ECE 404/504: Transmission and Distribution Applications of Voltage Sourced Converters
Spring 2013

DESCRIPTION	Introduce basic ac-dc voltage source converter topologies, switching schemes and control options for high power transmission and distribution applications. Applications include converter interfaces for type 3 and type 4 wind turbines, photovoltaic systems, VSC high voltage dc transmission, flexible ac transmission systems and other generation and storage application. Introduce modeling and simulation methods for normal and abnormal operating conditions.
PREREQUISITES	ECE 420 or ECE 421 or permission of instructor
CLASS TIME	1:30pm-2:20pm MWF, EP 203

INSTRUCTORS	Brian K. Johnson, PhD, P.E.	Herb Hess, PhD, P.E.
CONTACT INFO	Phone: 208-885-6902 (800-824-2889, ext. 6902) Fax: 208-885-6165 GJL 201 e-mail: bjohnson@uidaho.edu	Phone: 208-885-4341 (800-824-2889, ext. 4341) Fax: 208-885-6165 GJL 205 e-mail: hhess@uidaho.edu
OFFICE HOURS	M-F: 11:30-12:30 (Pacific time) Or any time my door is open	M-F: 2:30-5:00pm Or any time my door is open

COURSE WEB SITE	http://www.ece.uidaho.edu/ee/power/ECE404VSC/
TEXT	(1) N. Mohan, *Power Electronics: A First Course,* Wiley, 2011. ISBN: 9781118074800. (2) A. Yazdani and R. Irvavani, *Voltage-Sourced Converters in Power Systems,* Wiley-IEEE Press, 2010. ISBN 9780470521564
REFERENCES	1. D. Hart, *Power Electronics*. 2nd Edition, McGraw-Hill, 2010 (also 1st edition) 2. R. Teodorescu, M. Liserre, P. Rodriquez, *Grid Converters for Photovoltaic and Wind Power Systems.* Wiley-IEEE Press, 2011. **Note:** this book is available for free download for IEEE members from IEEEXplore (log in as yourself, go to Books, then select tab for Classics and search alphabetically.) It also available free to registered University of Idaho students through the library web page 3. J.D. Glover, M. S. Sarma, and T.J. Overbye, *Power System Analysis and Design, Fifth Edition*, CENGAGE Learning, 2011
SOFTWARE	MathCAD will be used for many of examples presented during the course and you will find it useful to have a copy. You can order the latest version of the student edition of MathCAD for a reduced price through the University of Idaho Department of Civil Engineering (208-885-6782) say you are in a UI Engineering Course. We will also present application examples implemented using the Alternate Transients Program (ATP), as will some assignments. There will more info about getting a copy on the course web page. Students are not restricted to using ATP if they have another program they want to use.

GRADING:

Item	Percent of Grade	
Homework	30%	A: 90-100
Exam 1	30%	B: 80-89
Final Exam	40%	C: 70-79
		D: 60-69
		F: < 60

COURSE OUTLINE

Lecture Topic	Chapter/Book
Introduction/overview	1/M and 1/Y&I
Basic Concepts/review of transient circuit analysis	2/M and 1/Y&I
General overview of voltage sourced converters	12/M and 2,5/Y&I
Generic models for simulation—introduction	Notes
Converter Topologies	
1. Single phase bridge	12/M and 2/Y&I
2. Single phase half bridge	12/M and 2/Y&I
3. Three phase bridge	12/M and 5/Y&I
4. Multilevel converter	12/M and 6/Y&I
5. Bridge of bridges/chain link converter	Notes
Switching Schemes	3,12/M and 2/Y&I
Inner Control Schemes	Notes, 3,9,10/Y&I
Basic concepts for outer control schemes	Notes, 7,8/Y&I
Applications (includes case studies with normal and abnormal operation, simulation models and results)	
1. Challenges with getting model data	Notes
2. Modeling the rest of the system	Notes
3. Wind turbines	14.4/M and 13/Y&I
a. Type 3	
b. Type 4	
4. Photovoltaic generation	14.4/M and Notes
5. VSC HVDC	14.7/M and 12/Y&I
6. FACTS/Custom Power	14.6/M and 11/Y&I
7. Energy Storage	
a. Flywheels	Notes
b. Battery and ultracapacitor	
6. DG sources	14.4/M and Notes

1. Exams may given as "take homes"
2. Note: homework assignments and projects will require software tools, especially MathCAD and Powerworld.

LECTURE DATES:

Monday Date	Monday	Wednesday	Friday
January 7	X	1	2
14	3	4	5
21	H	6	7
28	8	9	10
February 4	11	12	13
11	14	15	16
18	H	17	18
25	19	20	21
March 4	22	23	24
11	H	H	H
18	25	26	27
25	28	29	30
April 1	31	32	33
8	34	35	36
15	37	38	39
22	40	41	42
29	43	44	45

Final Exam: Monday May 6, 12:30-2:30pm (will probably be replaced by a take
home exam/project.

GENERAL GUIDELINES:

On-Campus Students:
1. Assignments handed in after the due date will be worth a maximum of 50%. However, we will allow extensions if you consult with us in advance and if you have a major schedule conflict
2. Feel free to contact us by phone or e-mail if you have questions and can't make it to our offices easily.

Outreach Students:
1. This is not a self-paced class. Engineering Outreach students are expected to finish the course at the same time as the on campus students.

2. Due dates for homework and projects will generally be specified the same as the due date for on-campus students. This is the date when your assignment reaches Moscow. Assignments will be worth a maximum of 50% after the due date. However, we will allow extensions if you consult with us in advance and if you have a major schedule conflict.

3. Returned homework and projects may not reach you prior to exams. Please make copies of any assignments that you believe may be useful before you submit them.

4. Please put your name and the course number on top of the first page of each exam and homework, especially if submitting by FAX or e-mail. It would be best if your name was in the header of each page. E-mail submission of assignments is ok, as long as compatible file formats are used.

   Allowable formats for electronic submission are Adobe Portable Document Format (PDF), Microsoft Word (*.doc or *.docx), Rich Text Format (*.rtf) or MathCAD 15 (or earlier) or Prime 2.0. Limit to one or two attached files. We don't want a large number of files with no documentation on what order to use them.

5. Make sure you number your pages as: 1/4, 2/4, etc., so we know whether or not we have a complete set. Also make sure writing is dark and clear on a FAX or a scan.

6. Phone calls or the use of e-mail for asking questions is encouraged. You are welcome to call outside of office hours. The Engineering Outreach 800 line is available 24 hours a day so you can reach us outside of their hours.

7. Library Resources: As a UI student, you not only have access to valuable print and electronic resources from the university's library, such as access to IEEEXplore, but you also have the access to personalized assistance from the librarians. If you have assignments or research questions and aren't sure how to make the most of library resources from off campus, you can visit the Off-Campus Access information page on the library's website at
    http://www.lib.uidaho.edu/offcampus/index.html