Introduction to Smart Grid
Spring 2025

1. Course Name and Number

Course Title: Introduction to Smart Grid
Course No.: EE 590 (Smart Grid)

2. Instructor

Name: Dr. Raziq Yaqub
Contact: dr.raziq@gmail.com
Phone: +1-908-319-8422 (Mobile)
Hours: Available to reach out to students before each class, or over phone, or through e-mail.

3. Class Schedule

Dates:- January 21, 2025, to May 07,2025
Time:- 06:00 PM to 08:30 AM (Via Zoom)

4. Course Material

Text Book: The Smart Grid: Enabling Energy Efficiency and Demand Response.
Author: Clark W. Gellings
ISBN No. 10: 0-88173-623-6

5. Course Description

Smart grid is essentially an integration of “Power Systems”, “Telecommunication Technologies”, and “Sensor Networks”. It delivers electricity from suppliers to consumers using advanced telecommunication infrastructure, Information Technology, and sensor networks.

The course will cover the evolution of the existing power grid to the smart grid, the role of telecommunication technologies in energy production, efficient transmission, smart distribution, and self-healing networks that can withstand a failure in its transmission paths, the flow of electricity in the system through intelligent metering infrastructure, which are the enablers of smart grid. The course will also explain infrastructure security, and consumers' confidentially and privacy. It would also discuss protective measures to ensure system integrity while supplying energy at greater reliability and economy.

The smart grid course will provide the students with a comprehensive understanding of the electric grid operation. It will also cover, demand analysis, demand response, conditions that encourage efficient and smart distribution control, distribution control of electric generation, control of interconnected power system, real-time supply and demand consideration, monitoring for adequate supply, and transmission of energy to best meet customers needs economically and dependably.

In short, the course will provide students with a broad vision of the deregulated energy market, discuss in detail the generation of electrical energy, smart distribution using advanced telecommunication technologies, and demand management via M2M (machine to machine communication).

6. Detailed contents of the course:

1. Introduction to Smart Grid and Emerging Technologies.

2. Alternate Energy Sources: A step towards Smart Power Generation

3. Overcoming Transmission Losses and shifting to Transmission Automation

3. Power Distribution Automation, Quality of Power, and Reliability Evaluation

4. Wireless Communication infrastructure for smart grid operation (Wireline/Optical and 4G Wireless technologies)

5. Sensors Networks – the enabler of Smart Grids

6. Cyber Security for the Smart Grid

7. Advanced Metering Infrastructure and control methods

8. Unit Commitment and Economic Dispatch

9. Introduction to Standards for Smart Grid and NIST Smart Grid Conceptual Model

10. Efficient Electric End-user technology alternatives.

7. Course Objectives

7.1. Learning

Students are expected to learn fundamental concepts in Smart Grid, more specifically, understanding in detail the alternate energy sources for electrical energy generation, overcoming transmission losses and shifting to Transmission Automation, smart distribution using advanced telecommunication technologies, and demand management via machine to machine communication.

Introduction to Smart Grid EE-490 is offered to graduate/undergraduates (EE-590). EE-590 students are expected to perform at a higher level. They are also expected to produce a research paper dealing with a current problem(s) in context with Smart Grid. The paper should provide an analysis of the current or envisioned future problem; and an innovative solution or recommendations for addressing the problem/issue. Students are required to submit a research paper and to give a presentation. The presentation would be evaluated by the instructor as well as the fellow students. (For Research Paper, the format is defined below in section 6.2, however, no format necessary for PowerPoint presentation. At least a 10-minute presentation per two students group is mandatory). Since research aptitude is needed for the research, and it is not essential that all the students have that kind of aptitude, therefore an option of choosing a home assignment instead of a Research Paper is also available.

7.2. Innovation (Research Paper):

A semester-long innovative research project is expected from a group of 3 graduate students. The project will require proposing an innovative idea. This will require (a) finding a problem, (b) prior art search (reading of journal and conference papers, etc), and (c) submission/presentation of a research paper. The paper shall be written in professional engineering style as if submitting it to a professional conference or journal. The paper shall include an (a) abstract, (b) prior art, (c) student's new idea, (d) conclusions, and (f) references. The paper is **due by the last day of class**, no exceptions. An oral presentation is required.

The length of the paper shall not exceed 5 pages (IEEE format.). For prior art searches, the IEEE Explorer database is an excellent search engine for finding papers (with downloadable pdf files). The database is accessible through the University library.

8. Course Format

The lecture portion of the class will present much of the foundation of the course. The text provides the basic concepts, vocabulary, and important details on which lecture material will be based. At the end of each class, there will be CRQ (Chapter Review Questions). Grades on CRQ will manifest students' physical and mental presence in the class. A few topics covered in the lecture may not be covered in the text and vice versa. Most of the lecture time will be spent examining the specific topics and or examples that provide a meaningful context with the concepts presented in the text. Assignments will be given at the end of some classes. To make the class interactive, questions from the assignments and lectures will be addressed.

9. Attendance/Makeup Exam:

The university's attendance policy will be applied. Attendance will carry points and more than **two** absences will result in loss of points. Make-up exams will be given in cases of excusable absence or any unusual circumstances.

10. My Teaching Philosophy

I know that some need extra attention or assistance, and I feel that it is my job to help you. So do not hesitate to ask innumerable questions. I will keep explaining, until eventually, it makes sense, no matter how long it takes.

My objective is not to get you to be able to learn textbooks as a subject only but do well in professional life. I believe that achievement isn't just a good grade on a test, but a feeling of accomplishment with mastering a subject; I am willing to work with you for that feeling. I want the best from you, and am willing to go the extra mile.

I would greatly appreciate your feedback and constructive criticism. I believe that constructive criticism fulfills the same function as pain in the human body. It calls attention to an unhealthy state of things. Please feel free to provide your feedback/criticism. This would enable me to meet your needs, and help me learn how to become a good teacher.

11. Teaching Milestones and Assessment Format

Teaching Milestones and Assessment Format

Teaching Milestones		
Date	**Task**	**Grading**
Week-1-4	**Teaching**	
Week-5	**Mid-Term Test-1(Closed Book)**	
Week-5-8	**Teaching**	
Week-9	**Mid-Term Test-2(Closed Book)**	
Week-9-12	**Teaching**	
Week-13	**Final Test-2(Closed Book)**	
Grading	Midterm Test-1, Test -2 and Final Test Grading	**50%**
	CRQ (Chapter Review Questions) Grading	**25%**
	*Research Paper (or Home Assignments)	**25%**
	Total Points	**100%**

*** Assessment of Research Paper Or Home Assignments.**

- Finding a Problem (7 %)
- Prior Art Search (7 %)
- Innovative Idea (7 %)
- Submission of Research paper and Presentation (7 %)

Grading Scale
A ≥ 90%
80 ≤ B ≤ 90
70 ≤ C<80
60 ≤ D ≤ 70
F < 60

12. Submission Rules

- Please submit the SOFT copy via Blackboard.
- Each Assignment due on the subsequent class day
- All submissions are to be an individual effort (except Research Paper)

NOTE

- If you think you did not get what you deserved, due to any reason, whatsoever, please notify in two weeks from the date of grading. No action will be taken if you bring it up after this period is elapsed.
- Honor Code violations are taken very seriously