INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

ELECTRICAL AND ELECTRONICS ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSYTEM**				
Course Code	AEE524				
Programme	B.Tech				
Semester	VIII	EEE			
Course Type	CORE				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms.K.Harshini, Assistant Professor				
Course Faculty	Ms.K.Harshini, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Describe the effect of series and shunt compensation using various FACTS controllers.
II	Static VAR compensator for voltage regulation and transient stability enhancement of system.
III	Analyse voltage source converter based FACTs controllers and their coordination.

COURSE OUTCOMES (COs):

CO 1	Understand the fundamentals of FACTS controllers and their role in improving power system performance.
CO 2	Understand SVC for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
CO 3	Analyse the use of control schemes of TCSC, TSSC, GSC in improving the power quality.
CO 4	Analyse the applications of Voltage Source Converter based FACTS Controllers.
CO 5	Explain the FACTS Controllers and their co-ordination.

COURSE LEARNING OUTCOMES (CLOs):

AEE524.01	Discuss about the introduction of FACTS technology in Power Systems and power flow in transmission lines
AEE524.02	Discuss about the Reactive Power Compensation in Transmission line and also the types of Compensation methods
AEE524.03	Explain the need of FACTS and types of FACTS Controllers.
AEE524.04	Discuss about the Static VAR Compensator, its configuration and Voltage Regulation
AEE524.05	Study the modelling of SVC for Stability and for Load flow analysis
AEE524.06	Designing of SVC to regulate transient stability enhancement and power oscillation damping
AEE524.07	Understanding the concepts Controlled Series Capacitors.
AEE524.08	Explain the operation, analysis and gate turn off characteristics of Thyristor Controlled Series Capacitor
AEE524.09	Modeling of TCSC and GCSC for Stability and for Load flow analysis.
AEE524.10	Operation of Static Synchronous Compensator(STATCOM) and Synchronous Series Compensator(SSSC)
AEE524.11	Modeling of Static Synchronous Compensator (STATCOM) and Synchronous Series Compensator (SSSC) Transient Stability and for Power Flow analysis.
AEE524.12	Modeling of UPFC and IPFC for Transient Stability and for Power Flow analysis
AEE524.13	Discuss about FACTS controller interactions
AEE524.14	Explain SVC interaction, co- ordination of multiple controllers using linear control techniques
AEE524.15	Explain the quantitative treatment of control co ordination
AEE524.16	Explore the knowledge and skills of employability to succeed in national and international

TUTORIAL QUESTION BANK

	UNIT- I			
	INTRODUCTION			
	Part - A (Short Answer Questions)			
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	What is need for FACTS Technology?	Understand	CO 1	AEE524.01
2	Define the term FACTS	Understand	CO 1	AEE524.01
3	Define Active Power?	Remember	CO 1	AEE524.01
4	Define Reactive Power?	Remember	CO 1	AEE524.01
5	Define Power Factor?	Remember	CO 1	AEE524.01
6	State the Disadvantages of Lagging Power Factor?	Remember	CO 1	AEE524.01
7	State the advantages of Unity Power Factor?	Remember	CO 1	AEE524.01
8	What are the methods for Power Factor Improvement?	Remember	CO 1	AEE524.02
9	Why Compensation Techniques are used in Power Systems?	Remember	CO 1	AEE524.02
10	How is the reactive power controlled, using FACTS devices?	Remember	CO 1	AEE524.02
11	What are the different power electronic switching devices?.	Remember	CO 1	AEE524.02
12	Different compensation techniques used in power system?	Remember	CO 1	AEE524.02
13	What are the Types of FACTS Controllers	Understand	CO 1	AEE524.03
14	Define STATCOM and SVC?	Understand	CO 1	AEE524.03
15	Define TCR and TSR? Define STATCOM and SVC?	Remember	CO 1	AEE524.03
16	Define SSSC, IPFC and UPFC?	Understand	CO 1	AEE524.03
17	What is role of action of TCSR and TSSR?	Understand	CO 1	AEE524.03
18	What is role of action of IPFC and UPFC?	Remember	CO 1	AEE524.03
19	Why IPC is used in Power Systems?	Understand	CO 1	AEE524.03
20	State the Difference between HVDC and FACTS?	Remember	CO 1	AEE524.03
	Part - B (Long Answer Question			
1	What are FACTS controllers and explain different categories of FACTS controllers?	Understand	CO 1	AEE524.01
2	Name and explain different types of stability issues that limit transmission capability	Understand	CO 1	AEE524.01
3	Explain the effect of shunt and series Compensation on power transmission capacity of a short symmetrical transmission line.	Understand	CO 1	AEE524.02
4	Compare Modern Shunt Compensator and Series Compensator in detail.	Understand	CO 1	AEE524.02
5	What is meant by Active and Reactive Compensation? Discuss the effects of various types of Passive Compensation on power transmission capacity with necessary diagrams and expressions?	Understand	CO 1	AEE524.02
6	Discuss the general features of shunt compensators with the help of a simplified system model?	Understand	CO 1	AEE524.02
7	Explain how shunt compensation can be achieved with ideal mid point reactive compensators. What is the effect of multi point segmentation on line performance?	Understand	CO 1	AEE524.02
8	Discuss how to prevent voltage instability at the end of line by using shunt Compensation	Understand	CO 1	AEE524.02
9	Explain temporary over voltages in power systems?	Understand	CO 1	AEE524.01
10	What do you mean by loading capability and explain different kinds of limitations? What is the importance of controllable parameters?	Understand	CO 1	AEE524.01
11	Discuss the technical benefits of FACTS technology. Explain the power flow considerations of a transmission interconnected systems	Understand	CO 1	AEE524.01
12	What are the objectives of Line Compensation? Explain the effect of series and shunt compensation on power transmission capacity of a short symmetrical transmission line. .	Understand	CO 1	AEE524.02
13	Compare the synchronous condenser, Phase Shifting Transformer and Fixed Series Compensator?	Understand	CO 1	AEE524.03
14	Describe briefly the load and system compensation schemes..	Understand	CO 1	AEE524.03
15	Explain the reactive power compensation at the sending, mid-point and	Understand	CO 1	AEE524.03

	receiving ends of the transmission lines.			
16	Explain about various type of shunt controller?	Understand	CO 1	AEE524.03
17	Explain about various type of series controller?	Understand	CO 1	AEE524.03
18	Explain how the over voltages are occurred in power systems?	Understand	CO 1	AEE524.03
19	How the voltage instability obtained at the end of line by using shunt Compensation?	Understand	CO 1	AEE524.02
20	Explain the Phase Shifting Transformer	Understand	CO 1	AEE524.03
Part - C (Problem Solving and Critical Thinking Questions)				
1	Consider a 735kVsymmetrical losseless transmission line with L=0.932mH/km, C=12.2nF/km and a line length of 900km.Frequency 50Hz. If a midpoint compensator is installed to regulate the midpoint voltage at 1.02puwith a rating of -400MVAR to +400MVAR, calculate the loading limits for which the compensator would regulate the bus voltage at 1.02p.u	Analyse	CO 1	AEE524.01
2	A 400 kV, 50 Hz, 600 km long symmetrical line is operated at the rated voltage. (a) A series capacitor is connected at the midpoint of the line to double the power transmitted. What is its reactance? (b) A shunt capacitor of value 450 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.97, compute the power flow in the line corresponding to this operating point.	Analyse	CO 1	AEE524.02
3	For the line described in the above question, a STATCOM is connected at the midpoint instead of a shunt capacitor of 450 ohms. If the operating point for both cases is same with Vm = 0:97, (a) compute the reactive current drawn by the STATCOM. (b) What is the maximum power flow in the line with constant reactive current calculated in (a).	Analyse	CO 1	AEE524.02
4	A 125kVsymmetrical losse less transmission line with L=0.254mH/km, C=25.2nF/km and a line length of 100km.Frequency 50Hz. If a midpoint compensator is installed to regulate the midpoint voltage at 1.02puwith a rating of -200MVAR to +200MVAR, calculate the loading limits for which the compensator would regulate the bus voltage at 1.02p.u	Analyse	CO 1	AEE524.01
5	A 440 kV, 50 Hz, 250 km long symmetrical line is operated at the rated voltage. (a) A series capacitor is connected at the midpoint of the line to double the power transmitted. What is its reactance? (b) A shunt capacitor of value 150 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.87, compute the power flow in the line corresponding to this operating point.	Analyse	CO 1	AEE524.01
6	A 825kVsymmetrical loss less transmission line with L=0.254mH/km, C=45.2nF/km and a line length of 100km.Frequency 50Hz. If a midpoint compensator is installed to regulate the midpoint voltage at 1.02puwith a rating of -10MVAR to +10MVAR, calculate the loading limits for which the compensator would regulate the bus voltage at 1.02p.u	Analyse	CO 1	AEE524.01
7	For the line described in the above question, a STATCOM is connected at the midpoint instead of a shunt capacitor of 50 ohms. If the operating point for both cases is same with Vm = 0:27, (a) compute the reactive current drawn by the STATCOM. (b) What is the maximum power flow in the line with constant reactive current calculated in (a).	Analyse	CO 1	AEE524.01
8	Analyse the shunt compensation can be achieved with ideal mid point reactive compensators.	Analyse	CO 1	AEE524.01
9	A 320 kV, 50 Hz, 850 km long symmetrical line is operated at the rated voltage. Calculate a shunt capacitor of value 560 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.67, compute the power flow in the line corresponding to this operating point.	Analyse	CO 1	AEE524.01
10	Analyse the operation synchronous condenser, Phase Shifting Transformer and Fixed Series Compensator	Analyse	CO 1	AEE524.01
	UNIT-II			
STATIC VAR COMPENSATOR (SVC)				
Part – A (Short Answer Questions)				
1	What are the various controller parameters	Understand	CO 2	AEE524.04

2	What is use of SVC in electrical power system networks	Understand	CO 2	AEE524.04
3	List the application of SVC regulator .	Understand	CO 2	AEE524.04
4	What is a SVC.	Understand	CO 2	AEE524.04
5	Mention the ole of SVC in preventing voltage instability.	Remember	CO 2	AEE524.04
6	What is the main problem with multiple SVCs in a power system network.	Understand	CO 2	AEE524.04
7	What are the functional benefits of SVC?	Remember	CO 2	AEE524.04
8	How the voltage stability is maintained using SVC in power system	Understand	CO 2	AEE524.04
9	List the advantages of the slope in the SVC dynamic characteristics	Understand	CO 2	AEE524.04
10	List the two ways of modeling voltage regulator using SVC.	Understand	CO 2	AEE524.05
11	Write the factors to be considered for designing SVC to regulate mid-point voltage	Remember	CO 2	AEE524.06
12	What is the effect of mismatched TSC-TCR in SVC operation?	Remember	CO 2	AEE524.05
13	What is PSDC?	Understand	CO 2	AEE524.05
14	Define effective short circuit ratio of SVC?	Understand	CO 2	AEE524.04
15	Explain different methods of controllable VAR generation ?	Understand	CO 2	AEE524.04
16	Distinguish between transient stability and steady state stability in power flow systems.	Remember	CO 2	AEE524.05
17	What are the different cases involved in power angle curves of a SMIB system?	Remember	CO 2	AEE524.05
18	What is the objective of SVC enhancement in transient stability?	Remember	CO 2	AEE524.05
19	Write short notes on prevention of voltage instability.	Remember	CO 2	AEE524.04
20	Explain TSC & TCR?	Remember	CO 2	AEE524.06
Part - B (Long Answer Questions)				
1	Explain the design of SVC voltage regulator. Also discuss the influence of SVC on system voltage.	Understand	CO 2	AEE524.04
2	Using a general schematic diagram, explain the three basic modes of SVC control in detail	Understand	CO 2	AEE524.04
3	Discuss in detail the effect of SVC for the enhancement of transient stability	Understand	CO 2	AEE524.04
4	Explain the application of SVC for prevention of voltage instability	Understand	CO 2	AEE524.04
5	How do you enhance the damping in power system using SVC?	Understand	CO 2	AEE524.05
6	Explain the design of SVC voltage regulator and discuss the voltage control capability of SVC. What are the advantages of slope in dynamic characteristics of SVC?.	Understand	CO 2	AEE524.06
7	Discuss in detail about the role of SVC in improving the stability limit and enhancing the power system damping.	Understand	CO 2	AEE524.06
8	Describe the construction and operating characteristics of synchronous condensers.	Understand	CO 2	AEE524.05
9	Derive and explain the series and shunt compensation of symmetrical transmission lines.	Understand	CO 2	AEE524.05
10	Explain the modeling of static VAR compensator for load flow analysis	Understand	CO 2	AEE524.05
11	Explain the principle of midpoint voltage regulation of a transmission line. Explain how midpoint voltage regulation for a transmission line increases the transient stability margin?	Understand	CO 2	AEE524.05
12	Explain the operation of two-machine Power system with an ideal midpoint reactive compensator with an equivalent circuit and necessary phasor diagram	Understand	CO 2	AEE524.05
13	Deduce the VI characteristic of SVC with FC and TCR in detail. Draw the Schematic and explain the basic operation of SVC?	Understand	CO 2	AEE524.04
14	Explain the modeling of static VAR compensator for stability studies.	Understand	CO 2	AEE524.05
15	Explain in detail about the role of SVC in enhancing the steady state power limit and power system damping	Understand	CO 2	AEE524.05
16	Write the various applications of SVC.	Understand	CO 2	AEE524.06
17	Compare the performance of SVC with fixed compensation	Understand	CO 2	AEE524.06
18	Show that with SVC transient stability margin can be improved by enhancing synchronizing torque. Derive the necessary equations	Understand	CO 2	AEE524.06
19	Describe the working principle of the two types of Static Var Compensators SVC with neat schematic diagrams	Understand	CO 2	AEE524.04
20	Draw the IEEE basic model for the SVC control system and explain each block?	Understand	CO 2	AEE524.04
Part - C (Problem Solving and Critical Thinking Questions)				

1	A 400KV,50 Hz,600 km long symmetrical line is operated at the rated voltage. (i)What is the theoretical maximum power carried by the line ? what is the midpoint voltage corresponding to this condition ? (ii) A series capacitor is connected at the midpoint of the line to double the power transmitted. What is its reactance ? (iii) A shunt capacitor of value 450 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.97, compute the power flow in the line corresponding to this operating point. Data : L=1 mH/Km, C= 11.1 *10-9 F/km	Analyse	CO 2	AEE524.05
2	Discuss in detail about the static and dynamic V-I characteristics of SVC?	Understand	CO 2	AEE524.05
3	Explain how the SVC can be used to enhance the power transfer capacity of the transmission line?	Understand	CO 2	AEE524.04
4	Derive the voltage and power expression in SVC?	Understand	CO 2	AEE524.04
5	Consider a SMIB system in which the synchronous machine is generating 0.9 p.u MW and 0.3 p.uMVAR. The voltage of infinite bus is 0.995+j0.0p.u. The machine transient reactance is 0.3p.u and the transmission line reactance is 0.650p.u (i) Calculate what should be the net susceptance of SVC to matain Vm at 1p.u (ii) Given B=susceptance offered by transformer =0.025p.u on 100MVA, 400kv base find B_{TCR} and B_{TSC}. Given rating of one capacitor bank is 50MVA.	Analyse	CO 2	AEE524.05
6	A three phase, 400 kV, 50 Hz, 900 km long line is operating with VS = VR = V = 1:0 p.u. and ± = 60±. A SVC is planned to be connected at the midpoint of the line to increase power transfer capability. The limits on the control range correspond to ± = 30± and ± = 90±. (a) Find the limits of SVC susceptance if the slope (Xs) of the control characteristic is (i) 0.0 and (ii) 0.05 p.u. (b) What is the maximum power °ow in the line for the two cases, (i) Xs = 0:0 and (ii) Xs = 0:05 (Data : Zn = 300 ohms, ¯ = 0:06±/km).	Analyse	CO 2	AEE524.04
7	The voltage regulator of a SVC is designed for an ESCR of 2.0. If the slope of the control characteristics is 0.05 p.u., determine the transfer function of the regulator. If the operating value of ESCR is 5.0, what is the response time (to reach 95% of the ¯nal value) and the steady state change in the SVC voltage if Vref is increased by 0.05 p.u. Assume the system frequency to be 50Hz.	Analyse	CO 2	AEE524.06
8	Consider a SMIB system in which the synchronous machine is generating 0.8 p.u MW and 0.5 p.u MVAR. The voltage of infinite bus is 0.584+j0.021p.u. The machine transient reactance is 0.3p.u and the transmission line reactance is 0.50p.u (i) Calculate what should be the net susceptance of SVC to matain Vm at 1p.u (ii) Given B=susceptance offered by transformer =0.025p.u on 200MVA, 420kv base find B_{TCR} and B_{TSC}. Given rating of one capacitor bank is 550MVA	Analyse	CO 2	AEE524.05
9	The voltage regulator of a SVC is designed for an ESCR of 5.0. If the slope of the control characteristics is 0.04 p.u., determine the transfer function of the regulator. If the operating value of ESCR is 4.0, what is the response time (to reach 90% of the ¯nal value) and the steady state change in the SVC voltage if Vref is increased by 0.09 p.u. Assume the system frequency to be 50Hz.	Analyse	CO 2	AEE524.05
10	A 320KV,50 Hz,100 km long symmetrical line is operated at the rated voltage. (i) What is the theoretical maximum power carried by the line ? what is the midpoint voltage corresponding to this condition ? (ii) A series capacitor is connected at the midpoint of the line to double the power transmitted. What is its reactance ? (iii) A shunt capacitor of value 52 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.97, compute the power flow in the line corresponding to this operating point. Data : L=1.2 mH/Km, C= 5 *10-9 F/km	Analyse	CO 2	AEE524.05
	UNIT–III			
	THYRISTOR AND GTO THYRISTOR CONTROLLED SERIES CAPACITORS (TCSC and GCSC)			

Part - A (Short Answer Questions)				
1	What is meant by TCSC?	Remember	CO 3	AEE524.07
2	Give short notes on Bypassed- thyristor mode.	Remember	CO 3	AEE524.07
3	Give short notes on Blocked - thyristor mode.	Understand	CO 3	AEE524.07
4	Give short notes on inductive Vernier mode.	Remember	CO 3	AEE524.07
5	What are the conclusions made from the TCSC modes of operation?	Remember	CO 3	AEE524.08
6	What are the modeling techniques involved in TCSC	Understand	CO 3	AEE524.09
7	What is the need for modeling of a TCSC	Understand	CO 3	AEE524.09
8	What is reactance boost factor of a TCSC model	Remember	CO 3	AEE524.09
9	Write short notes on Transient stability model	Understand	CO 3	AEE524.09
10	Write down the TCSC base reactance value	Understand	CO 3	AEE524.09
CIE-II				
11	What is long term stability model.	Understand	CO 3	AEE524.09
12	Write down the expression for proportional controller gain and integral controller gain	Understand	CO 3	AEE524.08
13	What is the need for improvement in the TCSC system stability limit	Understand	CO 3	AEE524.08
14	What are functions of damping controller?	Understand	CO 3	AEE524.07
15	Write short notes on bang-bang control	Understand	CO 3	AEE524.08
16	What are the different types of series compensators?	Understand	CO 3	AEE524.07
17	What are the local auxiliary signals for TCSC modulation?	Understand	CO 3	AEE524.07
18	What are the remote auxiliary signals for TCSC modulation	Understand	CO 3	AEE524.08
19	Why some range of the firing angle delay is inhibited in the operation of TCSC	Understand	CO 3	AEE524.08
20	Explain operation principle of TCSC?	Understand	CO 3	AEE524.07
Part – B (Long Answer Questions)				
1	Explain the different modes of operation of TCSC and its characteristics.	Understand	CO 3	AEE524.08
2	Explain the variable reactance models of TCSC	Understand	CO 3	AEE524.09
3	Analyze the capability of TCSC in damping the oscillation of power system	Understand	CO 3	AEE524.08
4	What is Bang-Bang Control and Explain the Auxiliary signal and its types in detail.	Understand	CO 3	AEE524.09
5	Explain the voltage collapse prevention of TCSC	Understand	CO 3	AEE524.07
6	Explain the modelling of TCSC for constant current and constant angle control	Understand	CO 3	AEE524.09
7	Explain the Applications of TCSC	Understand	CO 3	AEE524.07
8	Explain the analysis of TCSC, With a neat block diagram	Understand	CO 3	AEE524.08
9	Explain the power flow model of TCSC	Understand	CO 3	AEE524.08
10	Derive the expression of TCSC for the time interval ($-\beta \leq wt \leq \beta$)	Understand	CO 3	AEE524.08
CIE-II				
11	Explain the modeling TCSC and GCSC for stability studies	Understand	CO 3	AEE524.09
12	Explain in detail the Concepts of controlled series compensation	Understand	CO 3	AEE524.09
13	Explain the modeling of TCSC and GCSC for load flow studies	Understand	CO 3	AEE524.09
14	Describe control schemes of SSSC (static series synchronous compensator).	Understand	CO 3	AEE524.09
15	Draw the power angle characteristics of SSSC .	Understand	CO 3	AEE524.09
16	What are the different variable impedance type series compensators? Explain any one .	Understand	CO 3	AEE524.09
17	Derive transient stability and long term stability model	Understand	CO 3	AEE524.09
18	Discuss the advantages of TCSC in detail	Understand	CO 3	AEE524.09
19	Describe the steps to be followed for SSR mitigation by TCSC	Understand	CO 3	AEE524.09
20	Draw the single line diagrams of TCSC and SSSC with a clear explanation?	Understand	CO 3	AEE524.09
Part – C (Problem Solving and Critical Thinking)				
1	The analysis of TCSC operation in the vernier-control mode.	Analyse	CO 3	AEE524.09
2	Consider the SMIB system in which the synchronous machine is generating 0.9p.u MW and 0.25p.u MVAR. The infinite bus voltage is 1 at angle of 0. The machine transient reactance is 0.65 p.u. calculate the value of net reactance offered by the TCSC, the degree of series compensation and the voltage that has be injected by the TCSC to enhance the power flow to 1.0p.u	Analyse	CO 3	AEE524.08

3	The voltage regulator of a SVC is designed for an ESCR of 5.0. If the slope of the control characteristics is 0.04 p.u., determine the transfer function of the regulator. If the operating value of ESCR is 4.0, what is the response time (to reach 90% of the ¯nal value) and the steady state change in the SVC voltage if Vref is increased by 0.09 p.u. Assume the system frequency to be 50Hz.	Analyse	CO 3	AEE524.08
4	Consider the SMIB system in which the synchronous machine is generating 0.85 p.u MW and 0.25p.u MVAR. The infinite bus voltage is 1.5 at angle of 0.45 The machine transient reactance is 0.65 p.u. calculate the value of net reactance offered by the TCSC, the degree of series compensation and the voltage that has be injected by the TCSC to enhance the power flow to 1.0p.u	Analyse	CO 3	AEE524.08
5	Analyse the modeling TCSC and GCSC for stability studies	Analyse	CO 3	AEE524.09
	CIE-II			
6	Illustrate the complete modelling of TCSC for constant angle control	Analyse	CO 3	AEE524.08
7	Explain the controlling functions of TCSC?	Analyse	CO 3	AEE524.08
8	Analyse the mitigation of Sub synchronous Resonance with TCSC and GCSC	Analyse	CO 3	AEE524.09
9	Illustrate the modelling of TCSC for SSR Analysis	Analyse	CO 3	AEE524.09
10	Explain the analysis of SSR with GCSC?	Analyse	CO 3	AEE524.08
	UNIT –IV			
	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS			
	Part – A (Short Answer Questions)			
1	What is meant by STATCOM.	Remember	CO 4	AEE524.10
2	What are the common advantages of STATCOM?	Remember	CO 4	AEE524.10
3	Write short notes on principle of operation of STATCOM..	Remember	CO 4	AEE524.10
4	Why the converters (STATCOM) absorb the small amount of real power from the ac system?.	Remember	CO 4	AEE524.10
5	Write short on UPFC	Understand	CO 4	AEE524.12
6	What are the functions of series converter in the UPFC.	Remember	CO 4	AEE524.12
7	What are the functions of shunt converter in the UPFC?	Understand	CO 4	AEE524.12
8	What are the operating variable constraints of UPFC	Understand	CO 4	AEE524.12
9	What was the effect of damping by using UPFC in case study power system transmission lines?	Understand	CO 4	AEE524.12
10	List some application of STATCOM	Understand	CO 4	AEE524.10
11	State the function of converter 1 in UPFC	Remember	CO 4	AEE524.12
12	What is meant by SSR	Understand	CO 4	AEE524.10
13	What is the importance of V-I characteristics of STATCOM?	Understand	CO 4	AEE524.10
14	Differentiate STATCOM and SSSC	Understand	CO 4	AEE524.10
15	What is the role of dc link in UPFC	Remember	CO 4	AEE524.12
16	Distinguish between UPFC and IPFC	Understand	CO 4	AEE524.12
17	Define IPFC?	Understand	CO 4	AEE524.12
18	Explain the two basic concepts incorporated into UPFC?	Remember	CO 4	AEE524.12
19	State the advantages of UPFC over other FACTS devices.	Remember	CO 4	AEE524.12
20	Why UPFC is called the most versatile converter?	Understand	CO 4	AEE524.12
	Part – B (Long Answer Questions)			
1	Explain the principle of operation and VI characteristics of STATCOM with neat sketch?	Understand	CO 4	AEE524.10
2	Explain the operation of UPFC at different modes with phasor diagram?	Understand	CO 4	AEE524.12
3	Discuss in detail about the modeling of SSSC in load flow and transient stability studies?	Understand	CO 4	AEE524.11
4	Write the applications of STATCOM in power system?	Understand	CO 4	AEE524.12
5	Show that with Power-angle curve the STATCOM can enhance the transient stability margin?	Understand	CO 4	AEE524.10
6	Define UPFC, draw its circuit diagram and explain the working principle	Understand	CO 4	AEE524.12
7	Explain the protection of UPFC and derive the expression of UPFC connected at the mid point?	Understand	CO 4	AEE524.12
8	Discuss in detail about the modeling of SSSC in load flow and transient stability studies?	Understand	CO 4	AEE524.10
9	Discuss in detail about the modeling of SSSC in load flow and transient stability studies?	Understand	CO 4	AEE524.11

10	Compare the performance between STATCOM and SVC?	Understand	CO 4	AEE524.10
11	With the help of phasor diagrams, explain how UPFC provides voltage regulation, line impedance compensation and phase shifting?	Understand	CO 4	AEE524.12
12	Discuss the roles of shunt and series converters in unified power flow controller	Understand	CO 4	AEE524.10
13	What is the advantage of regulation slope control? Draw and explain the control scheme for STATCOM with regulation slope control.	Understand	CO 4	AEE524.11
14	What is a STATCOM? Discuss its advantages and applications.	Understand	CO 4	AEE524.10
15	What is interline power flow controller? With a schematic diagram, explain its working. Also list its applications?	Understand	CO 4	AEE524.12
16	Differentiate between unified control and coordinated control schemes.	Understand	CO 4	AEE524.12
17	Give a comparison between UPFC to IPFC.	Understand	CO 4	AEE524.12
18	Explain the modeling of UPFC and IPFC for load flow studies,	Understand	CO 4	AEE524.12
19	Explain the modeling of STATCOM and SSSC for transient stability studies	Understand	CO 4	AEE524.11
20	Explain the applications of the UPFC anf IPFC in detail?	Understand	CO 4	AEE524.12
	Part – C (Problem Solving and Critical Thinking)			
1	Explain the Simplified Analysis of a three phase six pulse STATCOM?	Understand	CO 4	AEE524.10
2	Illustrate the control of TYPE 1 Converter with block diagrams	Understand	CO 4	AEE524.10
3	Illustrate the control of TYPE 2 Converter with block diagrams	Understand	CO 4	AEE524.10
4	Analyse the Power angle curve of SSSC?	Analyse	CO 4	AEE524.11
5	Explain the power flow with constant active and reactive voltage injection in the line .	Understand	CO 4	AEE524.12
6	Analyse the operation of UPFC when it is connected at the Sending End?	Analyse	CO 4	AEE524.12
7	Analyse the operation of UPFC when it is connected at the Receving End?	Analyse	CO 4	AEE524.12
8	Explain the operation of Converters and its control of UPFC?	Understand	CO 4	AEE524.12
9	Explain the SSR charateristics of UPFC?	Understand	CO 4	AEE524.12
10	Explain the Application of IPC as Fault Current Limiting Transformer?	Understand	CO 4	AEE524.10
	UNIT -V			
	CONTROLLERS AND THEIR COORDINATION			
	Part - A (Short Answer Questions)			
1	What are the Influence of SVC Sites and the Nature of Loads?	Understand	CO 5	AEE524.13
2	What are the major benefits of SVC application in HVDC transmission systems?	Remember	CO 5	AEE524.13
3	What are the frequency ranges of the different control interactions?	Understand	CO 5	AEE524.13
4	What is meant by Controllers interactions?	Remember	CO 5	AEE524.13
5	What are the types of controllers interactions?	Remember	CO 5	AEE524.13
6	What is meant by steady state interactions ?	Remember	CO 5	AEE524.13
7	What is the analysis method used to determine the steady state interaction?	Understand	CO 5	AEE524.14
8	What is meant by Electromechanical oscillation interaction?	Understand	CO 5	AEE524.14
9	What is the analysis method used to determine the Electromechanical oscillation interaction	Understand	CO 5	AEE524.14
10	What is meant by control or small signal oscillation interaction?	Understand	CO 5	AEE524.14
11	What is the analysis method used to determine the small signal oscillation interaction	Remember	CO 5	AEE524.15
12	What is meant by Sub Synchronous resonance interactions?	Understand	CO 5	AEE524.15
13	How is coordination of FACTS controllers carried out?	Remember	CO 5	AEE524.13
14	What do you understand by coordination of FACTS controllers?	Understand	CO 5	AEE524.13
15	What is the need for coordination of different FACTS controllers	Remember	CO 5	AEE524.13
16	Write the assumptions of control coordination for damping enhancement?	Understand	CO 5	AEE524.13
17	What are the basics procedures of the controller design	Remember	CO 5	AEE524.14
18	Name the optimization tool used for controller coordination	Understand	CO 5	AEE524.14
19	How could the adverse interactions of controllers be identified?	Remember	CO 5	AEE524.14
20	What is genetic algorithm (GA)?	Understand	CO 5	AEE524.15
	Part - B (Long Answer Questions)			
1	Explain the FACTs Controller interactions?	Understand	CO 5	AEE524.13
2	Explain the SVC–SVC interaction?	Understand	CO 5	AEE524.13
3	Explain the co-ordination of multiple controllers using linear control techniques?	Understand	CO 5	AEE524.14
4	Describe the Quantitative treatment of control coordination?	Understand	CO 5	AEE524.15

5	Discuss the different classification of Controller Interaction?	Understand	CO 5	AEE524.13
6	Describe the genetic algorithm based control co-ordination	Understand	CO 5	AEE524.15
7	Explain the coordinated tuning of FACTS controllers using Genetic Algorithm for damping power system oscillation	Understand	CO 5	AEE524.14
8	Discuss Linear quadratic regulator based techniques, Control coordination using genetic algorithms in detail	Understand	CO 5	AEE524.15
9	Explain the Quantitative Treatment in FACTS Controller	Understand	CO 5	AEE524.15
10	Explain in detail about Electromechanical Oscillations.	Understand	CO 5	AEE524.14
11	Explain the Damping of Power Oscillations using Series FACTS Controllers?	Understand	CO 5	AEE524.14
12	Explain the Damping of Power Oscillations using Shunt FACTS Controllers?	Understand	CO 5	AEE524.14
13	Analyse the Transient Stability of a Two Machine System?	Analyse	CO 5	AEE524.14
14	Discuss Linear quadratic regulator based techniques, Global coordination Control coordination using genetic algorithms in detail	Understand	CO 5	AEE524.14
15	Explain in detail about small signal Oscillations.	Understand	CO 5	AEE524.14
16	Explain the co-ordinated tuning of FACTS controllers using power system oscillation	Understand	CO 5	AEE524.14
17	Explain the cordination of multiple controllers?	Understand	CO 5	AEE524.14
18	Explain the Controller coordination for damping enchacement?	Understand	CO 5	AEE524.14
19	Explain the Sub Synchronous resonance interactions	Understand	CO 5	AEE524.14
20	Explain the steady state interactions	Understand	CO 5	AEE524.14
Part – C (Problem Solving and Critical Thinking)				
1	Illustarte the Quantitative Treatment of FACTS Controllers in details	Understand	CO 5	AEE524.13
2	Analyse the Linear quadratic regulator based techniques	Analyse	CO 5	AEE524.13
3	Analyse the Steady State Stability of a Two Machine System?	Understand	CO 5	AEE524.14
4	Analyse the methods used to determine the steady state interaction	Understand	CO 5	AEE524.14
5	Illustrate the analysis method used to determine the Electromechanical oscillation interaction	Understand	CO 5	AEE524.15
6	Explain the assumptions of control coordination for damping enhancement	Understand	CO 5	AEE524.15
7	Explain the adverse interactions of controllers	Understand	CO 5	AEE524.14
8	Explain in detail the optimization tools used for controller coordination	Understand	CO 5	AEE524.13
9	Demostrate the basics procedures of the controller design	Understand	CO 5	AEE524.14
10	Explain the genetic algorithm (GA) in detail?	Understand	CO 5	AEE524.13

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