

GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)

POWER ELECTRONICS FOR POWER SYSTEM

SUBJECT CODE: 2732903

ME Semester: III

Type of course: Major Elective-IV

Prerequisite: fundamental knowledge of Power System, and the basic concept of Power Electronics devices and operation of converters.

Rationale: Power Electronics has grown as a major and extremely important discipline. This course provides the basic concept about the major role of Power Electronics in Power Transmission and Distribution System. It provides the basic concept about Flexible AC Transmission System, Harmonics related problems and different techniques for the mitigation of harmonics and concept of HVDC transmission.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended Problem.

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	Introduction Transmission line theory, Transmission interconnections, Load balancing, flow of power in an AC system, Power flow and dynamic stability considerations of a transmission interconnection, voltage profile at the point of common coupling (PCC), need for load compensation, load balancing using passive elements, Review of PWM techniques, Instantaneous reactive power theory, expression for active and reactive powers in terms of d-q components, Reference frame theory, Basic definition and description of FACT controllers, Basic types of FACT controller, Advantage and Application of FACT controller.	12	25
2	Shunt Compensators Introduction, Method of Controllable VAR generation: Thyristor Controlled Reactor (TCR), Thyristor Switched Capacitor (TSC), The Fixed Capacitor Thyristor Controlled Reactor (FC-TCR), Static Var compensators: SVC and STATCOM, the regulation slope, Transfer function and dynamic performance, Enhancement and power oscillation damping, applications.	11	23
3	Series Compensators Introduction and objective of series compensator, Comparison between Series and shunt compensator. Basic concept of series capacitive	10	22

	compensator, Various Equipment: GTO Controlled Series Capacitor (GCSC), Thyristor Switched Series Capacitor(TSSC), Thyristor Controlled Series Capacitor(TCSC), Static Synchronous Series compensator(SSSC),Mode of operation, Thyristor Controlled Voltage Regulator(TCVR) and Thyristor Controlled Phase Angle Regulator(TCPAR), applications.		
4	Combined Compensator Introduction, Unified power flow controller, basic operating principles, independent real and reactive power flow control, Control Structure, Basic control system for P and Q control.	7	15
5.	HVDC System Introduction, DC versus AC transition, Various possible HVDC configurations, Uni-polar and bipolar Link, Components of HVDC system, Multi pulse bridge converter, rectifier and inverter operation, Effect of source inductance, Equivalent Circuit Control of HVDC system, constant current control, Constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.	8	15

Reference Books:

1. T.J.E. Miller, "Reactive power control in Electrical system", John Wiley & Sons, New York, 1982.
2. Hingorani N. G,"Understanding FACTs concept and Technology of FACT system"IEEE press 2000.
3. K. R. Padiyar, "FACTs controllers in Power Transmission and Distribution System "New age international (P) Ltd., 1990
4. K. R. Padiyar: High Voltage Direct current Transmission, Wiley Eastern Ltd., New Delhi – 1992.
5. R. Mohan Mathur, Rajiv K. Verma., "Thyristor based FACT Controllers for Electrical transmission system", IEEE press, John Wiley & Sons, 2002.
6. Vijay K. Sood,"HVDC AND FACT CONTROLLERS Application of Static Converter in Power System" Kluvkar Academic Publisher, New York.2004.
7. M. H. Rashid,"Power Electronics Handbook: Devices circuits and Applications", Academic Press, 2001.
8. J.Arrillaga, N.R.Watson,"Power System Harmonics" John Wiley & Sons, 2003.

Course Objectives:

After learning the course the students should be able to:

1. Understand the fundamental concepts and the Operation of various FACT controllers.
2. Understand the basic concepts of Harmonics.
3. Understand the fundamental concept of HVDC system, its Control and Application.

List of Experiments :(with Open Ended Problems)

- To study Shunt compensator.
- To study series compensator.
- To study Thyristor Controlled Reactor (TCR).
- To study Thyristor Switched Capacitor (TSC).
- To study STATCOM.
- To study Thyristor Switched Series Capacitor(TSSC).
- To study Thyristor Controlled Series Capacitor(TCSC).
- To study Thyristor Controlled Phase Angle Regulator(TCPAR).
- To study Unified power flow controller.
- To study about HVDC transmission system.

Any Additional Experiment and Assignment can also be given by the concerned Subject teacher.

Major Equipment's:

- Computer Laboratory with MATLAB/Simulink software etc.

List of Open Source Software/learning website:

- www.nptl.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.