EE 330/330L Energy Systems, (3-1) 4 credits, SDSM&T, Spring 2012

Lecture Room & Time: EP208 MWF from 12-12:50pm

Laboratory Room & Time: See separate lab syllabus.

Instructor: Dr. Thomas Montoya, EP325, Tel: 394-2459, e-mail: Thomas.Montoya@sdsmt.edu

Office Hours: 3-4 pm MWF, or by appointment.

WWW: See link from http://montoya.sdsmt.edu. The course web page will be heavily utilized for posting assignments, examples, solutions, ... E-mail will be utilized to notify students of course-related information and events (**check daily**). Your first.last@Mines.sdsmt.edu address will be used.

Catalog Description: Production, transmission, and utilization of energy in systems with major electrical subsystems, with particular emphasis on electromagnetic and electromechanical systems and devices.

Prerequisites: EE 221 Circuits II

Text: S. J. Chapman, *Electric Machinery Fundamentals*, 5th Edition, McGraw-Hill Higher Education, 2012, ISBN 978-0-07-352954-7.

Course Policies

- Course instruction will be delivered in lectures and laboratories. Attendance is required. Notify instructor ahead of time (if possible) if you will be absent from class.
- **Laboratory-** You must register for one of the EE 330L sections. **All** laboratories must be completed by **every individual** at a passing level to pass the class. Laboratory assignments and completion dates will be announced/distributed as they come up. Further laboratory information and policies will be given during the first laboratory meeting and in the lab syllabus.
- Except when otherwise specified, all coursework is to be individually completed. Also, see the *Conduct* section in the catalog and the *Policy Governing Academic Integrity* for SDSM&T (link under http://sdmines.sdsmt.edu/studentlife).
- Students are encouraged to discuss homework/labs with classmates in general terms. However, copying, plagiarism, … is not acceptable and will be penalized.
- Missed quizzes will **not** be made up. If you know that you will be missing a class for a school-related activity (athletic travel, academic conference, etc.), you may stop by the day before and ask to take a quiz early (if available).
- Homework/labs are due at the beginning of class on the specified days (up to 20% penalty for being late w/out doctor's note …). Homework is **not** accepted after solutions are posted on web page. If you know that you will be missing a class for a school-related activity (athletic travel, academic conference, etc.), you may stop by the day before to turn in HW/labs early.
- If **2/3** of quizzes and **2/3** of HW assignments are completed at a **passing** level, the lowest HW and lowest two quiz grades will be dropped (no questions asked). If not, **all** quizzes and HW will count (no drops). The drops are meant to cover any absences, i.e., illness, interviews, trips…
- Bring notes, text, and calculator (capable of complex number linear algebra operations) to **every** class. Most quizzes will be unannounced, and many will require a calculator. In addition, occasionally a quiz may be open book/notes (no borrowing).
- Keep a course notebook for future reference/study (e.g., homework, quizzes, exams, and labs).

- In coursework, diagrams/figures/plots/graphs should be of a good size (e.g., 3" × 5" or more), and may contain colors. As applicable, they should be titled (at bottom), labeled (i.e., names / units on axes), scaled (i.e., numbers on axes), and clearly drawn. Tables should also be titled (at top).
- Any coursework that is typed should be in Times New Roman or Arial/Helvetica fonts, 11pt or 12 pt, 1.25 or 1.5 line spacing. Pages should be numbered (at the bottom).
- To facilitate grading, homework shall meet the following additional specifications (example on web page):
  (a) Use the front side (i.e., single-sided) of 8.5" × 11" Engineering graph paper or plain white paper (NO pages torn from spiral notebooks) for assignments.
  (b) At the top of **every** page should be the date, course number, HW #, problem number(s), your name, and numbering, i.e., page *n* of *nn* or *n*/*nn* formats in right hand corner. Ensure pages/problems are in order.
  (c) Write-out problem descriptions and **show all** work so it can be understood without the text. Reference equations derived in text (e.g., equation number and/or page number). Fundamental equations (e.g., Maxwell's equations, Ohm's Law, ...) are excluded from this requirement.
  (d) Writing/figures/graphs must be legible/large enough to read/neat → illegible mess = no credit.
  (e) All work exceeding one page should be stapled- no paper clips, folded corners, or folders.
  (f) Answers should be boxed/double underlined, in decimal format (if numbers), and the variables, values & units (if any) included. Use lead zeros for fractional answers, e.g., 0.4 not ".4".
  (g) Work problems sequentially in a vertical *single* column with subparts clearly labeled, e.g., a), b), ... Leave a space (e.g., 1/2") between consecutive parts of a problem, and draw a line across the page at the end of each complete problem. **No more than two problems on any page.**

Course Goals: The primary goal of this course is to provide students with a basic understanding of electrical machines, particularly their characteristics and operational behavior. Another goal of this course is to create the necessary foundation for students to take follow-on courses in the power area.

Student Learning Outcomes:

Upon completion of this course, students should demonstrate the ability to:

1. Analyze three-phase balanced circuits using single-phase equivalent circuits.
2. Use power triangle concept to analyze loads and for power factor correction.
3. Analyze or design simple magnetic circuits for electric machinery applications.
4. Perform open-circuit, short circuit, and load tests on single-phase transformers to develop equivalent circuit models.
5. Analyze or design transformer circuits to find or achieve currents, voltages, and powers as well as key performance parameters, e.g., voltage regulation and efficiency.
6. Understand principles and uses of three-phase transformer connections to achieve desired currents, voltages, and powers.
7. Understand basic principles of AC machines.
8. Understand basic principles of synchronous generator and motor operation.
9. Perform open circuit, short circuit, and load tests on synchronous generators to develop equivalent circuit models and measure key performance parameters, e.g., voltage regulation and efficiency.
10. Analyze or design synchronous generator circuits to find or achieve currents, voltages, and powers as well as key performance parameters, e.g., voltage regulation and efficiency.

11. Perform the no-load, blocked-rotor, and DC tests on induction motors to develop equivalent circuit models.
12. Analyze or design induction motors to find or achieve currents, voltages, and powers as well as key performance parameters, e.g., speed, torque, and efficiency.
13. Understand basic principles of DC machines.
14. Perform laboratory tests on DC machines to develop equivalent circuit models.
15. Analyze or design DC motors to find or achieve currents, voltages, and powers as well as key performance parameters, e.g., speed, torque, and efficiency.

Evaluation:

3 Hour Exams @ 10%/each	30%
Quizzes	15%
Homework	15%
Laboratory/Projects	25%
Final Exam (required).....	15%
Total	**100%**

Grading scale: 100 > A > 90, 90 > B > 80, 80 > C > 70, 70 > D > 60, F < 60.

Laboratory: We will have scheduled or formal laboratories. See separate lab syllabus.

Laboratory Safety: Read and comply with lab safety document posted to course web page. See separate lab syllabus.

ADA: Students with special needs or requiring special accommodations should contact the instructor and/or the campus ADA coordinator, Jolie McCoy, at 394-1924 at the earliest opportunity.

Freedom in learning: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.

Electronic Devices Policy: Please turn off your cell phone before class starts. No text messaging in class. No headphones. If you wish to use a laptop in this class for purposes of note taking, that's great; however, you will be required to download DyKnow software and then join ENGL350 to activate. Any attempt to circumvent the DyKnow monitoring system will be considered a form of cheating and a breach of academic integrity. Note that according to "Policy Governing Academic Integrity" in the SDSM&T Undergraduate Catalog, the instructor of record for this course has discretion of how acts of academic dishonesty are penalized, subject to the appeal process, and that "Penalties may range from requiring the student to repeat the work in question to failure in the course" (72-73). No other use of any other electronic/computer media is allowed during class time.

Topics/Course Schedule: All or parts of Appendix A and chapters 1, 2, and 4 - 9 are covered: Three-phase Circuits (Appendix A/Notes), Magnetic Circuits (Chapter 1/Notes), Transformers (Chapter 2), AC Machinery (Chapter 3), Synchronous Generators (Chapter 4), Synchronous Motors (Chapter 5), Induction Motors (Chapter 6), and DC Generators & Motors (Chapter 7 & 8). See attached tentative course lecture schedule. Some topics will may be dropped (likely) or perhaps added (unlikely). Tentatively, exam 1 will cover Appendix A as well as Chapters 1 & 2 material, exam 2 will cover Chapters 3 - 4, and exam 3 will cover remaining material.

Tentative Course Lecture Schedule

Class	Date(s)	Topics	Reading/ Text Sections
1	1/13	Course Introduction, **Three-Phase Circuits**- 3ϕ Generation	A.1
1/16		**Holiday**	
2	1/18	Voltages & Currents in Wye & Delta Connections, AC power (real, reactive, apparent, & complex), Power relationships (phase & line quantities), balanced systems, one-line diagrams, power triangle	A.2, 1.9
3	1/20		1.9
4	1/23		A.3-A.4
5	1/25		A.4-A.6
6	1/27	**Introduction to Machinery Principles**- Intro, units/notation, rotational motion, Newton's Law, power, magnetic field, Faraday's Law, Induced Force & Voltage, linear DC machine	1.1-1.3
7	1/30		1.3-1.4
8	2/1		1.4-1.8
9	2/3	**Transformers**- Intro, types & construction, ideal transformer, single-phase transformers, equiv. circuit for transformers, per-unit system of measurements, voltage regulation & efficiency, taps & voltage regulation, three-phase transformers, 3-phase trans. using 2 transformers, transformer ratings	2.1-2.3
10	2/6		2.3-2.4
11	2/8		2.5
12	2/10		2.6-2.7
13	2/13		2.8
14	2/15		2.10
15	2/17		2.11-2.12, 2.14
2/20		**Holiday**	
16	**2/22**	**Exam #1 (Appendix A, Chapters 1 & 2)**	
17	2/24	**AC Machinery Fundamentals-** simple loop in uniform mag. field, rotating mag. field, mmf & flux distrib., induc. voltage & torque, winding insul., power flows, voltage & speed regulat.	3.1-3.2
18	2/27		3.2-3.5
19	2/29		3.6-3.9
20	3/2	**Synchronous Generators-** construct'n, speed, int. gen. voltage	4.1-4.3
3/5 – 3/9		**Spring Break**	
21	3/12	equiv. circuit, phasor diagram, power & torque, measuring model parameters, single operation, parallel operation, transients, ratings	4.4-4.7
22	3/14		4.7-4.8
23	3/16		4.8-4.11
24	3/19	**Synchronous Motors-** basic principles, operation, starting, …	5.1-5.6(survey)
25	3/21	**Induction Motors-** construction, basic concepts, equiv. circuit, power & torque, torque-speed	6.1-6.3
26	3/23		6.4-6.5
27	3/26		6.5
28	**3/28**	**Exam #2 (Chapters 4 – 5)**	
29	3/30	variations in torque-speed, trends, starting, speed control, determining model parameters, ratings	6.6-6.9
30	4/2		6.11, 6.13-6.14
31	4/4	**DC Machinery Fund.-** simple loop, commutation (4-loop)	7.1-7.2
4/6 – 4/9		**Holiday**	
32	4/11	commut. & constr'n, commutation probs, int. voltage & induced torque, construction, power flow & losses	7.3-7.5
33	4/13		7.6-7.8
34	4/16	**DC Motors and Generators-** Intro, DC motor equiv. ckt, mag. Curve; separately excited, shunt, permanent-magnet & series DC motors, efficiency calculations, sep. excited DC generators (?), shunt & series DC generators (?)	8.1-8.4
35	4/18		8.4-8.5
36	4/20		8.6-8.7, 8.10
37	4/23		8.11-8.16, 8.17
38	4/25	**Exam #3 (Chapters 6 – 7, parts of Chap 9?)**	
39	4/27	Make-up & review day	
EE 330 Final Exam- Thursday, May 3, 2012 from 11 am - 12:50 pm in EP208			