ELEC8342 HVDC and FACTS

FIRST SEMESTER 2009 Unit Outline

This outline is distributed in the lecture.

Credit: 6 points Availability: Semester 1 (See Timetable)

Prerequisites: ELEC3305 Power and Machines and ELEC4307 Power Transmission and Control 457 or equivalent.

Objectives and Outcomes

In this unit, students develop an in-depth understanding of the theory and applications in power systems of High Voltage Direct Current (HVDC) transmission and Flexible AC Transmission Systems (FACTS) devices, including static VAr Compensators (SVC) and Static Synchronous Compensators (STATCOM) based on thyristors, GTO thyristors and IGBTs.

Instructional Contact

Contact Hours:

Lectures: 24 hrs	Tuesday, 3:00pm to 4:45pm in ENCM:109
Tutorials: 12 hrs	Tuesday, 5:00pm to 5:30pm in ENCM:109
Projects: 6 hrs	As per individual schedule

Unit Coordinator, Lecturer and Tutorial Demonstrator:

HVDC

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FACTS

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Unit Content

The unit comprises the following topics: (1) HVDC—conversion and inversion principles; converter and inverter configurations, rectifier operation; inverter operation; converter harmonics, harmonic elimination; high-pulse order configuration; harmonic filtering; analogue and digital control of converter and inverter; control strategies; individual phase control; equidistant firing control scheme; phase-locked oscillators; constant current control, inverter excitation angle control; control stability; interactions between ac and dc systems; computer simulation of HVDC interconnections; dynamic response evaluations; protection; HVDC transmission with voltage-source converters (VSCs) based on gate-turn-off (GTO) thyristors and insulated gate bipolar transistors (IGBTs); (2) Flexible AC Transmission Systems (FACTS) including thyristor-based reactive-power static VAr compensators (SVC), series compensation, inverter based Static Synchronous Compensators (STATCOM), Unified Power Flow Controllers (UPFC), and other devices — compensator control strategies; choice of control signals; compensator characteristics.

Study Materials

Required Reading:

J. Arrillaga, *High Voltage Direct Current Transmission, 2nd Edition.* IEE Power Engineering Series, 1998. ISBN 0-85296-941-4

Vijay K. Sood, *HVDC and FACTS controllers*, Kluwer, 2004, ISBN: 1-4020-7890-0, eBook ISBN: 1-4020-7891-9

E. Acha, V.G. Agelidis, O. Anaya-Lara, and T.J.E. Miller, *Power Electronic Control in Electrical Systems*, Newnes, 2002. ISBN: 0-7506-5126-1

Recommended Reading:

N.G. Hingorani and L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems.* IEEE Press, 2000. ISBN: 0-7803-3455-8

X.P. Zhang, C. Rehtanz and B. Pal, *Flexible AC Transmission Systems.* Springer, 2006. ISBN-10: 3-540-30606-4, ISBN-13: 978-3-540-30606-1

M. Mathur and R.K. Varma, *Thyristor-Based FACTS Controllers for Electrical Transmission Systems*. Wiley-IEEE Press, 2002. ISBN 0-471-20643-1.

Wildi, T. *Electrical Machines, Drives and Power Systems, 6th Ed*. (Chapters 29 and 30), Pearson Prentice Hall 2006, ISBN: 0-13-196918-8

Background Reading:
Mohan, N., Undeland, T.M., and Robbins, W.P. *Power Electronics; Converters, Applications, and Design,* 3rd Ed. Wiley 2003

Useful Websites:
Interactive Power Electronics Seminar (iPES) http://www.ipes.ethz.ch/
IEEE Power Electronics Society homepage http://www.pels.org/
Techonline: e-learning electronics http://www.techonline.com/
Engnet Online Books: http://www.engnetbase.com/ejournals/categories/default.asp

Unit Assessment

Assessment Percentages:

Assignments	20% (2 x 10%)
Project Proposal	10%
Project Presentation	10%
Project Report	60%

Students will be given two assignments through the semester. Each assignment must be completed and submitted on the due date given. Assignment marks will be given based on the marker's perception of the effort given by the student. Assignment solutions will be reviewed in the tutorials.

Each student will undergo a project of their own choosing and instigation. Each student will prepare a project proposal which will be due on **Thursday, 26-March-2009 at 5:00 pm**. Each student will prepare a project report. **This project report is due on Monday, 18-May-2009 at 5:00 pm**. The project presentation will be held in last 2 lectures.

The project reports will be assessed against the following criteria:

- Understanding and comprehension of HVDC and FACTS systems components in terms of operation, function, and suitability for specific applications, or to solve specific problems.
- Ability to implement HVDC and FACTS systems to achieve power flow objectives.
- The ability to undertake problem identification, formulation and solution.

Penalties:

Late assignment submissions will be given a mark of zero. Late project submissions are subject to a penalty of 20% (of assessment worth) per calendar day late. Each submission must have a properly completed and signed assignment cover sheet.

Warning on Plagiarism and Collusion:

The University Guidelines on Academic Misconduct, including plagiarism and collusion, will be followed (see **http://www.ecm.uwa.edu.au/for/students/plagiarism**). In cases where the lecturer believes that inappropriate plagiarism or collusion has occurred in a submission by a student, those determined to be responsible for the inappropriate plagiarism or collusion will receive a mark of zero for that portion of assessment for which the submission was made. This does not preclude the implementation of any provisions of Faculty or University policies.

Appeals:

Any appeal of a student's academic assessment/s will be handled as indicated in the Faculty Examination and Appeals Policy (see http://www.ecm.uwa.edu.au/for/students/exams).

Charter of Student Rights:

Applies to this unit. (see http://www.secretariat.uwa.edu.au/home/policies/charter).