**19EE42E3-Flexible AC Transmission Systems**

**(EEE)**

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| **Course Category:** | Professional elective | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture-Tutorial-Practical:** | 3-0-0 |
| **Pre-requisite:** | Circuit analysis, Field theory, Power system -I, Power system-II and Power electronics | **Sessional Evaluation:**  **External Exam Evaluation:**  **Total Marks:** | 40  60  100 |

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| **Course Objectives:** | Students undergoing this course are expected to learn: | |
| 1. The basic concepts of reactive power compensation.  2. The concept of Flexible A.C transmission and the associated  problems.  3. The working principles of FACTS devices (STATCOM) and their  operating characteristics.  4. The working principles of FACTS devices (SSSC) and their  operating characteristics.  5. About FACTS device for power quality improvement.  6. To initiate research to develop/design new schemes and techniques for power quality enhancement. | |
| **Course Outcomes:** | After completing the course the student will be able to: | |
| **CO1** | Understand the basic concepts of reactive power. |
| **CO2** | Gain knowledge about flexible A.C transmission system and its controllers. |
| **CO3** | Analyze voltage stability issues in high voltage electrical systems using static VAR compensators. |
| **CO4** | Demonstrate about static series compensation technique to increase power flow capability. |
| **CO5** | Describe the combination of static shunt and series compensation techniques used to increase power flow capability. |
| **CO6** | Develop/design new schemes and techniques for power quality enhancement. |
| **Course Content:** | **UNIT-I**  **Reactive power compensation:** Overview of reactive power compensation-Power flow through a transmission line- Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive power control during transients.  **UNIT-II**  **FACTS concept:** Introduction to FACTS power flow in an A.C system, loading capability limits, dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, operation of facts controllers, benefits from FACTS controllers.  **UNIT-III**  **Static shunt compensation:** Expression for real and reactive power flow with mid-point voltage regulation, variable impedance type static VAR generators, V-I characteristics and control schemes of TCR, TSR, TSC. switching converter type VAR generators, V-I characteristics and control schemes of STATCOM.  **UNIT-IV**  **Static series compensation:** Expression for real and reactive power flow with series line compensation,  **Variable impedance type series compensators**: V-I characteristics and control schemes of GCSC, TSSC, TCSC, modes of operation,  **Switching converter type series compensator:** V-I characteristics, internal and external control schemes of SSSC.  **UNIT-V**  **Unified power flow controllers:** Principle, expression for real and reactive power between two nodes of UPFC, independent real and reactive power flow control using UPFC, control schemes of UPFC.  **UNIT-VI**  **Dynamic voltage restorer and unified power quality conditioner:** Voltage sag/swell mitigation, dynamic voltage restorer, working principle and control strategies, series active filtering,unified power quality conditioner (UPQC), working principle, capabilities and control strategies. | |
| **Text books**  **&**  **Reference books:** | **Text books:**  1. “Understanding FACTS”, by NarainG,Hingorani, LarsloGyugi, Standard  publishers 2001.  2.“FACTS controllers”, by K.R.Padiyar, New age international publication  3. “Electrical power systems quality”, by Roger C. Dugan, Mark F.  McGranaghan, Surya Santoso and H. Wayne Beaty, 3rd Edition, TATA  McGraw Hill, 2010.  **Reference books:**   1. “Thyristor – based facts controllers for electrical transmission systems”, by Mohan Mathur, R, Rajiv. K. Varma, IEEE press and John Wiley & Sons, Inc. 2. “Flexible A.C transmission system”, by A.T.John, Institution of Electrical and Electronic Engineers (IEEE), 1999. 3. “Understanding power quality problems: voltage sags and interruptions”, by Math H J Bollen, Wiley, 2010. | |
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