EPE-902 – Technologies for Smart Transmission Systems

Course Code EPE 902	Credit Hours (Th-Pr) 3.0-0	Technologies for Smart Transmission Systems	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Background

1. Flexible AC Transmission Systems, called FACTS, got in the recent years a well-known term for higher controllability in power systems by means of power electronic devices. Several FACTS-devices have been introduced for various applications worldwide. A number of new types of devices are in the stage of being introduced in practice. Even more concepts of configurations of FACTS-devices are discussed in research and literature.

Rationale

2. In most of the applications the controllability is used to avoid cost intensive or landscape requiring extensions of power systems, for instance like upgrades or additions of substations and power lines. FACTS-devices provide a better adaptation to varying operational conditions and improve the usage of existing installations.

Education Objectives:

3. The objective of this course are:
    a. To familiarize students with the applications of power electronics in modern power system; specifically High Voltage Direct Current (HVDC), and Flexible AC Transmission Systems (FACTS).
    b. To develop an understanding of power electronic equipment and its operation with the emphasis on how these devices are applied, and interact with the rest of the power system.

International Standards/Practice

4. Similar scheme of studies is adapted in international universities, such as

    a. Royal Institute of Technology (KTH), Sweden [Times Higher Education Ranking: 159]
    b. Chalmers University of Technology, Sweden [Times Higher Education Ranking: 251]
    c. Norwegian University of Science and Technology, Norway [Times Higher Education Ranking: 251]

Proposed Timeframe of Commencement

5. Specifying semester with year.

    Fall-2018

Course Contents

6. Give details of the course, on the following lines:
   a. Course Code: EEE 902
   b. Title: Technologies for Smart Transmission Systems
   c. Credit Hours: 03
   d. Objectives (Repetition: Same as educational objectives)

Outcomes

7. Upon completion of the course, the student should be able to
   a. describe how FACTS and HVDC are designed,
   b. explain and analyze their functions,
   c. derive basic mathematical models for these components,
   d. analyze the impact of these components on power system stability,
   e. perform calculations on different control strategies for these devices.

8. **Contents with suggested contact hours**

No.	Topics	Book	Contact Hours
1.	• Introduction to the course and quick review of FACTS with additional flavor of HVDC Transmission • Review of power electronic devices and modulation techniques, transformations and tools for analysis and control of power electronics in power systems	HG / DK	4
2.	Concepts of power systems operation	HG	4
3.	Static Shunt Compensators: SVC and STATCOM	HG	8
4.	Static Series Compensators: GCSC, TSSC, TCSC, and SSSC	HG	4
5.	• Static Voltage and Phase Angle Regulators: TCVR and TCPAR • Combined Compensators: Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC)	HG	4
6.	HVDC with Current Source Converters: • Line-Commutated HVDC • Six-Pulse Diode and Thyristor Converter	DK	8

	• HVDC Rectifier Station Modelling, Control and Synchronization with AC Systems • HVDC Inverter Station Modelling and Control • HVDC Analytical Modelling and Stability		
7.	HVDC with Voltage Source Converters: • VSC HVDC Applications and Topologies • IGBT Switches and VSC Converter Losses • Single-Phase and Three-Phase Two-Level VSC Converters • Multilevel VSC Converters • Two-Level PWM VSC HVDC Modelling, Control and Dynamics	DK	8
8.	DC Transmission Grids: • DC Grids with Line-Commutated Converters • DC Grids with Voltage Source Converters • DC Grid Fault Management and DC Circuit Breakers	DK	5
Total			**45**

Recommended Books

S. No.	**Title**	**Author(s)**	**Assigned Code**	**Remarks**
1.	Understanding FACTS: concepts and technology of flexible AC transmission systems	N.G. Hingorani, L. Gyugyi	HG	Reference
2.	High Voltage Direct Current Transmission: Converters, Systems and DC Grids	Dragan Jovcic, Khaled Ahmed	DK	Reference