# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**
**Subject Code: 3734501**
**Semester – III**
**Subject Name: Application of Power Electronics in Power System**

**Type of course**: Engineering Science (ELECTRICAL**)**

**Prerequisite:** Power Electronics, Power System Analysis

**Rationale:** NA

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Reactive Power Control and Compensation by Conventional Controllers**<br>Control of power flow in AC transmission line, Analysis of uncompensated AC line, Passive reactive power compensation, effects on power transfer capability, Compensation by a series capacitor connected at the mid-point of the line, shunt compensation at the mid-point of the line, comparison of shunt and series connected capacitor, configuration and operating characteristics of Synchronous condensers, Saturated Reactor, Thyristor Controlled Reactor (TCR), Thyristor Controlled Transformer, Fixed Capacitor-TCR, Thyristor switched capacitor (TSC), TSC-TCR, TCSC, SSSC | 12 | 30% |
| 2 | **Combined Compensators: Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC)**<br>Introduction, The Unified Power Flow Controller: Basic Principles, Independent Real and Reactive Power Flow Control, Control Structure, Basic Control System for P and Q Control<br>The Interline Power Flow Controller (IPFC): Basic Operating Principles and Characteristics, Control Structure, Application | 10 | 25% |
| 3 | **HVDC Transmission:**<br>Introduction, Comparison of AC vs DC Transmission, Types of HVDC systems, Types of Converters in HVDC, Control of HVDC system, Realization of HVDC system using Voltage Source Converter | 08 | 15% |
| 4 | **Modular Multilevel Converters for Power System:**<br>Introduction to Modular Multilevel Converter, Types of Submodules and Submodule Strings, Arm Current and Capacitor Balance Control, Two-Terminal HVDC System, Multi-Terminal HVDC System, Control of Two-Terminal MMC-Based HVDC System, Control of Multi-Terminal MMC-Based HVDC System, MMC-Based Static Synchronous Compensator, MMC-Based Unified Power Quality Conditioner | 12 | 30% |

**Reference Books:**

1. Hingorani, N.G., Gyugyi, L. and El-Hawary, M.. 'Understanding FACTS: concepts and technology of flexible AC transmission systems', IEEE press: New York, 2000.
2. Sood VK, 'HVDC and FACTS controllers: applications of static converters in power systems', Springer Science & Business Media, 2006.
3. Mathur RM, Varma RK, 'Thyristor-based FACTS controllers for electrical transmission systems', John Wiley & Sons, 2002.
4. Du S, Dekka A, Wu B, Zargari N, 'Modular Multilevel Converters: Analysis, Control, and Applications', John Wiley & Sons, 2017.
5. Sharifabadi K, Harnefors L, Nee HP, Norrga S, Teodorescu R. 'Design, control, and application of modular multilevel converters for HVDC transmission systems', John Wiley & Sons, 2016.

**Course Outcome:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| 1 | Differentiate among different power electronics based reactive power controller and their applications in power system | 20 |
| 2 | Apply combined compensators in transmission lines based on active and reactive power control requirements | 20 |
| 3 | Determine control requirement of MMC based HVDC systems | 20 |
| 4 | Compare different MMC based high power applications for Power System | 20 |
| 5 | Design Power Electronic Converter for High Voltage DC Transmission System applications | 20 |

List of Software/Tools:

- ✓ MATLAB along with necessary toolbox
- ✓ PSCAD
- ✓ Scilab

**List of Open Source Software/learning website:**

1. https://onlinecourses.nptel.ac.in/noc18_ee44/preview