School of Electrical Engineering
Department of Electric Power Systems
ELECTRICITY MARKET RESEARCH GROUP
www.hesamzadeh.com

EG2060 ELECTRICITY MARKET ANALYSIS
Syllabus spring 2014

1. Contact persons

The course latest news can be found at the course web page at *https://www.kth.se/social/course/EG2060/*. It is also possible to contact:

Lecturers	Docent Mohammad R Hesamzadeh (mrhesa@kth.se)	MH
	Prof Lennart Söder (mrhesa@kth.se)	LS
Teaching Assistants	Ekaterina Moiseeva (moiseeva@kth.se)	EM
	Yaser Tohidi (tohi@kth.se)	YT
Lab Assistants	Mohamadreza Baradar (baradar@ee.kth.se)	MB
	Mahir Sarfati (sarfati@kth.se)	MS
	Kristina Östman (kostm@kth.se)	KÖ
	Yelena Vardanyan (yelenav@kth.se)	YV

1. Outline of the course

The course "Electricity Market Analysis" provides post-graduate students with an advanced knowledge of the theory of liberalized electricity markets. The course starts with introductions to fundamental concepts in microeconomics, electricity networks. It then provides an overall overview of the liberalized power markets. During the course, post-graduate students employ different optimization and equilibrium approaches to analyze variety of electricity market issues. The course is recommended for students with electrical engineering, economics, or mathematics background.

2. Learning Outcomes

The aim of the course is that the students learn methods and models for how the price is formed in an electricity market. The course comprises background information about possible ways to design an electricity market, impact from congestions, treatment of externalities such as methods to limit emissions, risk analysis and market power. Applied optimization is shown to be one suitable method to simulate market behaviour.

To pass the course, the students should show that they are able to:
- describe the principles of how an electricity market can be organised,
- describe treatment of flexible load,
- describe methods to handle congestion in power markets,
- describe methods for analyzing prices in markets with limited competition,
- describe basic methods for financial risk management in power markets,
- describe methods to handle externalities, such as environmental problems, in electricity markets,
- perform calculations of pricing in small systems with one of the above characteristics.

To receive a higher grade students should also show that they are able to:
- analyze pricing in larger power systems with combinations of several of the above named characteristics,
- apply methods for analyzing the trade off between low prices and reliability in larger power systems,

- formulate market simulation problems with mathematical expressions,
- analyze investment dynamics in electricity markets.

3. Course Registration

All students have to register for the course under *www.ee.kth.se/lab*. Check that your email address is correct.

4. Examination

The Master Level of the course gives 7.5 credits and it is examined by lab projects (20% of the total grade) and a written exam (80% of the total grade).

4.1 The exercises, quizzes and worked examples are designed to help students in understanding different concepts of the course. There are five quizzes scheduled for this course. These quizzes do not have any share of the final grade and are just for students to examine their knowledge of the course.

4.2 Projects in Electricity Market Lab are designed to give students hands-on experience on different topics of the course. For every lab project, each student individually submits the report where he or she explains the approach for doing the project. The template for the report with the information on necessary sections will be available on the course website. All projects need to be done using the Plexos software. An introductory workshop on Plexos will be given to the students in the beginning of the course and the pdf version of the tutorial will be posted on-line. Teaching assistant hours will take place in **Students Room** (1st floor, Teknikringen 33), where students can ask questions they have on the projects. The project reports (total 100 points) account for 20% of the final grade. This is valid for the exams in May 2014 and August 2014 respectively.

The headlines of the projects are:
- (1) Economic Dispatch (40 points)
- (2) Risk Management (20 points)
- (3) Market Power and Game Theory (20 points)
- (4) Generation Expansion Planning (20 points)

4.3 Exam is written and is given twice a year. To attend the exam it is **required to register** in advance using KTH "My pages", which can be accessed from the student web site (www.kth.se/student/minasidor). The premises of the exam can be changed depending on the number of examinees. Check the course web page for detailed information before the exam! (The central KTH exam schedule is not always updated in time.)

To pass it is necessary to score at least 51 points out of 100. Examinees who have failed the exam but are close to the requirement for passing (i.e., 45-50 points) may write a supplementary test. If the result of this test is approved, the student will get the grade E. The date of the extra test is decided by the course examiner after consulting the concerned students. However, the student must notify his or her intention to write the supplementary test no later than one month after the exam.

The following aids are allowed at the exams and extra tests:
- Calculator without information relevant to the course.
- One **handwritten**, **single-sided** A4-page with **your own** notes (original, not a copy), which should be handed in together with the exam.

Table 2: Grading

Total score (Lab + Exam)	Grade
91-100	A
81-90	B
71-80	C
61-70	D
51-60	E
45-50	Fx
0-44	F

The PhD level of this course gives 10 credits to the interested post-graduate students. The extra 2.5 credits are evaluated based on a research paper carried out by the post-graduate student. The interested students should set an appointment with Dr Mohammad R Hesamzadeh to discuss a research topic for their research papers.

5. Literature

The main literature sources for this course are:
(1) D. R. Biggar, M. R. Hesamzadeh, "The Economics of Electricity Markets", IEEE-Wiley Press, 2014
(2) L. Söder, "Electricity Market Analysis", Compendium, KTH Publishing house.
(3) Reading list

The following material will be handed out during the course and/or published on the course home page as they come along:
   • Information on the lab projects,
   • Model exams.

6. Computer Account

Those who want to use the computers in the EPS Students room for working on their projects will need a computer account from the department. The accounts are managed by Peter Lönn (Teknikringen 33, room 3337), who usually will be at his office after 13:00.

7. Course Evaluation Committee

The online forms are prepared for course evaluation. These forms should be filled in by each student.

Also, we need a few students who are willing to participate in the course evaluation committee. The committee is meeting shortly after the ordinary exam. This will be done during a Lunch organised by the Department of Electric Power Systems. Students who are interested in participating can contact the examiner.

8. Preliminary Schedule

The lectures will be given in English and in **room H1**. Plexos tutorial and teaching assistant hours will take place in **Students Room** (1st floor, Teknikringen 33). The preliminary schedule is listed below.

Week 13, 2014			Lecturer	Topic	Room
Mon	24 mar	15:00-17:00	MH	Introduction to electric power systems	H1
Tue	25 mar	15:00-17:00	MH	Introduction to microeconomics	H1
Thu	27 mar	10:00-12:00	MH	Introduction to electricity markets	H1
Thu	27 mar	13:00-15:00	MH	Efficient dispatch of electricity generation with no transmission constraint	H1
Fri	28 mar	13:00-15:00	MH	Market-based dispatch of electricity generation with no transmission constraint + Introducing the project "Economic Dispatch"	H1

Week 14, 2014					
Mon	31 mar	15:00-17:00	YV	Introduction to PLEXOS software	SR
Wed	02 apr	10:00-12:00	MH	Efficient short-term operation in the presence of transmission congestion 1	H1
Thu	03 apr	10:00-12:00	MH	Efficient short-term operation in the presence of transmission congestion 2	H1
Fri	04 apr	13:00-15:00	MH	Basic concepts of the risk management + Introducing the project "Risk Management"	H1

Week 15, 2014					
Mon	07 apr	08:00-10:00	MH	Hedging for generators and loads with no transmission constraints	H1
Mon	07 apr	15:00-17:00	MB, MS, KÖ	TA / Plexos project: "Economic Dispatch"	SR
Tue	08 apr	13:00-15:00	MH	Hedging in the presence of transmission constraints	H1
Wed	09 apr	08:00-10:00	MH	Game Theory and Equilibrium Problems 1	H1
Wed	09 apr	13:00-15:00	MH	Game Theory and Equilibrium Problems 2	H1

Week 16, 2014					
Mon	14 apr	08:00-10:00	LS	Congestion management 1	H1
Wed	16 apr	10:00-11:00	YV	TA / Plexos project: "Risk Management"	H1
Wed	16 apr	13:00-15:00	MH	Market power + Introducing the project "Market Power and Game Theory"	H1
Thu	17 apr	10:00-12:00	LS	Congestion management 2	H1

Week 17, 2014					
Tue	22 apr	15:00-17:00	MH	Market power, nodal pricing, and transmission congestion 1	H1
Wed	23 apr	15:00-17:00	MH	Market power, nodal pricing, and transmission congestion 2	H1
Thu	24 apr	10:00-12:00	MH	Measuring, forecasting, and mitigating market power 1	H1
Thu	24 apr	15:00-16:00	EM	TA / Plexos project: "Market Power and Game Theory"	SR
Fri	25 apr	13:00-15:00	MH	Measuring, forecasting, and mitigating market power 2	H1

Week 18, 2014					
Mon	28 apr	15:00-17:00	MH	Measuring, forecasting, and mitigating market power 3	H1
Tue	29 apr	15:00-17:00	MH	Efficient investment in electricity generation + Introducing the project "Generation Expansion Planning"	H1
Wed	30 apr	10:00-12:00	MH	Market-based investment in electricity generation	H1
Wed	30 apr	13:00-15:00	MH	Transmission investment	H1

Week 19, 2014					
Tue	06 may	15:00-17:00	MH	Coordination of transmission and generation investment	H1
Wed	07 may	15:00-17:00	MH	Is there a role for entrepreneurial market-based transmission investment?	H1
Fri	09 may	10:00-11:00	YT	TA / Plexos project: "Generation Expansion Planning"	SR

Week 20, 2014					
Mon	12 May	13:00-15:00	MH	Transmission Network Regulation	H1
Tue	13 May	15:00-17:00	-	Reserve	H1
Wed	14 May	08:00-10:00	-	Reserve	H1
Thu	15 May	13:00-15:00	-	Reserve	H1

Ordinary exam: Monday 2 June, 14 – 19, D32, D33, D34, D35
Last day to **sign-up for the exam**: 17th May. Each student is then assigned a seat.