THE UNIVERSITY OF WESTERN ONTARIO
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 9040/9400 – FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)

COURSE OUTLINE – Winter 2017

(M.Eng., M.E.Sc. & Ph.D.)

OBJECTIVE:

This course will introduce students to the transmission challenges of emerging modern electrical power systems. The course will present the basic concepts, principles and operation of fast high power electronic controllers known as Flexible AC Transmission Systems (FACTS) that enhance power system stability, and effectively increase transmission capacity thus yielding significantly higher flexibility of operation.

CONTACT HOURS: 3 lecture hours/week, half course

The initial meeting for this course will be held place on January 13, 2017 @ 5:30PM (Room SEB 1056). The time for the further classes will be chosen to accommodate schedule of as many students interested in the course as possible. The final schedule is Friday 5:30-8:30 PM in SEB 1056 from January 13 - April 7). Similar consensus arrangements will be made for the midterm and the final examination.

ANTIREQUISITE: None

PREREQUISITES: Bachelor's degree in Electrical Engineering. An undergraduate course in power electronics is desirable.

COURSE CONTENT:

- Introduction to power Systems
- Reactive Power Control in Transmission Systems
- The Concept of Flexible AC Transmission Systems
- Principle of Thyristor-based FACTS Controller
- Static Var Compensator (SVC): Control, Modeling and Applications
- Static Synchronous Compensator (STATCOM): Control, Modeling and Applications
- Thyristor Controlled Series Capacitor (TCSC): Modeling and Applications
- Static Synchronous Series Compensator (SSSC)

- Unified Power Flow Controller (UPFC)
- High Voltage Direct Current (HVDC)

SPECIFIC LEARNING OBJECTIVES:

1) To introduce the operating principles, control systems and modeling of different FACTS Controllers
2) To understand the influence of measurement systems, network resonances and harmonic interactions on the performance of FACTS control systems
3) To provide the techniques of FACTS controller design for enhancing power transfer, stability and damping, mitigating sub-synchronous resonances, preventing voltage instability, etc.
4) To understand the interactions amongst various FACTS Controllers and techniques for their coordination and placement

TEXTBOOK:

[1] R.M. Mathur and R.K. Varma, "*Thyristor-Based FACTS Controllers for Electrical Transmission Systems*", IEEE Press and John Wiley & Sons, New York, USA, Feb. 2002

REFERENCE BOOKS:

[2] N.G. Hingorani and L. Gyugyi, "*Understanding FACTS"*, IEEE Press, New York, USA, 1999.

[3] K.R. Padiyar, *FACTS Controllers in Power Transmission and Distribution*, New Age International Publishers, New Delhi, 2007

[4] V.K. Sood, *HVDC and FACTS Controllers - Applications of Static Converters in Power Systems*, April 2004, ISBN 1-4020-7890-0, Kluwer Academic Publishers

[5] Y.H. Song and A.T. Johns, et., *Flexible AC Transmission Systems (FACTS)*, IEE Press, U.K., 1999

[6] IEEE/Other Transactions and Conference Papers

[7] K.R. Padiyar, *HVDC Power Transmission Systems - Technology and System Interactions*, John Wiley & Sons, 1990, ISBN 0-470-21706-5

[8] E.W. Kimbark, *Direct Current Transmission - Volume I*, Wiley Interscience, 1971, ISBN 0-471-35550-X

[9] P. Kundur, *Power System Stability and Control*, McGraw-Hill, 1994, ISBN 0-07-035958-X.

PROJECT AND ORAL PRESENTATION:

The students in the course will be required to perform a computer simulation project or study project on an assigned topic related to FACTS Controller application and submit the project report. Also, the students will be required to make an oral presentation in a group for each FACTS devices.

- Project for ECE 9400 (Ph.D and MESc.): Simulation Studies for a FACTS Application
- Project for ECE 9040 (MEng): Real-Life projects Studies for a FACTS Application

EVALUATION:

For the purpose of evaluation, the course is divided into three components, namely

- Oral Presentation
- Project Report
- Midterm Examination
- Final Examination

The final course grade will be determined from students' performance in the oral presentation, project, the midterm examination and the final examination. Both the midterm and final examinations will be of two hours duration, each. The midterm examination will be conducted approximately in the middle of the term. The examinations shall be semi-open book; calculators and formula sheets will be allowed. In order to pass the course, a student must obtain a passing grade in each component. A student who fails either component shall receive a final grade not greater than 48%. The weighting of each of these components will be as follows:

Component	**Value**	**English** (Maximum Penalties)	**Presentation**
Oral Presentation	15 %	10 %	10 %
Project: Abstract, Report	35 %	10 %	10 %
Midterm Examination	20 %	10 %	10 %
Final Examination	30 %	10 %	10 %

- In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades assigned to all written and oral work will take into account all aspects of presentation including

conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures.

- All work will be marked first for content after which a penalty not to exceed the maximum shown above may be applied for lack of proficiency in English and/or presentation.

ATTENDANCE:

Any student, who in the opinion of the instructor is absent too frequently from class in this course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

CHEATING:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

PLAGIARISM:

University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning. (See Scholastic Offence Policy in the Western Academic Calendar).

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 X 82147 for any specific question regarding an accommodation.

COURSE INSTRUCTOR

Dr. Ehsan M. Siavashi

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