مؤسسة قطر
Qatar Foundation

جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY

Course Syllabus

Course Information:			
Course Title:	Smart Power Grids	**Course Code:**	SENR 654
Pre/Co-requisite(s):	**None**	**Credit Hours:**	3
Class Time:	**N/A**	**Class Room:**	N/A
Instructor Information:			
Name:	Islam Safak Bayram	**Office:**	CP4 Room 9
E-mail:	ibayram@qf.org.qa	**Office Hours:**	Mondays 3:15-4:15pm, Thursdays 8:45-10:30am
Course Descriptions: (as in Catalog)			
Smart Power Grids course will provide fundamental insights into century long energy studies that aims to match the demand with the supply, as well as a decade long re- search and development efforts in Smart Energy Grids to improve the energy efficiency, reliability, and environmental aspects of the power grids. More specifically, the course will provide a rich introduction to the new multi-disciplinary field of smart grids and it will cover variety of special topics including demand response, advanced metering networks, communication and sensing technologies, distributed energy generation and storage, electric vehicles, wide-area power system monitoring, energy markets, and cyber-security.			
Textbook(s):	*The Advanced Smart Grid: Edge Power Driving Sustainability*, Andres Carvallo, John Cooper, 1*st* Edition, **ISBN-13:** 978-1608071272		
Other Reading Material(s):	(1) *Smart Grids - Fundamentals and Technologies in Electricity Networks*, Bernd M. Buchholz, Zbigniew Styczynski, 1*st* Edition,**ISBN-13:** 978-3642451195. **(2)** *Peak Energy Demand and Demand Side Response,* Jacopo Torriti, 1st Edition, **ISBN**: 978 1138016255 (3) *Plug-in Electric Vehicle Grid Integration,* I.S. Bayram and A. Tajer, 1st edition, **ISBN**-13: 978-1630810511. (4) *Electric Power System Basics,* Steven W. Blume, 1st edition, **ISBN**: 978 0470129876		
Course Objectives:			

- Students will understand fundamental principles, generalizations, operations, and economies of smart power grids
- Students will learn factual knowledge (terminology, classifications, methods) of cyber-physical systems
- Students will analyze the issues with the transition towards the smart grids and evaluate and propose solutions for smart power grids

Student Learning Outcomes: **Upon successful completion of this course, students should be able to:**	
SLO 1	Analyze the current power grid operations and identify the current issues.
SLO 2	Identify and address the issues related to renewable energy integration, demand side management, and energy efficiency.
SLO 3	Design architectures for the electrification of transportation and transportation networks.
SLO 4	Understand the operation principles and the role of different control, optimization, and communication technologies in developing smart energy grids.
SLO 5	Conduct basic economic analysis to quantify and evaluate the smart grid benefits.
SLO 6	Analyze the role of electricity in sustainable development and energy security.
SLO 7	Analyze the enabling communication and sensing technologies for cyber-physical systems.

Weekly Schedule of Course Topics and Out of Class Assignments:

Week	**Topics**
Week 1	Introduction to Power Systems: A Historical Overview. Energy Security and Sustainable Development. Energy by the Numbers
Week 2	The Business of Electric Utilities: Market Types, Customer Types, Rate Making. Generation, Transmission, and Distribution Network
Week 3	The Need for Shift: Introduction to Smart Power Grids and Post Carbon Economy. Smart Grid Applications, Government, Industry, Standardization
Week 4	Enabling Technologies: Smart Grid Communications. Network Architectures, Power Line Communications, Advanced Metering Infrastructure, Sensor Technologies.
Week 5	Enabling Technologies: Distributed Generation. Stochastic Models, Forecasting, Carbon Footprint, Microgrid Architecture. Site Visit: QEERI Smart Grid Laboratory

Week 6	Enabling Technologies: Distributed Energy Storage. Applications, Barriers, Environmental Aspects
Week 7	In-class mid-term-1.
Week 8	Electrification of Transportation: Motivation, Definition, Economic Analysis. Barriers for Mainstream Acceptance, Impacts on Power Grids.
Week 9	Introduction to Optimization and Distributed Control. Theory and Examples-1
Week 10	Demand side management for smart grids, pricing models.
Week 11	Wide Area Power Systems: Applications and Challenges. Phasor Measurement Units, Fault Detection and Self Healing Systems
Week 12	Cybersecurity and Privacy in Smart Grid. False Data Injections, Load Altering, Defense Mechanisms
Week 13	Social, Political, and Regulatory Issues. Roadmap for Qatar's Smart Grid
Week 14	Student Paper Presentations, Projects due date.
Week 15	Final Exam

Grading Plan and Assessments:	
Methods	**Weights**
Homework assignments	20%
Project	30%
Presentations	10%
Exams	40%

Program Outcomes:

Program Learning Outcomes (PLOs)

MS/PhD Sustainable Environment

Learning Outcomes – the graduate can

- Expertly apply knowledge and skills to multi-disciplinary aspects of environmental sustainability.
- Develop products/solutions for environmental sustainability providing

economic, social and technological impact.

- Analyze, interpret, and communicate findings from a research project related to environmental sustainability to relevant audiences.
- Independently analyze complex environmental research problems, addressing multi-disciplinary facets.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes leadership, social consciousness, integrity and professionalism.

MS/PhD Sustainable Energy

Learning Outcomes – the graduate can

- Expertly apply knowledge and skills to multi-disciplinary aspects of energy efficient generation, storage, distribution as well as energy policy to address significant national and regional energy security and economic development issues.
- Develop technical products/solutions for efficient renewable energy production, transmission, and distribution with economic and social impact.
- Analyze, interpret, and communicate findings from a research project related to energy technology and policy to relevant audiences.
- Independently analyze complex energy-related research problems, crossing various disciplines.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

MS/PhD in Biological and Biomedical Sciences

Learning Outcomes – the graduate can

- Analyze a scientific problem in biological and biomedical sciences.
- Dissect and integrate the current state of knowledge in biological and biomedical sciences and related areas to formulate a cutting edge research question.
- Evaluate their own results as well as those of others, be aware of their limitations and effectively present their findings using written, spoken and presentations skills.
- Design coherent scientific projects while applying ethical standards and rigorous approach to research.
- Create an original body of work in the biological biomedical sciences field that reflects critical thinking and independent thought.

PhD in Computer Science and Engineering

Learning Outcomes – the graduate can

- Critically apply theories, methodologies and tools to address fundamental as

well as applied research in computer science and engineering.

- Creatively solve research problems in the related discipline or for a multidisciplinary project by demonstrating intellectual/engineering work of significance.
- Analyze, interpret, and communicate findings from a research project to relevant audiences.
- Lead entrepreneurial efforts, thereby contributing to national strategies and goals.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

MS in Cybersecurity

Learning Outcomes – the graduate can

- Analyze the computer network and information security needs of an organization to adequately protect its critical computing infrastructure, systems and information.
- Identify potential cybersecurity threats of existing computer hardware and software systems and develop advanced real-time security solutions and risk management policies.
- Critically apply theories, methodologies and tools to address fundamental research questions in cybersecurity.
- Analyze, interpret, and communicate findings from a research project related to cybersecurity to relevant audiences.
- Lead entrepreneurial efforts, thereby contributing to national strategies and goals.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

MS in Data Science and Engineering

Learning Outcomes – the graduate can

- Extract knowledge and insights from big data obtained from various sources.
- Design novel tools, methods and systems for big data collection, storage, processing and mining.
- Devise advanced and effective strategies and policies for business success.
- Analyze, interpret, and communicate findings from a research project to relevant audiences.
- Lead entrepreneurial efforts, thereby contributing to national strategies and goals.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

Master of Public Health

Learning Outcomes – the graduate can

- Identify health problems and needs in human populations locally and globally.
- Conduct qualitative and quantitative public health research using empirical methodologies.
- Demonstrate the ability to integrate knowledge, skills, and experience to solve public health problems and produce scholarly outcomes within the context of Qatar, becoming a well-rounded and culturally centered health professional.
- Analyze, interpret, and communicate findings from internships and a capstone experience on a public health concern to relevant organizations and to the community.
- Propose innovative solutions for public health problems using evidence- based decision making.
- Develop public health leadership focused on guiding and mobilizing people to accomplish a common vision of public health through the internships and a capstone experience.
- Evaluate processes by which the health needs of defined populations can be assessed and met.
- Create novel approaches to health care systems and policy.

Correlation Matrix between the course and the PLOs

Courses	Program Outcome 1	Program Outcome 2	Program Outcome 3	Program Outcome 4	Program Outcome 5	Program Outcome 6
Course Code/Title	×	×			×	

Course Policies

Grading Policy

University course work is measured in terms of quantity and quality. A credit normally represents one hour per week of lecture or recitation or not fewer than two hours per week of independent or laboratory work throughout a semester. The number of credits is a measure of quantity. The grade is a measure of quality. The university system for graduate course grading is as follows:

Letter Grade	Grade Points	Explanation of letter grades
A	4.00	Demonstrates a superior understanding of the subject matter
A-	3.67	Demonstrates exceptional understanding of the subject matter, a foundation of extensive knowledge, and a skillful use of concepts and/or materials.
B+	3.33	

B	3.00	Demonstrates capacity to use the appropriate concepts, a good understanding of the subject matter, and an ability to handle the problems and materials encountered in the subject.
B-	2.67	Demonstrates partial familiarity with the subject matter and some capacity to deal with relatively simple problems, but also demonstrating deficiencies serious enough to make it inadvisable to proceed further in the field without additional work. **Note**: No graduate student can graduate with a CGPA below 3.0.
C+	2.33	
C	2.00	
C-	1.67	
F	0.00	Means a student did not meet course requirements and must repeat the class.

Refer to the grading policy for more details.

Academic Integrity

The Honor Code is an integral part of university life. Students are responsible, therefore, for understanding the code's provisions. Cheating and attempted cheating, plagiarism, lying, and stealing of academic work and related materials constitute Honor Code violations. To maintain an academic community according to these standards, students and faculty must report all alleged violations.

HBKU expects its students to uphold high standards of academic integrity and conduct. In particular, students are required to:

- Attend classes regularly and punctually.
- Be actively involved in class discussions and other course related classroom activities.
- Complete assignments on time.
- Meet the requirements for course and program completion.
- Abide by high standards of academic integrity, ethics, and honesty.
- Refrain from cheating on homework and examinations, plagiarizing other people's work by submitting it as their own, or any other forms of academic dishonesty.
- Adhere to the published test or examination rules and regulations.
- Make every effort to maintain good academic standing.

Given the internet and easy access to information and knowledge sources, the University is committed to students' learning in an ethical manner. For all academic assignments, project work, and presentations, students need to ensure that due acknowledgement is given to the source of any information, which they incorporate in their work. The following are some examples of academic misconduct:

- Cheating/using unfair means in examinations.
- Significant paraphrasing in written academic work that is unacknowledged.
- Unacknowledged use of information or ideas.
- Citing sources which student has not read or referred to.
- Breaching the word limit of assignments and mentioning wrong word count.
- Plagiarism.

Plagiarism: Plagiarism is a serious academic offense. Plagiarism is the use of someone else's ideas, words, projects, artwork, phrasing, sentence structure or other work without properly acknowledging the ownership (source) of the property (item). Plagiarism is dishonest because it misrepresents the work of someone else as one's own. It is intellectual theft as it robs others of credit for their work. Plagiarism takes many forms including:

- Using someone else's words without putting those words in quotation marks and providing full information about their source, sufficient information so that another person could easily locate the words that are being quoted, whether it is in an article, a book, or on the web.
- Using unique, original ideas, phrases, sentences, paragraphs, or other materials, etc. from a single source or a variety of sources such as a text, journal, web page, electronic source, design, artwork, etc. in one's work without citing all sources. For a student found plagiarizing, the punishment will be a failing grade in the assignment without the right to redo the assignment up to a failing grade in the course.

Examples of Cheating: Acts of cheating include, but are not limited to:

1. Copying from another student's paper during an exam, or allowing or encouraging another student to copy from your paper during an exam.
2. Having someone else take your exam in your place, or taking an exam for someone else.
3. Obtaining unauthorized access to exams and accepting exams obtained by unauthorized access.

Examples of Plagiarism. Acts of plagiarism include, but are not limited to, the following:

1. Handing in as 'original', work prepared by someone else or preparing/completing someone else's work.
2. Copying from a book or other publication without citing sources.
3. Using the same work to satisfy the requirements of two or more courses (during the same or different terms).
4. Having someone else rewrite a rough draft or rewriting a rough draft that is not your own work.

Violations of plagiarism are subject to evaluation according to the criterion of "reasonable doubt". The student's right to appeal and the procedures to be followed in carrying out the appeal of the University's decision is clearly stated in the *Student Handbook*.

Any violations of the University's academic rules, regulations or directives are reported to the University and may result in disciplinary measures as outlined in the *Student Handbook*.

Please refer to the relevant section in the *Student Handbook* and ensure a clear understanding of the provisions of the University honor code and honor system in order to avoid infringement of the policy and attendant penalization.

Electronic Devices: Laptops in the classroom must be used for academic purposes only. Silence your mobile phones before class starts.

Classroom Etiquette: Everyone is expected to behave politely and considerately. You should respect each other and your teacher by arriving on time, not chatting with your seat mates while the teacher is talking, and not leaving the classroom once class starts. Leaving the classroom during class is especially disruptive and disturbing and should be done only for restroom emergencies.

Concerns about grades or other course matters: Students are responsible for their learning experiences. If you are concerned about a class matter, first discuss it with the instructor. If the matter is not resolved, the next step is to meet with the Program Coordinator. If you still have a concern, meet with the Dean. The matter is likely to be resolved before it reaches that point, but if it is not, then the following positions are next on the organization chart: the Associate Provost for Academic Affairs, and, finally, the Provost. Students who decide to "jump to the top" will be referred back to the appropriate next step.

Assignments: University policy is that assignments are due on the date assigned. Instructors may refuse to accept late assignments or lower the grade that would be otherwise given.

Attendance: Absences have a direct negative effect on your grade! In the event that you miss a class, you are responsible for the material covered in that class (announcements, handouts, assignments, etc.) and for preparation for the following class. It is your responsibility to find out what assignments were missed. It is important that you attend all classes. If you are ill or have a valid reason for your absence, you must supply an excuse to submit missed or late work without penalty. Excessive absences will be penalized with a grade reduction.