</td>
<td>25-Jan-06</td>
<td>Wed</td>
<td>Chapter 2 Application of Single Phase Circuit Analysis</td>
</tr>
<tr>
<td>4</td>
<td>30-Jan-06</td>
<td>Mon</td>
<td>Chapter 2 Application of Single Phase Circuit Analysis</td>
</tr>
<tr>
<td>5</td>
<td>01-Feb-06</td>
<td>Wed</td>
<td>Chapter 3 Three Phase Circuits</td>
</tr>
<tr>
<td>6</td>
<td>06-Feb-06</td>
<td>Mon</td>
<td>Chapter 3 Three Phase Circuits</td>
</tr>
<tr>
<td>7</td>
<td>08-Feb-06</td>
<td>Wed</td>
<td>Chapter 4 Transmission Lines and Cables</td>
</tr>
<tr>
<td>8</td>
<td>13-Feb-06</td>
<td>Mon</td>
<td>Chapter 4 Transmission Lines and Cables</td>
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<tr>
<td>9</td>
<td>15-Feb-06</td>
<td>Wed</td>
<td>Chapter 4 Transmission Lines and Cables</td>
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<tr>
<td>10</td>
<td>20-Feb-06</td>
<td>Mon</td>
<td>Exam I Chapter 1 to 4</td>
</tr>
<tr>
<td>11</td>
<td>22-Feb-06</td>
<td>Wed</td>
<td>Chapter 5 Transformers</td>
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<tr>
<td>12</td>
<td>27-Feb-06</td>
<td>Mon</td>
<td>Chapter 5 Transformers</td>
</tr>
<tr>
<td>13</td>
<td>01-Mar-06</td>
<td>Wed</td>
<td>Chapter 5 Transformers</td>
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<tr>
<td>14</td>
<td>06-Mar-06</td>
<td>Mon</td>
<td>Chapter 6 Synchronous Machines</td>
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<tr>
<td>15</td>
<td>08-Mar-06</td>
<td>Wed</td>
<td>Chapter 6 Synchronous Machines</td>
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<tr>
<td>16</td>
<td>13-Mar-06</td>
<td>Mon</td>
<td>Spring Vacation</td>
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<tr>
<td>17</td>
<td>16-Mar-06</td>
<td>Wed</td>
<td>Spring Vacation</td>
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<tr>
<td>18</td>
<td>20-Mar-06</td>
<td>Mon</td>
<td>Chapter 6 Synchronous Machines</td>
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<tr>
<td>19</td>
<td>22-Mar-06</td>
<td>Wed</td>
<td>Exam II Chapter 5 to 6</td>
</tr>
<tr>
<td>20</td>
<td>27-Mar-06</td>
<td>Mon</td>
<td>Chapter 7 Induction Motors</td>
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<tr>
<td>21</td>
<td>29-Mar-06</td>
<td>Wed</td>
<td>Chapter 7 Induction Motors</td>
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<tr>
<td>22</td>
<td>03-Apr-06</td>
<td>Mon</td>
<td>Chapter 7 Induction Motors</td>
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<tr>
<td>23</td>
<td>05-Apr-06</td>
<td>Wed</td>
<td>Chapter 7 Induction Motors</td>
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<tr>
<td>24</td>
<td>11-Apr-06</td>
<td>Mon</td>
<td>Chapter 8 DC Machines</td>
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<tr>
<td>25</td>
<td>12-Apr-06</td>
<td>Wed</td>
<td>Chapter 8 DC Machines</td>
</tr>
<tr>
<td>26</td>
<td>17-Apr-06</td>
<td>Mon</td>
<td>Chapter 8 DC Machines</td>
</tr>
<tr>
<td>27</td>
<td>19-Apr-06</td>
<td>Wed</td>
<td>Exam III Chapter 7 to 8</td>
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<tr>
<td>28</td>
<td>24-Apr-06</td>
<td>Mon</td>
<td>Chapter 9 Introduction to Motor Control and Power Electronics</td>
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<tr>
<td>29</td>
<td>26-Apr-06</td>
<td>Wed</td>
<td>Chapter 9 Introduction to Motor Control and Power Electronics</td>
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<tr>
<td>Date</td>
<td>Date</td>
<td>Day</td>
<td>Activity</td>
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<tr>
<td>30</td>
<td>01-May-06</td>
<td>Mon</td>
<td>Chapter 9 Introduction to Motor Control and Power Electronics</td>
</tr>
<tr>
<td>31</td>
<td>04-May-06</td>
<td>Wed</td>
<td>Review</td>
</tr>
<tr>
<td>48</td>
<td>08-May-06</td>
<td>Mon</td>
<td>FINAL EXAM .- ( 08:00 a.m.-10:30 a.m.)</td>
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</tbody>
</table>

* Homework will be assigned on Monday and will be due to the following Monday at the beginning of class.

Revised 01/17/2006
Description of ABET Outcomes addressed
In EE 3302
Fundamental to Power System

Course Outcome:

The main course goal is to provide students with a complete overview of interconnected power system operation, energy conversion, electric machines, and introduction to power electronics. At the completion of the course students should be able to develop appropriate models for an interconnected power system, and know the electric machine characteristics and their operating conditions.

A. By the time of Exam No. 1 (after approximately 10 ninety minute Lectures), the students should be able to do the following:

1. General knowledge on the US electric network, deregulation (h) (k).
2. Be familiar with energy sources, power plants namely conventional power plants such as steam turbine, gas turbine, nuclear and hydroelectric power plants. (k)
3. Understand electric distribution system, electric substations (k).
4. Understand the concepts of power factor angle, power factor, complex power, and conservation of power. (a) (e)
5. Solve single phase circuits for the real, reactive and complex power supplied by, or consumed by any device in the circuit. (a) (e).
6. Use reactive compensation to change a load’s apparent power factor to any specified value. (c) (k)
7. Solve simple three-phase circuits to calculate any system voltage, current or power. (a) (e)
8. Understand and be able to use per phase analysis to solve simple three-phase systems. (a) (e)
9. Apply concepts from basic electromagnetic to determine the inductance, capacitance, and resistance of three phase transmission lines, including lines with conductor bundling. (a) (e)
10. Be able to do basic design of transmission lines to specified parameters. (c) (k)
11. Be able to derive the equivalent pi model for a transmission line and then use this model to calculate the power flow through a transmission line. (a) (e)
12. Know the limits affecting the maximum amount of power that can be transferred through a transmission line. (e)
13. Be able to derive the voltage and current relationships for an ideal transformer. (a) (e)
14. Know the standard model for a real transformer and understand how winding losses, eddy currents, hysteresis losses, leakage flux, and finite magnetic permeability affect the model parameters. (c)
15. Be able to determine the parameters of the real transformer model from open-circuit and short-circuit test data. (b) (k)
16. Understand the rational behind per unit analysis, and be able to use per unit analysis to solve single and three phase circuits. (e)
B. By the time of Exam No. 2 (after approximately 10 lectures), the students should be able to do all the items listed under A, plus the following:

17. Know the four ways to connect three phase transformers, the strengths and limitations of each, and be able to solve simple three phase circuits using the different types of transformer connections. (c) (e)
18. Use per phase analysis to solve simple systems with three phase transformers connected in each of the four ways described in 14. (e)
19. Understand the basics of synchronous machine construction, operation and be able to derive the constant voltage behind synchronous reactance model. (a) (e)
20. Understand the generator reactive capability curve, and the limitations it imposes on the reactive power output of a generator. (a)
21. Students were demonstrated a synchronous generator operation and synchronizing in the lab. (b)
22. Students were demonstrated a synchronous motor operation and characteristics in the lab. (b)
23. Understand the basics of induction machine construction, operation principle, develop equivalent circuit, conduct a performance analysis. (a) (e)
24. Students were demonstrated the induction motor operation and characteristics. (b)

C. By the time of Final (after approximately 10 lectures), the students should be able to do all the items listed under A and B plus the following:

25. Understand the construction, operation principles and characteristics of DC motor and DC generator and develop equivalent circuit for different model for DC machines. (a) (e)
26. Understand application of power electronics in power system, and its application in controlling the machines. (a), (c) and (e)
27. Students were demonstrated the DC motor and generators operation and characteristics. (b)
<table>
<thead>
<tr>
<th>ABET Outcome</th>
<th>Primary Course Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a). an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Exams and HWs</td>
<td>High</td>
</tr>
<tr>
<td>(b). an ability to design and construct experiments, as well as to analyze and interpret data</td>
<td>Lab demonstration and requesting to analyzed the observed data</td>
<td>Low</td>
</tr>
<tr>
<td>(c). an ability to design system, component, or process to meet desired needs</td>
<td>HW and Project</td>
<td>High</td>
</tr>
<tr>
<td>(d). an ability to function on multidisciplinary teams;</td>
<td>Not Addressed</td>
<td>Not Addressed</td>
</tr>
<tr>
<td>(e). an ability to identify, formulate, and solve engineering problems;</td>
<td>Exams and HWs</td>
<td>High</td>
</tr>
<tr>
<td>(f). an understanding of professional and ethical responsibility</td>
<td>Not Addressed</td>
<td>Not Addressed</td>
</tr>
<tr>
<td>(g). an ability to communicate effectively</td>
<td>Not Addressed</td>
<td>Not Addressed</td>
</tr>
<tr>
<td>(h). the broad education necessary to understand the impact of engineering solutions in a global and societal context</td>
<td>Not Addressed</td>
<td>Not Addressed</td>
</tr>
<tr>
<td>(i). a recognition of the need for, and an ability to engage in lifelong learning</td>
<td>Utilizing Mathcad, Matlab, or any other tools in solving HW problems</td>
<td>Low</td>
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<tr>
<td>(j). a knowledge of contemporary issues</td>
<td>Not Addressed</td>
<td>Not Addressed</td>
</tr>
<tr>
<td>(k). an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>Utilizing Mathcad, Matlab, or any other tools in solving HW problems</td>
<td>Low</td>
</tr>
</tbody>
</table>
ABET Outcomes a-k

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and construct experiments, as well as to analyze and interpret data;
c. an ability to design system, component, or process to meet desired needs;
d. an ability to function on multidisciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in lifelong learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Rasool Kenarangui