Western Michigan University, Electrical and Computer Engineering Department
ECE 4300 Electric Power Systems (3 - 0), Spring 2019 Course Information and Policies
CRN: 11405-100  9:30 - 10:20 a.m. MWF (Lecture: Asumadu)

ACADEMIC INTEGRITY POLICY

“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/religion-observes-policy
- Disability Services for Students www.wmich.edu/disabilityservices.”

OFFICIAL CONTACT PLACES/HOURS:
Name: Johnson Asumadu  Email: johnson.asumadu@wmich.edu
Office: FLYOD B-0224  Office Hours: 10:30–11:30 a.m. MW & by appointment
Tel: +1 (269) 276 – 3147  Fax: +1 (269) 276 – 3151
Classroom Assigned: FLYOD D-0212  Class Hours: 9:30 – 10:20 a.m. MWF
Lab Room Assigned: NA  Lab Hours: NA
Web Site Addresses: URL for course: http://homepages.wmich.edu/~jasumadu/

KEY DATES:
1st Hour Mid Term Test February 25 2019 Normal Class Hour
2nd Hour Mid Term Test April 15, 2019 Normal Class Hour
Final Examination: According to the University’s Exam. Schedule

COURSE MATERIALS

Text Books:
5. MATLAB for Electrical & Computer Engineering Students & Professionals with SIULINK by Priemer

Materials (Required):
1. The Student Edition of MATLAB & SIMULINK by The MathWorks, Inc. (OR Free at CAE Center)
2. Electric Transient and Analysis Program (ETAP) - Provided by the Department of Electrical and Computer Engineering
4. Scientific Calculator that has at least the following features: (i) 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, (ii) solves linear algebra equations, including the case where
the coefficients are complex, (iii) perform repetitive computations, and (iv) finds roots of polynomials, linear and nonlinear equations, and (v) finds the inverse of at most 3x3 square matrix.

**CATALOG DESCRIPTION**
Transmission lines, network analysis, load flow, system faults, fault calculation, transients, and system stability.

**PRE-REQUISITES**
ECE 3300 Electrical Machinery or taken concurrently.

**COURSE OBJECTIVES**
Students successfully completing this course should be able to perform the following tasks with minimum degree of difficulty:
1. Analyses and design of electrical power systems.
2. Perform load flow and economic dispatch analyses of power systems.
3. Perform stability and transient analyses on power systems
4. Application of commercial software in power systems.

**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.
3. Electrical Machinery (ECE 3300 or Equivalent): Circuit analysis, transformers, and generators.
5. 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), Watts (W), Gain, and Decibel (dB)
6. Applying correct engineering factors: kilo (k = 10³), mega (M = 10⁶), giga (G = 10⁹), tera (T = 10¹²), 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 2 Years)**
1. Ability to create control system models from an electrical or an electromechanical feedback system.
2. Select the appropriate control design tools and tests procedures to analyze a control system.
3. Compile design report that documents simulation results, component selection, prototype construction, laboratory investigation/testing, and conclusion.
4. Using manuals to select off-the-shelf components that are appropriate for use in a larger system.

**LEARNING OUTCOMES (The relevant ECE Department learning outcomes a-k (ABET))**
1. Ability to analyze steady-state AC, balanced, three-phase circuits. (a, e, i)
2. Ability to develop resistance, inductance and capacitance models for conductors, cables and bundled cables for single-phase and three-phase transmission lines. (a, c, e, i)
3. Ability to compute transmission line voltage regulation and transmission efficiency vs. loading (a, i)
4. Ability to design reactive compensation circuitry for voltage control. (a, c, e)
5. Ability to develop one-line diagrams, circuit models for major power system components, i.e., three-phase generators, transformers, lines and equivalent loads. (a, c, e, k)
6. Ability to use per-unit notation for system analysis and design. (a, c, e)
7. Ability to reformulate and use for analysis the network equations in terms of the system bus admittance and impedance matrix. (a, c, e, k)
8. Ability to develop the non-linear “load flow” equations and solve using numerical analysis. (a, c, e, k)
9. Ability to use “load flow” analysis for system voltage control and power flow. (a, c, e, h, l, j, k)
10. Ability to develop and use for circuit breaker and fuse selection, the sub-transient, transient and steady-state model for symmetrical three-phase short circuits. (a, c, e, k)
11. Ability to develop and analyze system models in terms of symmetrical components for unbalanced faults and selection of protective devices. (a, c, e, i, k)
12. Learn how to use application software (MATLAB/SIMULINK, PSCAD, PowerWorld SIMULATOR, MATHCAD) for power systems. (a, b, c, e, i, k)
COURSE EVALUATION:
Individual Record Keeping (Maximum Points: 10%)
  Homework Assignments (Maximum Points: 10%)
  Team Agendas and Minutes
  Reflections on Team Dynamic
Examinations (Maximum Points: 70%)
  2 Mid Term Tests (Maximum Points: 20% of each)
  Final Examination (Maximum Points: 30%)
MATLAB & SIMULINK/Project (Maximum Points: 20%)

Grading Scale
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<tr>
<td>100 - 85</td>
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<td>69 - 65</td>
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<td>64 - 60</td>
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Policy on Homework and MATLAB & SIMULINK, ETAP/Project:
Homework, group, and design problems are assigned during class periods and are due at the scheduled time. Problems must be done neatly, submitted in numerical order on 8 1/2 X 11 inch paper, one side only. HOMEWORK AND MATLAB & SIMULINK, ETAP/PROJECT TURNED IN LATE WILL RECEIVE NO CREDIT. If you have questions about any homework, Project work or do not understand any course materials, you must see me in B-224 as soon as possible. Solutions to all homework and design problems will be made available.

Please do not skip doing homework. 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 are responsible for all pre-requisites especially ECE 3300 (or equivalent).

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".

DISCLAIMER ON THE WEB: THE UNIVERSITY AND I WILL NOT BE HELD LIABLE FOR ANY ERRORS OR INACCURACIES ON THIS WEBSITE.

EMAILS: I WILL TREAT ALL EMAILS AS NON-CONFIDENTIAL. IF ANY EMAIL SENT TO ME TO REQUEST INFORMATION THAT I BELIEVE WILL HELP OTHER STUDENTS, I WILL COPY THE REPLY TO ALL STUDENTS.

General Policy on use of Electronic Equipment During Tests/Examinations
1. Materials
All my tests and exams are open books/notes or anything printed on paper. I will ask that you bring green/blue book for tests/final examinations.

2. Calculator
You will not be allowed to share calculators. Your calculator must be able to perform the following:
(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/nonlinear algebra equations, including the case where the coefficients are complex,
(c) perform repetitive computations, and
(d) finds roots of polynomials, linear and nonlinear equations, and
(e) finds the inverse of at most 3x3 square matrix.

3. Electronic Equipment During Tests/Examinations
   NO electronic equipment with WIFI/any form of communication connection will be accepted. They must NOT be on sight (preferably in your backpack). This includes:
   (a) Cell Phones
   (b) Ipads/Surfaces/etc.
   (c) Laptops, Desktop Computers, etc.
   (d) etc.

If you see a student cheating, it is your responsibility to quietly call my attention to that. We must all stamp out cheating.
**COURSE SCHEDULE**

January
7 - 21   Review, Single-Three-Phase AC Circuits, Steady-state   Chs. 1, 2
          - Changing Landscape, Electrical Energy and Environment
          - Power – Complex/Balance, Power Flow, Single-phase, Three-phase connections

January
22 – February 25   Per-unit Notation, Generators, Transformer Models   Ch. 3
                     - Voltage Base, Power Base, Current Base, and Impedance Base
                     - Generator Mode, Equivalent Circuit, and Ratings
                     - Turns Ratio, Equivalent Circuit, Ratings, and Different Types
                     Transmission Lines, Distributed Resistance, Inductance and Capacitance   Ch. 4
                     - Resistance, Inductance, Capacitance
                     - Composite, Bundle, Multi-conductor, Spacing, Transpose

February 25   **1ST HOURLY TEST**

March
1 – 22   Line Models, Performance, Compensation   Ch. 5
          - Short, Medium, Long
System Modeling and Network Calculations
System Power Flow Analysis   Ch. 6
          - Bus Admittance, Power Flow Equations
          - Gauss-Seidel, Newton-Raphson Methods
          - Line Flows and Losses
          - Power Flow Programs

March
25 – April 15   Transients, Unsymmetrical and Symmetrical Three-Phase Faults   Ch. 9, 10
                     - Symmetrical Components, Sequence Networks, Balanced Fault
                     - Faults: Single line-to-Ground, Line-to-Line, Double line-to-Ground, Unbalanced

April 15   **2ND HOURLY TEST**

17 – 19   Power System Stability   Ch. 11
          - Swing Equation, Synchronous Machine Stability
          - Steady-State, Transient
          - Three-phase Fault

**FINAL EXAM. USING THE UNIVERSITY SCHEDULE**

**COMPUTER DESIGN ASSIGNMENTS**
The there will be at least five computer design assignments. Students may use the MATLAB & SIMULINK software installed (by MathWorks, Inc.) on the server at CAE’s center for the computer assignments. Students may also purchase their own copies from University Book Store. MATLAB & SIMULINK software is more appropriate for this course. PSCAD is free. ETAP will be provided by the Department of Electrical and Computer Engineering. However, students who use any other software must make sure that they include all programs generated in their reports.

**NOTE:**
(i) AT THIS TIME I DO NOT INTEND TO GIVE ANY MAKEUP HOMEWORK/TESTS/EXAM.
(ii) ALL THE INFORMATION PROVIDED ABOVE IS TENTATIVE AND SUBJECT TO CHANGE WITHOUT NOTICE.
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YES, BUT...