ACADEMIC INTEGRITY POLICY, DIVERSITY, RELIGIOUS OBSERVANCES, DISABILITY

“Students are responsible for making themselves aware of and understanding the University policies and procedures that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. The academic policies addressing Student Rights and Responsibilities can be found in the Undergraduate Catalog at http://catalog.wmich.edu/content.php?catoid=24&navoid=974. If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s) and if you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

Students and instructors are responsible for making themselves aware of and abiding by the “Western Michigan University Sexual and Gender-Based Harassment and Violence, Intimate Partner Violence, and Stalking Policy and Procedures” related to prohibited sexual misconduct under Title IX, the Clery Act and the Violence Against Women Act (VAWA) and Campus Safe. Under this policy, responsible employees (including instructors) are required to report claims of sexual misconduct to the Title IX Coordinator or designee (located in the Office of Institutional Equity). Responsible employees are not confidential resources. For a complete list of resources and more information about the policy see www.wmich.edu/sexualmisconduct.

In addition, students are encouraged to access the Code of Conduct, as well as resources and general academic policies on such issues as diversity, religious observance, and student disabilities:
- Office of Student Conduct www.wmich.edu/conduct
- Division of Student Affairs www.wmich.edu/students/diversity
- University Relations Office http://www.wmich.edu/policies/religious-observances-policy
- Disability Services for Students www.wmich.edu/disabilityservices.”

OFFICIAL CONTACT PLACES/HOURS:

Name: Johnson Asumadu Email: johnson.asumadu@wmich.edu
Office: CEAS B-0224 Office Hours: 10:30 -11:30 a.m. MW or by appointment
Tel: +1 (269) 276 – 3147 Fax: +1 (269) 276 – 3151
Classroom Assigned: CEAS D-0202 Class Hours: 1:30 - 2:20 p.m.
Lab: B-0212 Lab Hours: 8:30 – 11:10 am T /2:30 – 5:10 p.m. T
WeBCT Chat Hours: TBA
Web Site Address: URL for course: http://homepages.wmich.edu/~jasumadu/index.html

PREREQUISITES:


KEY DATES:

1st Hour Mid Term Test - October 12, 2018 Normal Class Hour
2nd Hour Mid Term Test - November 16, 2018 Normal Class Hour
Final Examination - According to the University’s Exam Schedule

COURSE MATERIALS:

Text Books:
3. ECE 3300 Lab Manual, 2011 by Kelemen/Asumadu – (Required)
5. AC Machines, 1983 5th Edition by Say (Reference)

Materials (Required):
1. Digital Multimeter, 0-500V, 0-10A, DC and AC – See WMU IEEE
2. Calculator: In this course I recommend that you use a scientific calculator that has at least the following features:
(a) Performs operations for real numbers and complex numbers without requiring the user to perform the operations on the real part and the imaginary part, or magnitude and angle, separately,
(b) solves linear algebra equations, including the case where the coefficients are complex,
(c) performs repetitive computations,
(d) finds roots of polynomials, linear and nonlinear equations, and
(e) finds the inverse of at most 3x3 square matrix.

CATALOG DESCRIPTION:
Three-phase circuits, analysis and design of transformers, electromechanical devices and machines.

COURSE OBJECTIVES:
1. Provide seniors in electrical engineering the ability to analyze and design electrical machinery.
2. Integrate power electronics into control concepts of electrical machinery.

PRE-ASSESSMENT: (Required skills at the start of the course)
1. Sending and receiving EMAIL, including attachments.
2. Accessing information on a network using Web browsers and file utilities.
6. Semiconductor diodes, BJTs, FETs including PSPICE models and electronic circuits.
8. Applying correct electrical engineering units (and symbols) to quantities using the English and SI systems: Ohms (Ω), Farads (F), Henries (H), Amperes (A), Volts (V), Volt-Amperes (VA), and Watts (W)
9. Applying correct engineering factors: kilo (k = 10^3), mega (M = 10^6), giga (G = 10^9), tera (T = 10^{12}), milli (m = 10^{-3}), Micro (μ = 10^{-6}), nano (n = 10^{-9}), pico (p = 10^{-12}), and femto (f = 10^{-15}).

COURSE LONG-TERM BEHAVIOR:
Behavior after 1 year:
1. Ability to create system models from individual components with known performance characteristics that can be used to predict system response to standard input.
2. Selecting appropriate tools and tests procedures to analyze electrical machine circuits.
3. Compile design report that documents simulation results, prototype construction, laboratory investigation/testing, and conclusion.

LEARNING COURSE OUTCOMES (The relevant ECE Department learning outcomes a-k, are included in parenthesis):
1. Ability to analyze, construct, and test steady-state AC single and three-phase circuits. Compare predicted vs. measured values of voltages, currents, and power and determine measurement uncertainties. (a, b, e)
2. Ability to analyze, test, and develop a steady-state AC model for magnetic hysteresis and eddy current effects. (a, b, e)
3. To use nameplate data, determine and apply necessary tests, and use test data to develop a 60 Hz circuit model for a commercial power transformer. (a, b, e, k)
4. To analyze, design, and test a bank of single-phase transformers to supply an unbalanced three-phase load. (a, b, c, e)
5. To analyze, test and develop a coupled circuits model for a transformer. (a, b, e)
6. To design, test and analyze data for a single-phase transformer. (a, b, c, e, k)
7. To test, analyze data and develop non-linear models for DC machines. (a, b, e)
8. To test a three-phase squirrel cage induction motor and use data to develop a classical circuit model. Use the model and MATHCAD to predict motor performance for speeds from zero to synchronous. \((a, b, e, k)\)

9. To test a synchronous generator and use the data to develop a linear and non-linear circuit model. \((a, b, e, k)\)

**LEARNING LABORATORY OUTCOMES \((a, b, c, d, e, g, i, k)\):**

1. Laboratory Safety and Equipment Familiarization.
2. Balanced and unbalanced three-phase loads.
3. AC magnetic, Faraday’s and Ampere’s Laws.
4. Transformer open and short-circuit tests.
5. Three-phase transformer and load.
6. Coupled magnetic circuits.
7. Power Quality, magnetic saturation.
8. DC generators
9. DC motor.
10. Three-phase induction motor tests.
11. Three-phase synchronous generator tests.

**COURSE ORGANIZATION:**

In electrical machinery, two things occur, (i) electrical energy (in form of magnetic) is converted to mechanical energy (in form of rotation) – motor, and/or (ii) mechanical energy (prime rotational mover) is converted to electrical energy (in form of magnetic) – generator. In both motor and generator actions speed and torque can be controlled. Therefore, the characteristics and performance of the motor/generator are determined by comparing the speed/torque vs. measured values of voltages, currents, and power and to determine measurement uncertainties. Here are some of the things you will encounter in this course:

1. You will be expected to draw speed, torque, nodal voltage, and branch current waveforms for varying speed, torque, voltage, and branch current.
2. You will be expected to use laboratory measurements to help you verify the waveforms of 1).

Students learn best if they understand how to learn, if they aware of all aspects of the process of learning, and if they take personal responsibility for their own learning; some of the principles of Process Education. The content of this course is classified into five categories and collectively called Knowledge Map.

**Concept:** Idea that represents a set of relationships.

**Processes:** Series of actions, steps, or changes that bring about a result.

**Tools:** Something that assists in carrying out a process.

**Context:** A well-defined situation in which concepts, processes, and tools may be applied.

**Culture:** "Way of being."

For example, consider the idea of torque. Torque is a concept that involves causing say electrical energy to be converted to mechanical energy in order to rotate a load. Solving for speed, nodal voltages and branch currents, and troubleshooting are all processes of determining torque. Motors, MATHCAD simulation, etc. can be thought of as tools that are used to assist in analysis of the Torque. Data sheets, safety precautions, etc. can be thought of as contexts (they allow us to apply concepts, processes, and tools).

**COURSE KNOWLEDGE MAP:**

<table>
<thead>
<tr>
<th>Key Concepts</th>
<th>Contexts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Machinery</td>
<td>Data Sheets</td>
</tr>
<tr>
<td>Speed</td>
<td>Safety Precautions</td>
</tr>
</tbody>
</table>
Torque
Indicators
Ohms Law
Kirchhoff’s Current Law
Kirchhoff’s Voltage Law
Fourier Transformer
Equivalent Circuits
   Equivalent Resistor
   Current Source
   Voltage Source
Waveform Behavior
   DC, Sine wave, Square Wave
   Triangular Wave, PWM Wave
Differential Equations
Network Analysis
   Single- and Three-phase Circuits
Electric and Magnetic Fields
Processes
Circuit Diagrams
   Nodes, Branches
   Active Current Source
   Inductors
Problem-Solving
Troubleshooting

Norton’s Equivalent Circuit
Thevenin’s Equivalent Circuits
Tools
Transformers
Motors
Generators
Simulation
Technical Report

DC, Sine wave, Square Wave
Triangular Wave, PWM Wave

COURSE EVALUATION:

Individual Record Keeping (Maximum Points: 22%)
   Homework Assignments (Maximum Points: 10%)
   Group Work (Maximum Points: 12%)
Reading Assignments

Examinations (Maximum Points: 58%)
   2 Mid Term Tests (16% of each)
   Final Examination (26%)

Lab and Reports (Maximum Points: 20%)

Grading Scale

Maximum Points (%)    GRADE
  100 - 85               A
  84 - 80                BA
  79 - 75                B
  74 - 70                CB
  69 - 65                C
  64 - 60                D
  59 & BELOW             E

Policy on Laboratory and Homework:
Laboratory and homework assignments are assigned during class periods and are due at the scheduled time. Laboratory results are to be written on the lab manual. Problems must be done neatly, submitted in numerical order on 8 1/2 X 11 inch paper, one side only. LABORATORY REPORT AND
HOMEWORK TURNED IN LATE WILL RECEIVE NO CREDIT. If you have questions about any homework, laboratory, or do not understand any course materials, you must see me in B-0224 PARKVIEW CAMPUS as soon as possible. Solutions to all homework problems will be made available.

Please do not skip doing homework assignments. Do not rely on reading through the solutions as techniques for studying for the course. The practice of consulting the solution before working a problem is a bad habit to acquire. It is much better to spend the effort trying to do the solution on your own - even if you are not able to complete the solution. You will find that the homework, though not impossible, is usually harder than the exam questions. Solving other problems on your own is the best way to understand the course materials and to study for the exams. There is a strong correlation between homework scores and course grades. Furthermore, homework scores are important in deciding borderline cases when determining course grades.

YOU MUST ATTEND ALL LABORATORY SESSIONS (REQUIRED UNLESS EXEMPTED). YOU WILL RECEIVE NO SCORE FOR LABORATORY SESSION(S) REPORT/QUIZ IF DO NOT ATTEND THE LAB SESSION(S). ALL FINAL LABORATORY REPORTS ARE DUE BEFORE THURSDAY DECEMBER 06, 2018 AT 4:00 PM OR AS SCHEDULED BY YOUR LABORATORY INSTRUCTOR.

***IF YOU FAIL THE LABORATORY, YOU FAIL THE COURSE***

Policy on Class Attendance:
I highly recommend that you attend classes. Please, make every effort to attend every class. Low attendance is almost always correlated with low grades. “You must be present to win”.

General Policy on use of Electronic Equipment During Tests/Examinations
1. Electronic calculators/anything CANNOT be shared.
2. All cell phones/WIFI equipment must be turned off and NOT be on sight (preferably in your backpack).
3. I will inspect and make sure that your IPad/surface/etc. can only be used for ebook or eText, notes, etc. and if necessary these must be loaded before coming for test and/or exam. All WIFI connections must be turned off.
4. There should be no attempt to produce a video/scan/or any electronic copy of the examination questions from the paper containing the questions during the test/exam period.
5. There should be no attempt to produce a video/scan/or any electronic copy of your own solutions from the green/blue book or the loose sheets during the test/exam period.
6. If you see a student cheating, it is your responsibility to quietly call my attention to that. We must all stamp out cheating.
COURSE TENTATIVE SCHEDULE

August
29 – 10 Review Appendix B (Also See Notes)
   Single-phase AC Circuits
   Three-phase Circuits

September
12 – October 10 Magnetic Fields, Materials and Circuits Ch. 1
   Transformers Ch. 2

October 12 1ST HOURLY TEST: TEST I

15 – 22 Transformers Ch. 2
   DC Machines Ch. 4

24 – November 14 Induction Motors Ch. 5
   Synchronous Machines Ch. 6

November 16 2ND HOURLY TEST: TEST II

November
24 – December 07 Synchronous Machines Ch. 6
   Power Electronics & Machines

FINAL EXAM USING THE UNIVERSITY SCHEDULE

NOTE: (i) AT THIS TIME I DO NOT INTEND TO GIVE MAKEUP HOMEWORK/TESTS/EXAM.

(ii) ALL THE INFORMATION PROVIDED ABOVE IS TENTATIVE AND SUBJECT TO CHANGE WITHOUT NOTICE
Objectives:
1. To develop problem solving skills.
2. To make students solve problems.

Outcomes:
1. Two months from now students can use their acquired skills to identify the proper model representation of non-linear devices in given problems.
2. One year from now students will be able to use the non-linear devices in their senior projects.
3. When students graduate, they will take with them problem-solving skills and design know-how to industry.

GROUP MEMBERS:

Each student must belong to a group. At any one time each group will have to nominate students to perform the following duties: a captain, a recorder, a spokesperson, a skeptic, reflector, and an optimist. Each student may have the chance of serving in any of the duties mentioned. The captain will serve as a liaison between the instructor and the group. ONLY THE CAPTAIN may see the instructor. Each group must maintain its own portfolio. How groups conduct their affairs is left to the members of the groups.

GROUP SOLUTION:

At the end of discussing materials in some chapters of the course textbook, each group will be assigned four (4) problems on those chapters.

On the first Monday the instructor will pass a copy of group solutions to the other groups for assessment. A group CANNOT access their own solutions.

On the second Friday each group will have five (5) minutes in class to critique the solutions the group reviewed.

FLASH REPORTS:

Each student will submit a one-page (ONLY in the format attached) report on the meetings of the student’s group. At each meeting all attending students must sign this one-page report. Flash reports will be collected on first Wednesday, first Friday, and the second Monday after the group work is issued. The instructor will ONLY accept flash reports in class.

GROUP SCORING:

All members in the same group will receive the same score and will be assigned by the instructor. A student(s) in a group MUST ATTEND ALL IN-CLASS SESSIONS AND SUMBIT AT LEAST TWO FLASH REPORTS FOR EACH GROUP WORK to receive a final score. A student who fails to attend AT LEAST ONE (1) IN-CLASS SESSION and fails to submit AT LEAST TWO FLASH REPORTS FOR EACH GROUP WORK will receive ZERO (0) score for the semester.

**NOTE:** If for any reason(s) (must be very tangible) a student cannot join a group, the student must see me immediately.
Please see attached for the definitions of the duties.
(Courtesy of Dr. Dan Apple, Pacific Crest Institute)

**Captain:**
1. Keeping the process enjoyable and rewarding for team members.
2. Make sure each member has a role and is performing within that role.
3. Ensure that all team members can articulate what has been learned.
4. Manage time, stress, and conflict.
5. Control the process and its pacing; keep members focused.
6. Contribute to the group and actively learn.
7. Maintain accountability.

**Recorder:**
1. Record group roles and instructions at the beginning of a task
2. Document legibly and accurately group discoveries in a “Recorder’s journal” or “learning journal”.
4. Control information flow; articulate concepts in alternative forms if necessary.
5. Prepare a report, which can be used for discussion purposes when required; integrate and synthesize when several ideas are presented.
6. Contribute to the group and actively learn.

**Spokesman:**
1. Speak for the team when called to do so.
2. Ask questions posed by the team, or request clarification.
3. Make oral presentations to the class for the team.
4. Use the Recorder’s journal to share the team’s discoveries and insights.
5. Collaborate periodically with the Recorder.
6. Contribute to the group and actively learn.

**Skeptic:**
1. Determine issues on why quality is not at expected level.
2. Check for assumptions/equations/laws that are being made.
3. Constructive in helping to improve the team’s performance.

**Reflector:**
1. Observe performance, interactions, and dynamics among team members.
2. Be a good listener and observer.
3. Analyze and record strengths, improvements and insights into a “Reflector’s journal”.
5. Report from the Reflector’s journal, rephrasing evaluations positively and constructively.
6. Intervene with observations about the process and suggest strategies for change.
7. Remind the Captain of his or her duties.
8. Contribute to the group actively learn.

**Optimist:**
1. Focus on why things will work.
2. Problem solve the issues that the team discovers.
3. Keep the team in a positive frame of mind.
REPORT FORMAT

LOG:

Notes and Observation:
How the non-linear device is modeled in the problem - unless a specific model is required.

Circuit diagram(s) used if any - circuit diagram(s) are very critical because if they are improperly drawn, they may lead to incorrect equations and therefore, solution.

How long it took to do the homework? MUST ANSWER

How long it took to complete the assessment? MUST ANSWER

Etc.

Key Laws:
Ohm's law, KVL, KCL, Norton's Equivalent Circuit Law, Thevenin's Equivalent Circuit Law, and other equations (such as diode equations, transistor equations, etc)

Etc.

Key Equations:
Correct Equations.

Etc.

ASSESSMENT:

Strengths:
1. Thought process that goes into starting the problem.
2. What circuit diagrams are used.
3. How the circuit diagrams are used.
4. How and what models are used to make the solution straightforward and easier.
5. Etc.

Improvements:
1. Such things as correct circuit diagrams always help.
2. Application of appropriate laws (for example, it can be easier to solve a problem using KVL than KCL) and laws.
3. Etc.

Insights:
1. New ways and efficient means of solving problems.
2. Specific model used to facilitate the problem solving.
3. Etc.
Mention at least 3 things you did at the group meeting:

List at least 3 things you learnt at the group meeting:

Members present:

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<thead>
<tr>
<th>#</th>
<th>NAME OF STUDENT</th>
<th>SIGNATURE</th>
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Student Signature:_________________________ Date:_____________

Instructor Feedback
### ECE 3300 ELECTRICAL MACHINERY: FALL 2018 TIME TABLE

<table>
<thead>
<tr>
<th>#</th>
<th>ACTIVITY</th>
<th>DUE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Homework 1</td>
<td>September 10, 2018</td>
</tr>
<tr>
<td>2</td>
<td>Homework 2</td>
<td>September 19, 2018</td>
</tr>
<tr>
<td>3</td>
<td>Group Work I Starts</td>
<td>September 26, 2018</td>
</tr>
<tr>
<td>4</td>
<td>Homework 3</td>
<td>September 28, 2018</td>
</tr>
<tr>
<td>5</td>
<td>TEST 1</td>
<td>October 12, 2018</td>
</tr>
<tr>
<td>6</td>
<td>Homework 4</td>
<td>October 15, 2018</td>
</tr>
<tr>
<td>7</td>
<td>Homework 5</td>
<td>October 26, 2018</td>
</tr>
<tr>
<td>8</td>
<td>Group Work II Starts</td>
<td>October 31, 2018</td>
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<tr>
<td>9</td>
<td>Homework 6</td>
<td>November 07, 2018</td>
</tr>
<tr>
<td>10</td>
<td>TEST II</td>
<td>November 16, 2018</td>
</tr>
<tr>
<td>11</td>
<td>Homework 7</td>
<td>November 21, 2018</td>
</tr>
<tr>
<td>12</td>
<td>Homework 8</td>
<td>December 03, 2018</td>
</tr>
</tbody>
</table>
...YES, BUT...