

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE464	Flexible AC Transmission Systems	3-0-0-3	2016
<b>Prerequisite:</b> Nil			
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>To introduce various Power Electronics controllers used in the Power Systems for the fast real and reactive power control.</li> </ul>			
<b>Syllabus</b>			
Power flow control - Benefits of FACTS -Transmission line compensation. Uncompensated line - shunt and series compensation .Reactive power compensation . Static shunt and series compensators - Static Voltage and Phase Angle Regulators (TCVR & TCPAR). Switching Converter type shunt and series Compensators - principle of operation, configuration and control. Unified Power Flow Controller			
<b>Expected outcome .</b>			
The students will be able to:			
<ul style="list-style-type: none"> <li>Understand various power electronics based FACTS devices for the control of active and reactive power in the system</li> <li>Understand the control schemes of various FACTS devices.</li> </ul>			
<b>References:</b>			
<ol style="list-style-type: none"> <li>Hingorani and L Gyugyi, "Understanding FACTS", IEEE Press, 2000</li> <li>J Arriliga and N R Watson, "Computer modeling of Electrical Power Systems", Wiley, 2001</li> <li>T J E Miller, "Reactive Power Control in Power Systems", John Wiley, 1982</li> <li>K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007</li> <li>Ned Mohan et. al "Power Electronics", John Wiley and Sons.</li> <li>Y.H. Song and A.T. Johns, "Flexible ac Transmission Systems (FACTS)", IEE Press, 1999</li> </ol>			
<b>Course Plan</b>			
Module	Contents	Hours	Sem. Exam Marks
I	Power flow in Power Systems – Steady-state and dynamic problems in AC systems – Voltage regulation and reactive power flow control in Power Systems – control of dynamic power unbalances in Power System Power flow control -Constraints of maximum transmission line loading - Benefits of FACTS - Transmission line compensation: Compensation by a series capacitor connected at the midpoint of the line, Shunt Compensation connected at the midpoint of the line -Phase angle control	7	15%
II	Reactive power compensation – shunt and series compensation principles – reactive compensation at transmission and distribution level – Static versus passive VAr Compensators	6	15%
<b>FIRST INTERNAL EXAMINATION</b>			
III	Static shunt Compensator - Objectives of shunt compensations, Methods of controllable VAR generation -		15%

	Variable impedance type VAR Generators -TCR , TSR, TSC, FC-TCR Principle of operation, configuration and control Static Series compensator - Objectives of series compensations, Variable impedance type series compensators - TCSC - Principle of operation, configuration and control.	8	
<b>IV</b>	Static Voltage and Phase Angle Regulators (TCVR & TCPAR): Objectives of Voltage and Phase angle regulators Thyristor controlled Voltage and Phase angle Regulators	7	15%
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	Switching converter type shunt Compensators.- Principle of operation, configuration and control , Comparison between SVC and STATCOM- Applications Switching converter type Series Compensators-(SSSC)- Principle of operation, configuration and control	7	20%
<b>VI</b>	Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC General Equivalent Circuit for Facts Controllers (Shunt+series) Introduction to interline power flow controller.	7	20%
<b>END SEMESTER EXAM</b>			

**QUESTION PAPER PATTERN:**

Maximum Marks: 100

Exam Duration: 3Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.  
Student has to answer all questions. (8 x5)=40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part C:** 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part D:** 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.