

# 2014-2015 SHORT SIGNATURE SHEET




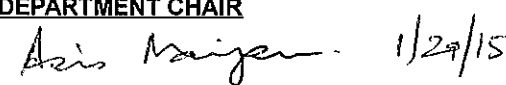
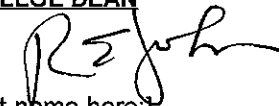
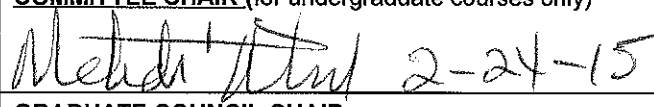
UNC CHARLOTTE

Date: 1-12-15

Subject: New course proposal for ECGR 4172

Originating Department: Electrical and Computer Engineering

TYPE OF PROPOSAL: UNDERGRADUATE \_\_\_\_\_ GRADUATE \_\_\_\_\_ UNDERGRADUATE & GRADUATE X  
 (Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE FORWARDED	COMMENTS: APPROVED, APPROVED WITH REVISIONS, ETC.	SIGNATURES
			<b>PERSON ORIGINATING PROPOSAL</b>  [print name here:] <u>BADRUL CHOWDHURY</u>
		Approved	<b>DEPARTMENT CHAIR</b>  [print name here:] <u>ASIS NASIPURI</u>
		Approved	<b>COLLEGE CURRICULUM COMMITTEE CHAIR</b> [print name here:]
	2/25/15	Approved	<b>COLLEGE DEAN</b>  [print name here:]
		Approved	<b>GENERAL EDUCATION</b> (if applicable; for General Education courses only) [print name here:]
		Approved	<b>UNDERGRADUATE COURSE &amp; CURRICULUM COMMITTEE CHAIR</b> (for undergraduate courses only)  [print name here:] <u>2-24-15</u>
		Approved	<b>GRADUATE COUNCIL CHAIR</b> (for graduate courses only)
			<b>FACULTY GOVERNANCE ASSISTANT</b> (received and processed in Academic Affairs)



# UNC CHARLOTTE

## SHORT FORM COURSE AND CURRICULUM PROPOSAL

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\*To: Dr. Mehdi Miri

From: Badrul H. Chowdhury, ECE

Date: 1/12/15

Re: New course proposal for ECGR 4172

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The Short Form is used for minor curriculum changes. Minor changes may include:

- Changes to course numbering (note: must follow Course Numbering Policy)
- Editorial changes to current catalog copy
- Individual new courses (undergraduate only)
- Other small changes that have limited to no impact on other departments or units

Submission of this Short Form indicates review and assessment of the proposed curriculum changes at the department and collegiate level either separately or as part of ongoing assessment efforts.

\*Proposals for undergraduate courses should be sent to the Undergraduate Course and Curriculum Committee Chair. Proposals related to both undergraduate and graduate courses, (e.g., courses co-listed at both levels) must be sent to both the Undergraduate Course and Curriculum Committee and the Graduate Council.

**SUMMARY:** State clearly and concisely the proposed changes. Please give a brief statement as to why the change is being proposed.

The Electrical and Computer Engineering Department proposes to add a new course, ECGR 4172: Energy Markets. Energy markets, such as the oil, natural gas and coal markets thrive on supply and demand

Revised 11/20/13  
OAA/mjw

dynamics. Although the same paradigm does not always apply to electricity markets, the latter still depends, to a large part, on the availability of fossil fuels. Therefore, energy value chains, costing, levelized cost of energy, risk management, etc. become critically important. There is a growing concern, though, on the impact of fossil fuels, particularly on the environment, and as such, there is now a tremendous interest in renewable forms of energy, such as solar and wind energy for electricity generation. However, there are many operational and regulatory issues that generally accompany such types of generation in competitive markets. This course will attempt to fill this need.

This course counts as one of the electives for the undergraduate Power and Energy Concentration in the ECE Department. This will be a 3 credit class.

**FOR CONSULTATION WITH OTHER DEPARTMENTS:**

1. Does the proposed change affect other departments (including additions and/or changes to degree requirements or prerequisites offered in other departments)?

\_\_\_\_\_ Yes     No

2. If Yes, please list the other departments affected by the proposed change:

3. Have you consulted with each department listed in item 2 regarding the proposed change?

\_\_\_\_\_ Yes    \_\_\_\_\_ No

Result(s) of Consultation(s) (please attach documentation):

For a new course or for major modification of an existing course, include Consultation on Library Holdings.

**RESOURCES:**

1. For a new course or revisions to an existing course, check all the statements that apply:

This course will be cross listed with another course.

There are prerequisites for this course.

\_\_\_\_\_ There are co-requisites for this course.

\_\_\_\_\_ This course is repeatable for credit.

\_\_\_\_\_ This course will affect the number of credits hours for its program.

\_\_\_\_\_ This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

\_\_\_\_\_ This proposal will alter an agreement with a North Carolina community college.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

2. Indicate the additional resources required, if any, to implement and maintain the proposed change. NONE

**CREDIT HOUR (Mandatory if new and/or revised course in proposal): 3**

Review statement and check box once completed.

- The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of a credit hour.

**PROPOSED CATALOG COPY:** For existing courses copy and paste the current catalog copy and use the Microsoft Word “track changes” feature (or use red text with “~~strikethrough~~” formatting for text to be deleted, and adding blue text with “underline” formatting for text to be added). For new courses, draft comprehensive catalog copy.

**ECGR 4172. Energy Markets. (3)** Prerequisite: ECGR 4171. Energy and power systems in regulated and competitive environments and implications on business decisions for firms in these industries. Topics include: mechanism of energy markets; comparative market systems; determination of prices under different market structures; gas, oil, coal, and electricity market architecture; electricity market design; dispatch and new build decisions; smart grid and renewable energy in electricity markets; risk and risk management in energy including demand and price volatility and use of financial derivatives; and the impact of financial market trends and current and proposed policies on the energy industry.

**ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY):** Does the proposed change impact an existing Academic Plan of Study?

- Yes. If yes, please provide updated Academic Plan of Study in template format.  
 No.

**STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE):** Does this course or curricular change require a change in SLOs or assessment for the degree program?

- Yes. If yes, please provide updated SLOs in template format.  
 No.

**TEXTBOOK COSTS:** It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?

- Yes. Briefly explain below.  
 No. Briefly explain below.

**The textbook currently in use is an ebook available through the library free of cost to the students.**

**IMPORTANT NOTE:** A Microsoft Word version of the final course and curriculum proposal should be sent to [facultygovernance@uncc.edu](mailto:facultygovernance@uncc.edu) upon approval by the Undergraduate Course and Curriculum Committee and/or Graduate Council chair.

# Energy Markets Syllabus

EMGT 5962/MBAD 6962 (also cross-listed as SEGR 4962, ECGR 4090, ECGR 5090, PPOL 8000, INES 8090)

Profs. Chowdhury & Schwarz

Spring 2015

**Instructors:** Prof. Badrul H Chowdhury  
**Phone:** (704) 687-1960 **Fax:** (704) 687-5588  
**E-mail:** [b.chowdhury@uncc.edu](mailto:b.chowdhury@uncc.edu)  
**Office:** EPIC 1162  
**Hours:** M & T: 11:00 am – 12:00 pm

Prof. Peter M. Schwarz  
**Phone:** (704) 687-7614 **Fax:** 7-1384  
**E-mail:** [pschwarz@uncc.edu](mailto:pschwarz@uncc.edu)  
**Office:** FRI 223A  
**Hours:** T Th 11-12 am, 1-1:30 pm  
and by appointment

## Course Description:

Energy and power systems in regulated and competitive environments and implications on business decisions for firms in these industries. Topics include: mechanism of energy markets; comparative market systems; determination of prices under different market structures; gas, oil, coal, and electricity market architecture; electricity market design; dispatch and new build decisions; smart grid and renewable energy in electricity markets; risk and risk management in energy including demand and price volatility and use of financial derivatives; and the impact of financial market trends and current and proposed policies on the energy industry.

**Prerequisite:** Basic math (including elementary Calculus, and economics (including Principles of Microeconomics) or consent of instructor(s)). SEGR 4961/EMGT 5961 Introduction to Energy Systems or ECON 5181 Energy and Environmental Economics. **Corequisite:** If students have not completed SEGR 4961/EMGT 5961 Introduction to Energy Systems or ECON 5181 Energy and Environmental Economics, they should enroll in one of these courses concurrently with this one; or permission of instructor(s).

**Required Textbook:** *Fundamentals of Power System Economics*, D. Kirschen, G. Strbac, John Wiley & Sons, Ltd., 2004 (printed on demand), ISBN: 978-0-470-84572-1, last reprinting March 2010.

This text can be viewed online at no charge via a new limited free service offered by the UNC Charlotte library.  
URL: <https://librarylink.uncc.edu/login?url=http://onlinelibrary.wiley.com/book/10.1002/0470020598>.

Students who follow the link from a non-UNCC IP address will be prompted to log in with their NinerNet username and password before they are connected to the publisher's site.

## Reference Textbooks:

1. *Power System Economics: Designing Markets for Electricity*, Steven Stoft, May 2002, Wiley-IEEE Press, ISBN: 978-0-471-15040-4
2. *Energy Markets: Price Risk Management and Trading* (Wiley Finance), Tom James, December, 2007, Wiley; ISBN-13: 978-0-470-82225-8
3. *Power Markets and Economics: Energy Costs, Trading, Emissions*, Barrie Murray, March 2009, ISBN: 978-0-470-77966-8
4. *Operation of Restructured Power Systems*, Bhattacharya, Bollen, Daalder. Kluwer Academic Press, 2001.

5. *Electricity Economics: Regulation and Deregulation*, Geoffrey Rothwell and Tomas Gomez, 2003, ISBN 0-471-23437-0 (printed on demand)
6. *International Energy Markets: Understanding Pricing, Policies and Profits*, Carol A. Dahl, Pennwell Corp , March 2004, ISBN: 978-0878147991
7. *Understanding Today's Electricity Business*, John Ferrare and Bob Shively, Enerdyanics, San Francisco, 2008
8. *Investing in Energy*, Gianna Bern, Bloomberg Press, 2011
9. *Power System Operations and Electricity Markets*, Fred Denny and David Dismukes, CEC, 2002, ISBN: 9780849308130
10. *Electricity Markets and Power System Economics*, Deqiang Gan, Donghan Feng, Jun Xie, CEC, 2013, ISBN: 9781466501690
11. *Evolution of Global Electricity Markets*, Fereidoon Sioshansi, Elsevier, 2013, ISBN: 9780123978912

**Supplementary Materials:** Lecture notes and non-textbook readings (from among the listed readings below) will be provided through the course website on Moodle2. We anticipate using clickers, which can be purchased (new or used) or rented at the University Bookstore. You will need a clicker for class participation.

**Learning Objectives:**

After completing the course, the students will be able to

1. Have a working knowledge of the mechanisms of energy markets
2. Understand supply and demand dynamics
3. Understand marginal cost
4. Understand electricity market economics and the constitution of locational marginal price
5. Understand the impact of transmission congestion on pricing
6. Understand risk management policies.

## Course Requirements:

- (1) This class is offered as both an on-campus face-to-face delivery and an online version. Online students don't have to be present in class to take this course if they sign up for the online section. Each lecture will be recorded using Panopto software. The software is maintained by Classroom Support. All students (both on-campus and on-line) will be able to watch the recording on Moodle shortly after the lecture ends.
- (2) Regular, on-time attendance, including arriving on time, staying until the end of class, and not leaving class except during breaks, is a requirement for on-campus students. There will be a participation grade each week based on attendance, being on time and staying until the end of class, and answering questions during class on that day's material.

A student whose religion requires that (s)he miss class for a religious observance must fill out a "Request for Religious Observances" form and submit it prior to the census date for that semester to receive an excused absence for that event. The University's inclement weather number is 704-786-2877.

For *online students*, it is expected that they will watch the lecture on the day the lecture is recorded. However, if that's not possible, they should finish watching the lecture before the next lecture. There will not be a participation grade for online students. Instead, each of the three exams will count 25% for online students.

- (3) There will be two in-course examinations and a final examination. Details will be distributed.
- (4) During the semester undergraduate students will be required to present a ten-minute presentation (no more than 5 slides) on some aspect of energy markets at your employer. If you are not currently working you may choose to focus on any organization with operations in NC or SC. The goal of your presentation should be to educate us about a practice that needs improvement and possible solutions or about a model energy markets practice at your organization that you think others would benefit from learning about. Depending on class size, these may be team presentations.

On-campus graduate students will do one team project. Teams will be required to submit a written version of the project and present their project to class on the last day of class. Online graduate students will do a solo project (not team), and will not present it in class. Detailed instructions will be distributed separately.

- (5) Special requirements for *on-line students* for exams, homework, and projects.  
For on-line students, the exams and homework submission are handled via Moodle. The exams are emailed to all distance students at a pre-set time of the exam day. We anticipate all exams will be take-home exams, in which case online students will have the same amount of time as the on-campus students to take the exam. Moodle will not accept submissions past a specific time. Homework submissions work in a similar fashion - students have to upload their scanned homework to Moodle by the submission deadline. You must name your file as 'HW#\_Lastname\_Firstname' or 'Exam#\_Lastname\_Firstname' where # is replaced by the assignment number, Lastname and Firstname are your last and first names. You must also scan into a pdf document before uploading the assignment. Online students will turn in a solo term project, but will not present it in class.
- (6) Graduate and undergraduate sections will be taught jointly, but obtaining graduate credit will require the inclusion of more advanced assignments on the homework, project, and exams.

**Grading:**

Exam I	20% (25% for on-line students)
Exam II	20% (25% for on-line students)
Final Exam	25%
Homework	15%
Presentation/Project	10%
Participation Grade	10% (0% for on-line students)

The grading scale is as follows:

A = 90 -100	B = 80 - 89.99	C = 70 - 79.99	D = 60 - 69.99
F = < 60	Graduate students	U = < 70	

**Moodle Environment:**

This course includes a significant and required use of the Moodle on-line environment. You must be able to access course materials and announcements on-line. You can login to Moodle here: <https://moodle2.uncc.edu/login/index.php>

**Email:**

You *must* be reachable via your UNC Charlotte email account. All course communication will be directed to you at your UNC Charlotte email address. If you primarily use a different email account, then you should forward your email to your primary account.

**Diversity:**

The Belk College of Business and the William Lee States College of Engineering strive to create an inclusive academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

**Academic Honesty:**

You are required to complete 100% of your own work in this class (including making a full contribution to the team project). Cheating violates the UNC Charlotte Code of Academic Integrity and may result in course failure, suspension, and/or expulsion. For more information see the following: <http://integrity.uncc.edu/>

**Disability and Impairment Accommodation:**

If you require course adaptations or accommodations because of a disability, or if you have emergency medical information about which we should be informed, please speak with us as soon as possible. Students who require such accommodations must work with the Office of Disability Services (704-687-4355).

**Course Outline and Reading Schedule: (C = Prof. Chowdhury; S = Prof. Schwarz)****A. Overview of Energy markets****I. Week 1 Jan. 13 Course Overview: Syllabus and Energy and Electricity Markets (S)**

- Reading:



1. U of TX document, Chapter 1: International Energy Markets<sup>i</sup>  
*Martin Luther King Holiday Monday Jan. 19*

**II. Week 2 Jan. 20 Review of Microeconomics (S)**

- Readings:
  1. Text Ch. 2

**Weeks 3, 4 Jan. 27, Feb. 3 Energy Markets: Fuel Markets (S) and Value Chains  
(Guest Speaker Ronak Bhatt)**

- Readings:
  1. Schwarz provisional text: Ch's on NG, Nu, Alt. Fuels (Moodle)
  2. Oil and Natural Gas: U of TX materials: Section 2, Ch's 2-4<sup>ii</sup>.
  3. Uranium: Uranium Development Partnership, Ch. 1<sup>iii</sup>.
  4. Pricing coal and natural gas: Energy Charter Secretariat
    - a. chapters 3 and 4<sup>iv</sup>.

***Exam 1 handed out Feb. 3, due Feb. 10***

***B. Overview of Electricity Markets***

**III. Week 5, 6 Feb. 10, 17 Introduction to Electricity Markets (C/S)**

- Readings:
  1. Kirschen Ch. 1, Material on Regulation (to be posted on Moodle)
  2. Selected reading material from US electricity markets

*Spring Recess March 2-7*

**IV. Week 7, 8 Feb. 24, Mar. 10 Markets for Electrical Energy (C/S)**

- Readings:
  1. Kirschen Ch's 3, 4
  2. Selected reading material from US electricity markets
  3. J Griffin and S Fuller: A Primer on Electricity and the Economics of Deregulation<sup>v</sup>
  4. Joskow: Intermittent vs. Dispatchable Technologies<sup>vi</sup>.

***Exam 2 handed out March 10, due March 17***

***Tues. Mar. 17 11:59 pm Last day to withdraw from course with a 'W' grade***

**V. Week 9 Mar. 17 Ancillary Services (C)**

- Readings:
  1. Kirschen Ch. 5
  2. Selected reading material from US electricity markets

Spring Weekend: Apr. 3-4

**VI. Week 10, 11 Mar. 24, 31 Transmission Networks (C)**

- Readings:
  1. Kirschen Ch. 6
  2. Selected reading material from US electricity markets

**VII. Week 12, 13 Apr. 7, 14 Investing in Generation and Transmission (C)**

• Readings:

1. Kirschen Ch. 7, 8

**VIII. Week 14 Apr. 21 Summing Up (S) and Guest speaker Ronak Bhatt Investing in Energy**

**IX. Week 15 Apr. 28 Graduate student presentations (S)**

Reading Day: Apr. 29 (Wednesday)

*Final Exam handed out Apr. 28 and due May 5 (Tuesday), 5-7:30 PM.*

*You may complete your final exam in class during this time, or earlier. But you must come to class and turn in a hard copy between 5-7:30 PM.*

*If any undergraduate or graduate presentations are postponed, they will take place during the final exam period.*

**ALL PARTS OF THIS SYLLABUS ARE SUBJECT TO REVISION  
ANY REVISIONS WILL BE ANNOUNCED IN CLASS OR VIA MOODLE**

## Citations

- Griffin, J. M., & Puller, S. L. (2005). A Primer on Electricity and the Economics of Deregulation. In J. M. Griffin & S. L. Puller (Eds.), *Electricity Deregulation: Choices and Challenges* (pp. 1-28): Bush School Series in the Economics of Public Policy, vol. 4.
- Joskow, P. L. (2011). Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies. *American Economic Review*, 101(3), 238-241. doi: [http://www.aeaweb.org/aer/Capturing the Full Potential of the Uranium Value Chain in Saskatchewan](http://www.aeaweb.org/aer/Capturing%20the%20Full%20Potential%20of%20the%20Uranium%20Value%20Chain%20in%20Saskatchewan). (n.d.). *Uranium Development Partnership*. Retrieved November 11, 2013, from <http://www.gov.sk.ca/adx/asp/adxGetMedia.aspx?mediaId=767&PN=Shared>
- Economics of the Energy Industries. (n.d.). *Center for Energy Economics*. Retrieved November 11, 2013, from <http://www.beg.utexas.edu/energyecon/Economics%20of%20Energy%20Industries.pdf>
- Putting a Price on Energy. (n.d.). *Energy Charter Secretariat*. Retrieved November 11, 2013, from [http://www.encharter.org/fileadmin/user\\_upload/document/Oil\\_and\\_Gas\\_Pricing\\_2007\\_ENG.pdf](http://www.encharter.org/fileadmin/user_upload/document/Oil_and_Gas_Pricing_2007_ENG.pdf)

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- ii <sup>1</sup> <http://www.beg.utexas.edu/energyecon/Economics%20of%20Energy%20Industries.pdf>
- iii <http://www.beg.utexas.edu/energyecon/Economics%20of%20Energy%20Industries.pdf>
- iv <http://www.gov.sk.ca/adx/asp/adxGetMedia.aspx?mediaId=767&PN=Shared>
- v [http://www.encharter.org/fileadmin/user\\_upload/document/Oil\\_and\\_Gas\\_Pricing\\_2007\\_ENG.pdf](http://www.encharter.org/fileadmin/user_upload/document/Oil_and_Gas_Pricing_2007_ENG.pdf)
- vi <http://econweb.tamu.edu/puller/AcadDocs/primer.pdf>
- <http://economics.mit.edu/files/6317> (See Moodle2 for AER 2011 version).