Alternative Energy Systems and Modeling

A. Level of the Course

Advance

B. Who Should Attend?

Students who are interested in studying alternative energy sources, power electronics, energy management, grid connection of renewables should attend the course. The course will be held on cad lab and all the students have to know basic computer skills. The modelling will be done by using MATLAB Simulink so the ones who are not familiar with computers should not attend. Also it should be better for attendees to have basic knowledge at least one of the topics; alternative energy systems, power electronics, energy measurement and management.

C. Aim of the Course

This 45 hours course discusses how to model alternative energy systems in the Simulink® environment using Simscape Power Systems™ (formerly SimPowerSystems™).

D. Sufficiency of the lecturer
1. Journals of the lecturer about the courses

a) VURAL B., BOYNUEGRİ A. R., NAKİR I., ERDİNC O., BALİKCİ A., UZUNOGLU M., GORGUN H., DUSMEZ S., "Fuel Cell and Ultra-Capacitor Hybridization: A Prototype Test Bench Based Analysis of Different Energy Management Strategies for Vehicular Applications" Int. Journal of Hydrogen Energy, vol. 35 no.20, pp 11161-11171, October 2010.

b) ERDINC, O., ELMA, O., UZUNOGLU, M., SELAMOGULLARI, S., VURAL, B., UGUR, E., **BOYNUEGRI, A.R.,** DUSMEZ, S., "Experimental Performance Assesment of an Online Energy Management Strategy for Varying Renewable Power Production Suppression" International Journal of Hydrogen Energy, vol.6 no.37, pp 4737-4748, March 2012.

c) **BOYNUEGRİ, A.R.,** VURAL, B., TASCİKARAOGLU, A., UZUNOGLU, M., YUMURTACI R., "Voltage regulation capability of a prototype Static VAr Compensator for wind applications", Applied Energy, vol.93, pp 422-431, May 2012.

d) TAŞCIKARAOĞLU, A., **BOYNUEĞRİ, A. R.**, UZUNOĞLU, M., "A demand side management strategy based on forecasting of residential renewable sources: A smart home system in Turkey." Energy and Buıldıngs, vol.80, pp 309-320 Sep. 2014.

e) Arabul Keskin, F., Arabul, A.Y., Kumru, C.F., **Boynuegri, A.R.**, "Providing Energy Management of a Fuel Cell-Battery-Wind Turbine-Solar Panel Hybrid Off Grid Smart Home System", Int. Journal of Hydrogen Energy. **(Accepted for Publication).**

f) **Boynuegri, A.R.** "A Power Management Unit With a Polarity Changing Inverter for Fuel Cell/Ultracapacitor Hybrid Power Systems", Int. Journal of Hydrogen Energy Doi: 10.1016/j.ijhydene.2017.05.171 .

2. International Conference papers

a) TASCIKARAOGLU A., UZUNOGLU M., TANRIOVEN M., **BOYNUEGRI A.R.**, ELMA O., "Smart Grid-Ready Concept of a Smart Home Prototype: A Demonstration Project in YTU", Power Engineering, Energy and Electrical Drives Conferance, Istanbul (TR), May. 2013.

b) **BOYNUEGRI A.R.**, YAGCITEKIN B., BAYSAL M., KARAKAS A., UZUNOGLU M., "Energy Management Algorithm for Smart Home with Renewable Energy Sources", Power Engineering, Energy and Electrical Drives Conference, Istanbul (TR), May. 2013.

c) ERDINC, O., CATALAO, J. P., UZUNOĞLU, M., **BOYNUEĞRI, A. R.**, "Smart insular grids: Opportunities and challenges" IEEE 3rd International Conference on Electric Power and Energy Conversion Systems (EPECS), Istanbul (TR), 2013.

d) ATES, Y., **BOYNUEĞRI, A. R.**, UZUNOĞLU, M., KARAKAŞ, A. "The Transient Reactive Power Regulation Capability of SVC for Large Scale WECS Connected to Distribution Networks" World Academy of Science, Engineering and Technology, International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering, pp. 792-798. Waset, Paris (France), August 2015.

e) ARABUL, F. K., SENOL, I., ARABUL, A. Y., **BOYNUEĞRI, A. R.**, "Providing Energy Management of a Fuel Cell-Battery Hybrid Electric Vehicle. Providing Energy Management of a Fuel Cell-Battery Hybrid Electric Vehicle" Waset ICEEE 2015 : 17th International Conference on Electrical and Electronics Engineering, pp. 935-939, Paris (France), August 2015.

f) ARABUL, F. K., ARABUL, A. Y., KUMRU, C. F., **BOYNUEĞRI, A. R.**, "Providing Energy Management Of A Fuel Cell-Battery-Wind Turbine-Solar Panel Hybrid Grid Independent Smart Home System" International Green Energy Conference & Euro-Mediterranean Hydrogen Technologies Conference ETRERA 2020, Tunusia, May 2016.

g) **Boynuegri, A. R.**, Eren Y., "A power management unit with a polarity changing inverter for fuel cell/ultracapacitor hybrid power systems." International Green Energy Conference & Euro-Mediterranean Hydrogen Technologies Conference ETRERA 2020, Tunusia, May 2016.

3. National Conference papers

a) **BOYNUEĞRİ A.R.**, VURAL B., UZUNOĞLU M., "Rüzgar Santrallerinin Şebekeye Bağlanmasi ile Oluşan Gerilim Dalgalanmalarina SVC ile Çözüm Getirilmesi" Nükleer Yenilenebilir Enerji Kaynakları Sempozyumu Nüyek 2009, Ankara, Ekim 2009.

b) ARABUL, A.Y. , SARUL, M.H. , **BOYNUEĞRİ A.R.** , KUMRU C.F., "Evsel Bir Yük Talebinin Karşılanmasında Yakıt Pili Kullanılmasına Yönelik Bir Benzetim Çalışması" Elektrik Elektronik Ve Bilgisayar Mühendisliği Sempozyumu ELECO 2012, Bursa, Türkiye, Aralık 2012.

4. Patent

a) UZUNOĞLU M., **BOYNUEĞRI A.R.**, ELMA, O., TASCİKARAOGLU, A.,"A SMART BUILDING SYSTEM WITH ENERGY MANAGEMENT ABILITY, [SYSTÈME DE CONSTRUCTION INTELLIGENT AVEC CAPACITÉ DE

E. Scoring

Quiz (10 every week)   %05
Projects (will be presented at last week)   %15
I. midterm exam   %20
II. midterm exam   %20
Final Exam   %40

F. Weekly Course Plan

Weeks	Subjects
1	Introduction to MATLAB&Simulink
2	System modeling and simulation based Simulink applications
3	System modeling and simulation based Simulink applications
4	Modeling for general engineering and dynamic analysis at Simulink
5	Modeling for general engineering and dynamic analysis at Simulink
6	MATLAB/Simulink/SimpowerSystems for Electrical Engineering applications
7	MATLAB/Simulink/SimpowerSystems for Electrical Engineering applications
8	MATLAB/Simulink/SimpowerSystems for Electrical Engineering applications
9	I Midterm Exam
10	Simulation of systems with batteries and photovoltaic

systems (MPPT)

11	Simulation of systems with photovoltaic systems and Fuel cells (off-grid)
12	Simulation of systems with photovoltaic systems and Fuel cells (on-grid)
13	II. Midterm Exam
14	Simulation of systems with Wind Turbines
15	Project presentations

This weekly plan may include the subjects partially given below according to attendees' performance.

Subjects; Simulink basics, Creating single-phase systems with passive elements and measuring electrical parameters, Modelling load and sources using controllable current and voltage sources, Modeling Fundamental DC-DC Power Converters, Modeling Fundamental Rectifiers, Modeling Inverters, Creating three-phase systems with passive elements, Creating three-phase systems with electrical machines, Analyzing and controlling electrical power systems, PI controllers, Modeling three phase power electronic components, Reactive power compensation, Harmonic filtering, On-grid, off-grid solar systems, Wind turbine systems, Speeding up simulation of electrical models, Hydrogen energy systems, Batteries.

G.   Useful sources

1. https://www.mathworks.com/support.html?s_tid=gn_supp

2. Mehmet Uzunoğlu, Ali Kızıl, Ömer Çağlar Onar Her Yönü ile Matlab

3. Perelmuter, Viktor Renewable Energy Systems Simulation with Simulink® and SimPowerSystems™