

# **EE 5371: POWER SYSTEM PLANNING, OPERATION, AND CONTROL IN A DEREGULATED ENVIRONMENT - Spring 2019**

**Instructor:** Dr. Robert Spangler

**Office Number:** Engineering Lab Building Rm 313A

**Office Telephone Number:** 817-272-2671

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

**Faculty Profile:** <http://www.uta.edu/profiles/robert-spangler>

**Office Hours:** TBD

**Section Information:** EE5371-001 (91971)

**Time and Place of Class Meetings:** Geoscience (GS) 109, TuTh 5:30 – 6:50 PM

## **Description of Course Content:**

The course will focus on the study of the engineering, energy economics and financial topics associated with the operational aspects of the regulated monopoly and competitive electricity markets. The course is designed to develop a skill set utilizing the typical software applications used by Independent System Operators and Market Participants (Generation Suppliers and Load Serving Entities) engaged in the conduct of Electric System and Electricity Market Operations.

The subjects of real time system planning and operation and control in vertically integrated and competitive electricity markets are discussed. This course covers the application of planning and operating functions in vertically integrated regulated monopoly markets and restructured utilities and end-use customers operating in competitive electricity markets. Specific course topics cover the traditional power system reliability and security requirements, the operating characteristics of current generation technologies, and the application of economic optimization models in the operation of the Day-Ahead Capacity and Energy Markets and the Real Time Energy Electricity Markets. The integration of renewable and nonrenewable generation resources and load/demand response in the context of the “intelligent network/smart grid” is introduced. Topics will be approached from the viewpoints of Government Regulatory and Quasi-Regulatory Authorities, the Market Operator and the Market Participants (GENCO, TRANSCO and Retail Electric Supplier) and will consider the economic and operational motivations of each.

Lectures will be available on the UTA Echo Lecture Capture system.

## **Student Learning Outcomes:**

The course is designed to develop a skill set based on the typical software applications utilized in the conduct of Electric System and Market Operations processes by the Independent System Operator and Market Participants (Generation Suppliers and Load Serving Entities).

Students will gain:

1. Increased knowledge base of the current practices and methods that are applied in power system operations in both monopoly and competitive electricity market structures;
2. A working knowledge of the types of generation and load resources utilized in the current electric power systems in the US and overseas; and
3. An understanding of the mathematical optimization methods and their application to practical power system operating problems and practices including hands on exercises utilizing the various optimization applications available, for example, in the Microsoft Excel, MatLab, Matpower, and Gurobi application packages.

**Required Textbooks and Other Course Materials:**

1. "Power Generation, Operation, and Control," 3<sup>rd</sup> Edition, Allen J. Wood, Bruce F. Wollenburg and Gerald B. Sheble, John Wiley & Sons 2013, ISBN 978-0-471-79055-6.
2. "Electricity Markets, Theories and Applications," Jeremy Lin, Fernando H. Magnago, John Wilry & Sons (IEEE Press), ISBN 978-1-119-17935-1

**Optional References (ordered by relevance):**

1. "Power System Economics," Daniel S. Kirschen and Goran Strbac, John Wiley & Sons, 2004, ISBN 0-470-84572-4.
2. "Market Operations in Electric Power Systems," Mohammad Shahidehpour, Hatim Yamin and Zuyi Li, 2002, ISBN 0-471-44337-9.

**Descriptions of Major Assignments, Examinations and Grading:****Examinations:**

- Three 1½ hour examinations
- One 2½ hour comprehensive final
- The total weight for the 4 examinations is 70% of the final class grade.
- The instructor reserves the right to adjust the number and coverage of the examinations.

**Homework and Programming Projects:**

Various assignments totaling 30% of the final class grade.

Homework must be turned in at the beginning of class on day assignment is due. Twenty-five percent (25%) will be deducted for each class period late (Note: score reduces to zero if late four class periods). Homework submitted after the answer key is posted will be awarded a zero score.

**Final Grade Range:****Final Grade Range**

90 to 100 A  
80 to 89 B  
70 to 79 C  
60 to 69 D  
00 to 59 F

**Attendance:** Attendance at all sessions is strongly encouraged as much of the knowledge derived from studying the textbook and supplemental materials will be reinforced during discussions among the class participants and the instructor. Attendance will not be taken; however, if you are unable to attend a session, students are requested to advise the instructor by Email.

**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://www.uta.edu/aao/fao/>).

**Disability Accommodations:** UT 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)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. 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 disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified** by the Office for Students with

Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: **The Office for Students with Disabilities, (OSD)** <http://www.uta.edu/disability/> or calling 817-272-3364. 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/).

**Counseling and Psychological Services (CAPS)** [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [uta.edu/eos](http://uta.edu/eos).

**Title IX Policy:** The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Michelle Willbanks, Title IX Coordinator at (817) 272-4585 or [titleix@uta.edu](mailto:titleix@uta.edu)*

**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 in their courses by 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. Additional information is available at <https://www.uta.edu/conduct/>. Faculty are encouraged to discuss plagiarism and share the following library tutorials <http://libguides.uta.edu/copyright/plagiarism> and <http://library.uta.edu/plagiarism/>

**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>.

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Student Feedback Survey:** At the end of each term, students enrolled in face-to-face and online classes categorized as “lecture,” “seminar,” or “laboratory” are 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 via the SFS database is aggregated with that of other students enrolled in the course. Students’ anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** for semester-long courses, 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 exits, which are located to on either of your the right or left upon exiting the classroom. 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.

**Student Support Services:** UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/studentsuccess/success-programs/programs/resource-hotline.php>

The English Writing Center (411LIBR):] The Writing Center offers FREE tutoring in 15-, 30-, 45-, and 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Register and make appointments online at <https://uta.mywconline.com>. Classroom visits, workshops, and specialized services for graduate students and faculty are also available. Please see [www.uta.edu/owl](http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library’s 2<sup>nd</sup> floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library’s hours of operation. <http://library.uta.edu/academic-plaza>

## Course Schedule

*Please note that as the instructor for this course, I reserve the right to adjust the following schedule in any way that serves the educational needs of the students enrolled in this course – Dr. Robert Spangler.*

| Class Period | Date      | Subject                                     | Comments  |
|--------------|-----------|---|---|
| 1            | 1/15      | Introduction                                | Introduction                                      |
| 2            | 1/17      | PGOC Ch.1; Ch.2; Ch.3.11 & EM/TA Ch.1; Ch.3 | PGOC: Power Generation, Operation and Control     |
| 3            | 1/22      |   | EM/TA: Electricity Markets, Theory & Applications |
| 4            | 1/24      | PGOC Ch.3; Ch.5 & EM/TA Ch.5.1 – 5.6        | Economic Dispatch                                 |
| 7            | 2/5       | PGOC Ch. 4 & EM/TA Ch. 4                    | Unit Commitment                                   |
| 10           | 2/14      | Exam 1                                      | Exam 1  |
| 11           | 2/19      | PGOC Ch. 6 & EM/TA Ch. 2; Ch. 5.7 – 5.8     | Transmission Network – Losses & Constraints & LMP |
| 16           | 3/7       | Exam 2                                      | Exam 2  |
|              | 3/12-3/15 | Spring Break                                | Spring Break                                      |
| 17           | 3/19      | PGOC Ch. 8 & EM/TA Ch. 6                    | Optimum Power Flow (OPF)                          |
| 19           | 3/26      | PGOC Ch. 7; Ch. 10                          | Operations Security & Control                     |
| 22           | 4/4       | PGOC Ch. 11 & EM/TA Ch. 7, 8, 9             | Regulated & Competitive Market Operations         |
| 27           | 4/23      | Exam 3                                      | Exam 3  |
| 28           | 4/25      | EM/TA Ch. 11                                | Markets & Intelligent Grids                       |
| 30           | 5/2       | Final Review                                | Last Class Day                                    |

**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. Non-emergency number 817-272-3381

**LIBRARY** [library.uta.edu](http://library.uta.edu)

### RESOURCES FOR STUDENTS

#### Research or General Library Help

Academic Plaza Consultation Services [library.uta.edu/academic-plaza](http://library.uta.edu/academic-plaza)

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

Library Tutorials [library.uta.edu/how-to](http://library.uta.edu/how-to)

Subject and Course Research Guides [libguides.uta.edu](http://libguides.uta.edu)

Librarians by Subject [library.uta.edu/subject-librarians](http://library.uta.edu/subject-librarians)

Research Coaches <http://libguides.uta.edu/researchcoach>

## **Resources**

A to Z List of Library Databases [libguides.uta.edu/az.php](http://libguides.uta.edu/az.php)

Course Reserves [pulse.uta.edu/vwebv/enterCourseReserve.do](http://pulse.uta.edu/vwebv/enterCourseReserve.do)

Study Room Reservations [openroom.uta.edu/](http://openroom.uta.edu/)