**The UT Arlington Syllabus Template for 2014-15
*Frequently Asked Questions***

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| **What’s newfor 2014-15?** | The two most important revisions to this year’s template are:1. The new section titled “Title IX”; and
2. An important change in the wording of the attendance policy.

Both of these two elements include required verbiage. We have also made minor revisions throughout; added a new optional paragraph about the Writing Center; inserted a new end-of-syllabus text box with emergency contact numbers; and updated the information about the library.  |
| **When must my course syllabus be issued and posted?** | A syllabus for each course that you teach (as the instructor of record) must be made available to students in a medium of your choosing (hard copy, electronic format, or both) by the first day of class. |
| **Where must each syllabus be posted?** | Regardless of how you make a syllabus available to students, a syllabus for each course you teach **must** be posted to your faculty profile by the first day of class.* To access your faculty profile, go to [**https://www.uta.edu/mentis**](https://www.uta.edu/mentis).
* For guidance on how to upload your syllabus to the Profile System, visit [**https://www.uta.edu/provost/administrative-forms/index.php**](https://www.uta.edu/provost/administrative-forms/index.php) and choose one of the two “how to” options under “course-related information.”

Use of the Profile System has allows for compliance with state law regarding public access to course information. This system, housed with the “Mentis” platform, is the sole official University repository for all syllabuses. While you may post or archive a syllabus in other locations, doing so does not meet the requirement to post the syllabus in the Profile System. |
| **Who is responsible for ensuring that a syllabus has been posted online?** | The timely and accurate posting of all course syllabuses is the joint responsibility of the course instructor and his or her immediate supervisor. While some units may delegate the task to an administrative staff person, the instructor and his or her immediate supervisor share responsibility for adherence to relevant policies. |
| **What must be in the syllabus?** | See the following pages for University-required elements. Contact your home unit for additional advice pertaining to any relevant local policies. |
| **Is my syllabus binding?** | Yes, in that the syllabus represents a good faith account of what you have planned for the course. As the instructor of record, you may always make adjustments that serve your students’ best educational interests. Any changes to the syllabus should be announced in a timely fashion, particularly if the change involves a major exam, paper, or project. It is further advised that any syllabus changes be issued in writing *(e.g., via* e-mail, in Blackboard, or with a handout). |
| **May I adjust the formatting of the official template?** | Yes! You control the formatting and visual presentation of your syllabus. What’s most important to take from this template is content. In the template:* **Black text** is **required**.
* **Blue text (except for hyperlinks)** is **optional**.
* **Red text** is **information for you**; be sure to **remove** it from the final document.

Specific colleges, schools, departments, or programs may require additional text. Consult your unit administration for details. |

**Direct questions about syllabus policies to** **David Silva****, Vice Provost for Faculty Affairs.**

**This first page is not part of the syllabus. The syllabus template begins on the following page.**

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**EE5374/EE4328 Power System Protective Relaying**

Spring 2015

**Instructor(s):** Wei-Jen Lee, PhD, PE

**Office Number:** ELB 304

**Office Telephone Number:** (817) 272-5046

**Email Address:** wlee@uta.edu

**Faculty Profile:** https://mentis-test.uta.edu/public/#profile/profile/edit/id/258/

**Office Hours:** 8:30 AM – 11:30 AM, TUESDAY & WEDNESDAY (OTHER TIME BY APPOINTMENT)

**Section Information:** EE5374

**Time and Place of Class Meetings:** NH108, 17:00-18:20, Tuesday and Thursday

Description of Course Content: Fundamental understanding of symmetrical components, applications of symmetrical components in system protection, philosophy of power system protection, various protective relay systems, and the special considerations in applying the microprocessor based relays are covered. Experiments utilizing the Power System Simulation Laboratory and relay testing equipment are required.

**Student Learning Outcomes:** The goal of this course is to give students a good understanding of the function and applications of the protective relays. This course emphasizes the symmetrical components, applications of symmetrical components in system protection, philosophy of power system protection, various protective relay systems, and the special considerations in applying the microprocessor based relays.

Power system protection is essential to the reliability and security of the power system. Learning the materials in this course is an important step toward a rewarding career as a power engineer.

**Required Textbooks and Other Course Materials:** J. Lewis Blackburn, “Protective Relaying – Principles and Applications”, 4th Edition, Marcel Dekker

**Descriptions of major assignments and examinations:** Homework are due at the end of the class on the day the assignment is due. All work presented must meet professional standards regarding materials and format. Homework will be checked as to effort and number of problems presented. The homework grade is based on ten (10) points per problem per assignment. Since it is faculty’s strongly belief that a student’s success is directly proportional to success with homework, it is imperative that the homework be done.

It is the expressed policy of the faculty of the department to take decisive action involving any incidence relating to academic dishonesty. The instructor of this course will strictly enforce this policy!

**LATE HOMEWORK ASSIGNMENTS:** Homework must be turned in at the end of the class period on the day the assignment is due. No late homework will be accepted after the solution is posted in the copy center or web site. There will be a 25% grade reduction for each class period late.

**MAKE UP OF MISSED EXAMINATION:** There will be no makeup of a missed examination.

**CONSIDERATION OF RE-GRADING REQUEST:** It is the student’s responsibility to keep up with various grades assigned to their work by the instructor. If there is any question concerning the assigned grade, the instructor will accept a formal request to examine the grading in question if such a request is presented to the instructor within one-week following the returning of the material in question from the instructor. The entire original work in question must be submitted to the instructor. The instructor reserves the rights to re-grade the entire materials.

**Course Evaluation & Final Grade:**

# ITEM POINTS

1. HOMEWORK 20.00

2. FIRST EXAMINATION 20.00

3. FIRST PROJECT 15.00

4. SECOND PROJECT 20.00

5. FINAL EXAMINATION 25.00

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 TOTAL COURSE POINTS 100.00

STUDENT COURSE AVERAGE FINAL LETTER GRADE

 90.0 - 100.0 A

 80.0 - 89.9 B

 70.0 - 79.9 C

 60.0 - 69.9 D

 0.0 - 59.9 F

Attendance: The general format of the class will include formal lectures and lab sessions to develop the ideas and knowledge required for the understanding of Programmable Logic Controller and its applications. Since this is your education, you will be required to participate by:

* being aware of class procedures as set forth in this syllabus,
* attending all the lectures and labs,
* reading all assigned materials prior to the lecture,
* working the assigned homework problems,
* being aware of the course calendar, particularly examination times and dates

The grade of **W** will be assigned only if the conditions imposed by the University are met. The grade of **“Incomplete”** will be assigned only if the student has encountered circumstances beyond his or her control and the student’s previous actions have not created these circumstances. The assignment of this incomplete grade will be made at the decision of the instructor after consideration of the facts as presented in a written request from the student.

**Grade Grievances**: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog. Please refer to <http://catalog.uta.edu/academicregulations/grades/#graduatetext> for additional information.

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wweb.uta.edu/aao/fao/>).

**See the Registrar’s Bulletin or the University Calendar in the front part of the UTA catalog for drop dates.**

**Americans with Disabilities Act:** The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability) or by calling the Office for Students with Disabilities at (817) 272-3364.

**Title IX:** The University of Texas at Arlington is committed to upholding U.S. Federal Law “Title IX” such that no member of the UT Arlington community shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity. For more information, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX).

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents’ Rule* 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University.

**Lab Safety Training:**  **Students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities.** Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., through the following August) and must be completed anew in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned.

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Student Feedback Survey:** At the end of each term, students enrolled in classes categorized as “lecture,” “seminar,” or “laboratory” shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest building exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities. Please visit ([https://www.uta.edu/policy/procedure/7-6)](https://www.uta.edu/policy/procedure/7-6%29) for additional information regarding Emergency/Fire Evacuation Procedures.

**Course Schedule**

**Tentative Lecture/Top Schedule (Course Content):**

Chapter 1 Introduction and General Philosophies

* Introduction and Definition
* Typical Protective Relays and Relay Systems
* Typical Power Circuit Breakers
* Nomenclature and Device Numbers
* Typical Relay and Circuit Breaker Connections
* Basic Objectives of System Protection
* Factors Affecting the Protecting System
* Classification of Relays
* Protective Relay Performance
* Principles of Relay Application
* Information for Application

Chapter 2 Fundamental Units: Per Unit and Percent Values

* Introduction
* Per Unit and Percent Definitions
* Advantages of Per Unit and Percent
* General Relations Between Circuit Quantities
* Base Quantities
* Per Unit and Percent Impedance Relations
* Per Unit and Percent Impedance of Transformer Units
* Changing Per Unit (Percent) Quantities to Different Bases

Chapter 3 Phasor and Polarity

* Introduction
* Phasors
* Circuit and Phasor Diagram for a Balanced Three-Phase Power System
* Phasor and Phase Rotation
* Polarity
* Application of Polarity for Phase-Fault Directional Sensing
* Directional Sensing for Ground Faults: Voltage Polarization
* Directional Sensing for Ground Faults: Current Polarization
* Other Directional Sensing Connections

Chapter 4 Symmetrical Components: A Review

* Introduction and Background
* Positive-Sequence Set
* Nomenclature Convenience
* Negative-Sequence Set
* Zero-Sequence Set
* General Equations
* Sequence Impedance
* Positive Sequence Sources
* Sequence Networks
* Shunt Unbalance Sequence Network Interconnections
* Series and Simultaneous Unbalances

Chapter 5 Relay Input Sources

* Introduction
* Equivalent Circuits of Current and Voltage Transformers
* Current Transformers for Protection Applications
* Current Transformer Performance on a Symmetrical AC Component
* Secondary Burdens During Faults
* CT Selection and Performance Evaluation for Phase Faults
* Performance Evaluation fro Ground Relays
* Effect of De-energized CTs on Performance
* Flux Summation Current Transformer
* Current Transformer Performance on a DC Component
* Current Transformer Performance Evaluation
* Voltage Transformers for Protective Applications

Chapter 6 Protection Fundamentals and Basic Design Principles

* Introduction
* The Differential Principle
* Overcurrent-Distance Protection and the Basic Protection Problem
* Back-up Protection: Remote Versus Local
* Basic Design Principles
* Ground Distance Relays
* Solid-State Microprocessor Relays

Chapter 7 System Grounding Principles

* Introduction
* Ungrounded Systems
* Transient Overvoltages
* Ground-Detection Methods for Ungrounded Systems
* High Impedance Grounding Systems
* System Grounding for Mine or Other Hazardous Type Applications
* Low Impedance Grounding
* Solid (Effective) Grounding
* Ferroresonance in Three-Phase Power Systems
* Safety Grounding

Chapter 8 Generator Protection: Utility and Non-Utility Owned

* Introduction and Potential Problems
* Generator Connections and Typical Protection
* Stator Phase-Fault Protection for All Sizes Generators
* Unit Transformer Phase Fault Differential Protection (87TG)
* Phase Fault Back-up Protection (51V or 21)
* Negative Sequence Current Back-up Protection
* Stator Ground Fault Protection
* Multiple Generator Units Connected Directly to a Transformer: Grounding and Protection
* Field Ground Protection (64)
* Generator Off-Line Protection
* Reduced or Lost Excitation Protection (40)
* Generator Protection for System Disturbances and Operational Hazards
* Synchronous Condenser Protection
* Generator-Tripping Systems

Chapter 9 Transformer, Reactor, and Shunt Capacitor Protection

* Transformers
* Factor Affecting Differential Protection
* Magnetizing Inrush
* Transformer Differential Relay Characteristics
* Application and Connection of Transformer Differential Relays
* Load-Tap Changing Transformers
* Application of Auxiliaries for Current Balancing
* Parallel CTs in Differential Circuits
* Special Connections for Transformer Differential Relays
* Differential Protection for Three-Phase Banks of Single-Phase Transformer Units
* Ground Differential Protection for Transformers
* Equipment for Transfer Trip Systems
* Mechanical Faults Detection for Transformers
* Grounding Transformer Protection
* Ground Differential Protection with Directional Relays
* Protection for Regulating Transformers
* Transformer Overcurrent Protection
* Transformer Overload-Through-Fault-Withstand Standards
* Transformer Thermal Protection
* Overvoltage on Transformers
* Reactors
* Capacitors

Chapter 10 Bus Protection

* Introduction: Typical Bus Arrangements
* Single Breaker – Single Bus
* Single Buses Connected with Bus Tie
* Main and Transfer Buses with Single Breaker
* Single Breaker – Double Bus
* Double Breaker – Double Bus
* Ring Bus
* Breaker-and-a-Half Bus
* Transformer – Bus Combination
* Differential Protection for Buses
* Other Bus Differential Systems
* Ground-Fault Bus

Chapter 11 Motor Protection

* Introduction
* Potential Motor Hazards
* Motor Characteristics Involved in Protection
* Induction Motor Equivalent Circuit
* General Motor Protection
* Phase-Fault Protection
* Differential Protection
* Ground-Fault Protection
* Thermal and Locked-Rotor Protection
* Locked-Rotor Protection fro Large Motors
* System Unbalance and Motors
* Unbalance and Phase Rotation Protection
* Undervoltage Protection
* Bus Transfer and Reclosing
* Repetitive Start and Jogging Protection
* Multifunction Microprocessor Motor Protection Units
* Synchronous Motor Protection

Chapter 12 Line Protection

* Classification of Lines and Feeders
* Line Classification for Protection
* Techniques and Equipment for Line Protection
* Coordination Fundamentals and General Setting Criteria
* Distribution Feeder, Radial Line Protection, and Coordination
* IPP, DSG, and Other Sources Connected to Distribution Lines
* Instantaneous Trip Application for a Loop System
* Short-Line Applications
* Network and Spot Network Systems
* Distance Protection for Phase Faults
* Distance Relay Applications for Tapped and Multiterminal Lines
* Voltage Sources for Distance Relays
* Distance Relay Applications in Systems Protected by Inverse-Time-Overcurrent Relays
* Ground-Fault Protection for Lines
* Distance Protection for Ground Faults and Direction Overcurrent Comparison
* Fault Resistance and Relaying
* Directional Sensing for Ground-Overcurrent Relays
* Polarizing Problems with Autotransformers
* Voltage Polarization Limitations
* Dual Polarization for Ground Relaying
* Ground Directional Sensing with Negative Sequence
* Mutual Coupling and Ground Relaying
* Ground Distance Relay with Mutual Induction
* Long EHV Series-Compensated Line Protection
* Back-up, Remote, Local, and Breaker Failure

Chapter 13 Pilot Protection (Time permit)

* Introduction
* Pilot System Classifications
* Protection Channel Classifications
* Directional Comparison Blocking Pilot Systems
* Directional Comparison Unblocking Pilot Systems
* Directional Comparison Overreaching Transfer Trip Pilot Systems
* Directional Comparison Underreaching Transfer Trip Pilot Systems
* Phase Comparison: Pilot Wire Relaying – Wire Line Channels
* Phase Comparison: Audiotone or Fiber-Optic Channels
* Segregated Phase Comparison Pilot Systems
* Single-Pole-Selective-Pole Pilot Systems
* Directional Wave Comparison Systems
* Transfer Trip Systems
* Communication Channels for Protection

Chapter 14 Stability, Reclosing, and Load Shedding (Time permit)

* Introduction
* Electric Power and Power Transmission
* Steady State Operation and Stability
* Transient Operation and Stability
* System Swing and Protection
* Out-of-Step Detection by Distance Relay
* Automatic Line Reclosing
* Distribution Feeder Reclosing
* Subtransmission and Transmission Line Reclosing
* Reclosing on Lines with Transformers or Reactors
* Automatic Synchronizing
* Frequency Relaying for Load Shedding (Load Shaving)
* Frequency Relaying for Industrial Systems

Additional Supersynchronous and Subsynchronous Resonance (Time permit)

* Introduction
* Factors that cause Supersynchronous and Subsynchronous Resonance
* Analyze the Supersynchronous and Subsynchronous Resonance
* Mitigate the Supersynchronous and Subsynchronous Resonance

*As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.*

**Emergency Phone Numbers**: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911.

For non-emergencies, contact the UTA PD at 817-272-3381

**This final section is not part of the syllabus template, but a message from the UT Arlington Library.**

Faculty members should feel free to incorporate any of the following information into your course syllabus or other course materials.

Library Home Page <http://www.uta.edu/library>

Subject Guides <http://libguides.uta.edu>

Subject Librarians <http://www.uta.edu/library/help/subject-librarians.php>

Database List <http://www.uta.edu/library/databases/index.php>

Course Reserves <http://pulse.uta.edu/vwebv/enterCourseReserve.do>

Library Tutorials <http://www.uta.edu/library/help/tutorials.php>

Connecting from Off- Campus <http://libguides.uta.edu/offcampus>

Ask A Librarian [http://ask.uta.edu](http://ask.uta.edu/)

The following URL houses a page where we have gathered many commonly used resources needed by students in online courses: <http://www.uta.edu/library/services/distance.php>.

The subject librarian for your area can work with you to build a customized course page to support your class if you wish. For examples, visit <http://libguides.uta.edu/os> and <http://libguides.uta.edu/pols2311fm> . If you have any questions, please feel free to contact Suzanne Beckett, at sbeckett@uta.edu or at 817.272.0923.