University of Jordan
School of Engineering
Department of Electrical Engineering
1st Term – A.Y. 2017-2018

Course: Smart Grids and Sustainable Electricity– 0903780 (3 Cr. Course)

Catalog Data: Smart grid. Distributed low carbon technologies. Solar photovoltaic generation. Wind generation. Electrical vechicles and heat pumps. Active network management. Congestion and voltage control. Sustainable electricity systems. Low carbon thermal generation. Thermal storage. Heat networks. Operational reserve. Capacity credit. Storage facilities. Demand response.

Prerequisites by Course: None

Textbook: None

References:

[1] M. H. Bollen, "The smart grid: Adapting the power system to new challenges," 2011.
[2] Ekanayake, N. Jenkins, K. Liyanage, J. Wu, and A. Yokoyama, “Smart grid: technology and applications,” 2012.
[3] P.Mancarella and G. Chicco, "Distributed multi-generation systems: energy models and analyses", 2009.
[4] W. H. Kersting, "Distribution system modeling and analysis," 2012.
[5] D. S. Kirschen and G. Strbac, “Fundamentals of power system economics,” 2004.

Schedule & Duration: 16 Weeks, 48 lectures, 50 minutes each (including exams).

Course Objectives: This course provides students with the concepts of smart grids and sustainable electricity systems. This course will also explore the benefits from different smart-grid technologies and strategies to facilitate the integration of low-carbon technologies into future low-carbon networks.

Course Learning Outcomes and Relation to Program Learning Outcomes:

1. Describe the challenges of existing and future power systems. [i, ii]
2. Understand the concepts and the drivers of smart grid and their impacts on the operation and planning of power systems. [i, ii]
3. Understand the concept of active network management in future distribution networks including voltage control and congestion management schemes. [i, ii]
4. Assess the technical, economic and environmental impacts of demand response and energy storage on future power systems. [i, ii, iii]
5. Evaluate the cost and benefits of different electricity, heat and transport low-carbon technologies. [i, ii, iii]

Course Topics:

	Topic Description	Hrs
1.	Future challenges for transmission and distribution systems: operational and planning perspectives. Introduction to smart grids: Definitions, drivers and elements.	6
2.	Distributed low carbon technologies: Introduction to distribution networks and distributed low-carbon technologies (PV, electrical vehicles and electrical heat pumps). Issues for low-carbon technologies connections.	10
3.	Active Network Management (ANM): Definition, elements, congestion and voltage control of distribution networks with DG: Generation curtailment, reactive power control, coordinated voltage control. Active management of low voltage networks with low-carbon technologies.	8
4.	Sustainable Electricity Systems: Introduction to nuclear, carbon capture and storage low-carbon thermal generation. Wind energy. Introduction to cogeneration, tri-generation, thermal storage and heat networks. Integration issues of renewables on power systems. Environmental models and metrics.	10
5.	Role of storage facility and Demand response: Introduction. Contribution from demand response and storage to low carbon system operation. Role of Aggregators. Regulatory frameworks.	8

Ground Rules: Attendance is mandatory and highly encouraged. To that end, attendance will be taken every lecture. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessments: Exams, projects, and term papers.

Grading policy:

Semester work	60 %
Final Exam	40 %
Total	100%

Computer Usage: students are encouraged to write/use computer programs for mathematical modelling.

Attendance: Class attendance will be taken and the University policy on absence will be followed.

Instructor:

Instructor Name	Office	Ext.	E-mail
Dr. Sahban Alnaser	EE	--	S.alnaser@ju.edu.jo

Program learning outcomes

i	Demonstate a sound, in-depth and up-to-date technical knowledge in the field of specialization.
ii	Ability to identify and solve engineering problems in their chosen field of study.
iii	Acquir the skills for continued professional development and independent self-study.
iv	Demonstrate the ability to communicate technical informatiom effectively and professionally both orally and in writing.

Last Update: 2017-03-27