GUJARAT TECHNOLOGICAL UNIVERSITY
ELECTRICAL ENGINEERING
B. E. SEMESTER: VII

Subject Name**: Advanced Power System-I (Department Elective-I)**
Subject Code**: 170905**

Teaching Scheme				Evaluation Scheme			
Theory	**Tutorial**	**Practical**	**Total**	**University Exam (E)**		**Mid Sem Exam (Theory) (M)**	**Practical (Internal)**
				Theory	**Practical**		
4	0	2	6	70	30	30	20

Sr. No.	Course Contents	Total Hrs
1.	**Introduction:** **1.1** Background **1.2** Electrical Transmission Networks **1.3** Conventional Control Mechanisms **1.3.1** Automatic Generation Control (AGC) **1.3.2** Excitation Control **1.3.3** Transformer Tap-Changer Control **1.3.4** Phase Shifting Transformers **1.4** Flexible ac Transmission Systems (FACTS) **1.4.1** Advances in power Electronics Switching Devices **1.4.2** Principles and Applications of Semiconductor Switches **1.5** Emerging Transmission Networks	06
2.	**Reactive Power Control in Electrical Power Transmission Systems** **2.1** Reactive Power **2.2** Uncompensated Transmission Lines 2.2.1 A simple Case 2.2.2 Lossless Distributed Parameter Lines **2.3** Passive Compensation **2.3.1** Shunt Compensation **2.3.2** Series Compensation **2.3.3** Effect on power-Transfer Capacity **2.3.3.1** Series Compensation **2.3.3.2** Shunt Compensation	06

3.	**Principles of Conventional Reactive Power Compensators** **3.1** Introduction **3.2** Synchronous Condensors 3.2.1 Configuration 3.2.2 Applications **3.3** The saturated Reactor **3.4** Thyristor Controlled Reactor(TCR) **3.4.1** The single phase TCR **3.4.2** The three phase TCR **3.4.4** The segmented TCR **3.4.5** The 12-Pulse TCR **3.4.6** Operating Characteristics of a TCR **3.4.6.1** Operating Characteristics Without Voltage Control **3.4.6.2** Operating Characteristics With Voltage Control **3.5** The Fixed Capacitor Thyristor Controlled Reactor (FC-TCR) **3.5.1** Configuration **3.5.2** Operating Characteristic **3.6** The Mechanically Switched Capacitor-Thyristor-Controlled Reactor(MSC-TCR) **3.7** The Thyristor-Switched Capacitor (TSC) **3.7.1** Switching a Capacitor to a Voltage Source **3.7.2** Switching a Series Connection of a Capacitor and Reactor **3.7.3** Turning Off of the TSC Valve **3.7.4** The TSC Configuration **3.7.5** Operating Characteristic **3.8** The Thyristor-Switched Capacitor-Thyristor-Controlled Reactor(TSC-TCR) **3.8.1** Configuration **3.8.2** Operating Charateristics **3.8.3** Current Characteristic **3.8.4** Susceptance Characteristics **3.8.5** Mismatched TSC-TCR **3.9** Comparison of different SVCs	10
4.	**HVDC Transmission-Development** **4.1** Introduction **4.2** Historical Development **4.3** Equipment required for HVDC System **4.4** Comparison of AC and DC transmission **4.5** Limitation of HVDC Transmission Lines **4.6** Reliability of HVDC Systems **4.7** Standard Rated Voltages of HVDC and EHV AC systems **4.8** Choice of EHV AC and UHV AC lines and substation **4.9** Comparison of HVDC link with EHV AC link **4.10** HVDC-VSC Transmission System	6

5.	**HVDC Convertors** **5.1** Introduction **5.2** Insulated Gate Bipolar Transistor (IGBT) **5.3** HVDC Convertor Valve and Valve Assembly **5.4** HVDC –VSC Operation and Principles **5.5** Three Phase Six Pulse Converter using SCRs **5.6** Twelve Pulse Bridge Converters	04
6.	**Six Pulse Converter Operation and Analysis** **6.1** Introduction **6.2** Conduction Sequence in Six Pulse Converter **6.3** Ideal Commutation Process without Gate control **6.4** DC output Voltage **6.5** Gate control of valve **6.6** Analysis of Voltage Waveform with overlap angle **6.7** Voltage dropped in PU Quantities **6.8** Complete Characteristics Of converter as Rectifier /Inverter **6.9** Analysis of Twelve Pulse Converter **6.10** Power flow in HVDC Link **6.11** Operation and Analysis Of VSC converters	06
7.	**Control of HVDC converter and system** **7.1** Introduction **7.2** Mechanism of AC power Transmission **7.3** Principles of Control **7.4** Necessity of Control in case of DC link **7.5** Rectifier Control **7.6** Compounding Of Rectifier **7.7** Power Reversal in DC link **7.8** Voltage Dependent Current Order Limit- Characteristics of Converter **7.9** System Control Hierarchy and Basic Philosophy **7.10** Inverter Extinction Angle Control (EAG)	06
8.	**Harmonics in HVDC Systems** 8.1 Introduction 8.2 Importance of Harmonic Study 8.3 Generation of Harmonics by Converters 8.4 Characteristics Harmonics on the DC Side 8.5 Characteristics Current Harmonics	04

Text Books:

1. Thyristor-Based FACTS Controllers for Electrical Transmission Systems- R.M.Mathur/ R.K.Verma, John Wiley & Sons, Inc., 2002

2. Power System Stability and Control – Prabha Kundur, Mc Graw Hill, ISBN: 9780070635159

3. N. Hingorani, L. Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC transmission Systems, Delhi Publishers, ISBN-13: 9788186308790

4. HVDC Transmission: S Kamakshaiah, V Kamaraju , McGrawHill, ISBN: 9780071072533