POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Course Code:13EE2104 **L P C**
4 0 3

Pre requisites: Power Electronics & Power Systems

Course Educational Objectives:
The students shall be exposed to application of power electronics, to High Voltage Direct Current HVDC) and FACTS (Flexible AC Transmission Systems) in the power transmission area.

Course Outcomes: After Completion of this Course, the Student will be able to

1. Analyze the Operation of the Graetz circuit.
2. Design the Filter for respective Harmonics
3. Analyze the Harmonics
4. Understand the operations of various FACTS Devices

UNIT-I : BASIC CONCEPTS
Introduction, Comparison of AC and DC Transmission (Economics of power transmission, Technical performance and Reliability), Application of DC transmission, Description of DC transmission system (Types of DC links and Converter station), Planning for HVDC transmission, Modern trends in HVDC technology.

UNIT-II : ANALYSIS OF HVDC CONVERTERS
Introduction**,** Analysis of Graetz circuit – with grid control but no overlap-with grid control and overlap less than 60^0 -relationship between AC and DC quantities-equivalent circuit of rectifier, Inversion-equation of average direct current and voltage in terms of β and γ – equivalent circuit of inverter, 12 Pulse converters-relations between AC and DC quantities-modified equivalent circuit.

UNIT-III

HVDC SYSTEM CONTROL&HARMONICS AND FILTERS: Basic means of control-desired features of control-actual control characteristics-constant minimum ignition angle control-constant current control-constant extinction angle control-tap changer control-power control and current limits, System control hierarchy, firing angle control-IPC-EPC. Introduction, Generation of harmonics (Characteristics and Non characteristics harmonics), Design of AC filters (design and types of filters), Passive AC- filters, DC filters (Criteria of Design and Passive DC Filters), Active Filters.

UNIT-IV

FACTS CONCEPTS & STATIC SHUNT COMPENSATION: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, Benefits from FACTS controllers. Objectives of Shunt Compensation, midpoint voltage regulation voltage instability prevention, Improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.

UNIT-V

STATIC SERIES COMPENSATORS: Concept of series capacitive compensation, Improvement of transient stability, power oscillation damping, subsynchronous oscillation damping. Functional requirements of GTO Thyristor controlled series capacitor (GCSC), Thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) control schemes for GCSC TSSC and TCSC.

TEXT BOOKS:

1. K.R. PADIYAR," *HVDC Transmission Systems*" 2nd edition (in Two Colour) , New Age International publishers 2012.

2. N.G. Hingorani and L. Gyugui "*Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems*", B.S. Publications, Indian Reprint 2000.

REFERENCES:

1. E.Uhlmann, "*Power Transmission by Direct Current"*, Springer 1st edition 2012.

2. Vijay K. Sood, "*HVDC and FACTS Controller: Application of Static Converters in power systems*", IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, First edition January 2004.

3. E.W. Kimbark "*Direct Current Transmission"*, Wiley Inter Science-New York, 1971.

4. R.Mohan Mathur, Rajiv K Varma, "*Thyristor based FACTS Controller for Electrical Power Systems*" , John Wiley Sons,2011.

5. X.P.Zhang, C.Rehtanz, B.Pal "Flexible *AC Transmission System Modeling and Control*" Springer,2006