

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



VIII SEMESTER

1905801 FLEXIBLE AC TRANSMISSION SYSTEMS

Regulation – 2019

Academic Year 2022–23 (Even)

Prepared by

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SUBJECT: 1905801 FLEXIBLE AC TRANSMISSION SYSTEMS

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UNIT I - INTRODUCTION				
SYLLABUS: Real and reactive power control in electrical power transmission lines– loads & system compensation-Uncompensated transmission line–shunt and series compensation.				
PART-A				
Q.No	Questions	BT Level	Competence	COs
1.	List the limits of line loading capability.	1	Remember	CO1
2.	Mention the need of reactive power control in electrical power transmission lines.	1	Remember	CO1
3.	What are the objectives of FACTS?	1	Remember	CO1
4.	Distinguish between load compensation and system compensation.	2	Understand	CO1
5.	What are the different types of compensation schemes?	2	Apply	CO1
6.	How the reactive power is controlled in FACTS devices?	2	Understand	CO1
7.	Define Symmetrical Line,	2	Evaluate	CO1
8.	Write the expression for the real and reactive power flowing through a transmission line.	1	Apply	CO1
9.	State the objectives of FACTS controllers.	1	Apply	CO1
10.	Illustrate the phasor diagram for the load compensation.	1	Remember	CO1
11.	Mention the limitations of the AC system.	3	Analyze	CO1
12.	List the classification of FACTS controllers.	3	Remember	CO1
13.	Compare the difference between the series and shunt compensation.	3	Analyze	CO1
14.	Illustrate the phasor diagram for the system	4	Analyze	CO1

	compensation.			
15.	List the advantage of FACTS technology	4	Evaluate	CO1
16.	Define Linear loads.	4	Understand	CO1
17.	List the conventional control mechanisms to control the real and reactive power in a power system.	6	Create	CO1
18.	Define nonlinear loads.	5	Understand	CO1
19.	Give an example of shunt connected FACTS devices.	5	Understand	CO1
20.	Give an example of series connected FACTS devices.	6	Understand	CO1
21.	Give an example of shunt-series connected FACTS devices.	1	Understand	CO1
22.	Compare the difference between compensated and uncompensated power system.	1	Remember	CO1
23.	What are inherent limitations of conventional FACTS devices?	3	Analyze	CO1
24.	Compare the active and passive VAR compensation.	2	Understand	CO1
PART-B				
1.	Derive an expression for power transfer between the two bus systems assuming that transmission line is lossless.	2	Evaluate	CO1
2.	Explain the concept of flexible AC transmission system?	3	Apply	CO1
3.	Explain the effect of shunt and series compensation on power transmission capacity of a short symmetrical transmission line.	1	Evaluate	CO1
4.	Give a brief note on shunt compensation that is required to enhance the power transfer capability of a long transmission line.	1	Remember	CO1
5.	Explain briefly about load compensation.	3	Remember	CO1
6.	Explain the factors which limits the Loading Capability of a power system.	2	Understand	CO1
7.	Explain the principle, working and characteristics of static VAR compensator with a neat circuit diagram.	2	Analyze	CO1
8.	Derive the real and reactive power in ac system and sketch the instantaneous power waveforms.	4	Understand	CO1
9.	Explain load compensation with neat phasor diagram.	4	Apply	CO1

10.	Explain in detail about the classification of different FACTS controllers.	1	Remember	CO1
11.	Explain the V-I capability characteristics of single module TCSC.	1	Remember	CO1
12.	Describe briefly the load and system compensation schemes.	4	Analyze	CO1
13.	Explain the working and characteristics of Thyristor switched series capacitor with a neat diagram.	4	Analyze	CO1
14.	Give a brief note on series compensation that is required to enhance the power transfer capability	5	Analyze	CO1
15.	Explain the operation of UPFC with diagram.	4	Apply	CO1
16.	Discuss the possible control actions to maintain the voltage at rated value in transmission line.	5	Evaluating	CO1
17.	With necessary phasor diagram explain briefly about System compensation.	6	Creating	CO1
PART-C				
1.	Explain the system and load compensation by considering the short lossless transmission line.	5	Analyze	CO1
2.	Explain the mid - point voltage conditions of a symmetrical line.	4	Evaluate	CO1
3.	Explain the reactive power compensation at the sending, mid-point and receiving ends of the transmission lines.	5	Create	CO1
4.	Discuss briefly about the variation of the TCSC reactance with firing angle 'alpha'.	4	Evaluate	CO1
5.	Explain with neat circuit diagram about fixed capacitor-Thyristor controlled reactor.	5	Analyze	CO1

UNIT II – STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS				
SYLLABUS: Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–TCR-FC-TCR- Modelling of SVC for power flow and fast transient stability– Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.				
PART-A				
	Questions	BT Level	Competence	Cos
1.	List the application of SVC regulator.	2	Remember	CO2
2.	Draw the various configurations of SVC.	2	Remember	CO2
3.	List the advantages of the slope in the SVC dynamic characteristics.	2	Remember	CO2

4.	What are the three basic modes of SVC control?	1	Remember	CO2
5.	Write the various applications of SVC.	1	Remember	CO2
6.	State the principle of SVC.	1	Understand	CO2
7.	Define SVC.	2	Apply	CO2
8.	Draw the power angle curve of SMIB system with midpoint SVC.	1	Analyze	CO2
9.	Draw the V-I characteristics of FC-TCR SVC.	1	Understand	CO2
10.	State the capabilities of SVC.	1	Understand	CO2
11.	Write any two applications of synchronous condensers.	3	Remember	CO2
12.	What are the different power electronic switching devices?	3	Understand	CO2
13.	What are the few approximations made in multi modal decomposition?	3	Remember	CO2
14.	Define voltage stability	4	Create	CO2
15.	Mention the characteristics used in SVC voltage control.	4	Evaluate	CO2
16.	Draw the MSC-TCR SVS configuration.	4	Evaluate	CO2
17.	List the two ways of modeling the voltage regulator using SVC.	6	Analyze	CO2
18.	Draw the TSC-TCR SVC congiguration.	5	Analyze	CO2
19.	Why shunt compensation is attempted always at midpoint?	5	Understand	CO2
20.	Draw the block diagram of SVC voltage regulator in integrated current droop form.	6	Create	CO2
21.	Define the term Static VAR Compensator.	1	Remember	CO2
22.	Draw the V-I characteristics of SVC	1	Remember	CO2
23.	Draw the operating characteristics of SR compensator	2	Apply	CO2
24.	Define droop in V-I characteristics of VSC.	2	Apply	CO2
PART-B				
1.	Elaborate the Advantages of the Slope in the FC-TCR SVC Dynamic Characteristic in detail.	1	Remember	CO2
2.	Derive the Transfer function & explain Dynamic performance of static VAR compensator.	1	Remember	CO2
3.	Explain the V-I characteristic of SVC.	1	Remember	CO2
4.	Explain how transient stability is enhanced due to static VAR compensator	2	Apply	CO2
5.	Explain how the SVC increase the power transfers capability in steady state operation.	3	Remember	CO2
6.	Describe the working principle of the two types of Static Var Compensator (SVC) with neat	2	Understand	CO2

	schematic diagrams.			
7.	Discuss the Advantages of the Slope in the SVC Dynamic Characteristic in detail.	2	Understand	CO2
8.	Explain the control (Influence) parameter of the SVC in the System Voltage.	2	Analyze	CO2
9.	Explain briefly how to prevent the voltage instability in a power system using SVC.	4	Analyze	CO2
10.	Show that with Power-Angle Curves the SVC can enhance the transient stability margin.	1	Analyze	CO2
11.	Write the short notes on increasing the power system damping.	1	Analyze	CO2
12.	Using a general schematic diagram, explain the three basic modes of SVC control in detail.	1	Apply	CO2
13.	Explain the design of SVC voltage regulator. Also discuss the influence of SVC on system voltage.	5	Create	CO2
14.	Derive the voltage and power expression in SVC.	4	Evaluate	CO2
15.	Derive the expression for susceptance(B) of single phase TCR.	2	Analyze	CO2
16.	List the applications of SVC. Explain any one application.	4	Evaluate	CO2
17.	How do you enhance the damping in power system using SVC?	5	Analyze	CO2
PART-C				
1.	Explain in detail about the role of SVC in enhancing the steady state power transfer limit and power system damping.	5	Analyze	CO2
2.	Derive the Transfer function & explain Dynamic performance of static VAR compensator.	4	Evaluate	CO2
3.	Explain in detail about the role of SVC in enhancing the steady state power limit and power system damping.	5	Create	CO2
4.	List the applications of SVC. Explain any two applications.	4	Evaluate	CO2
5.	Explain the modeling of SVC for load flow studies.	5	Create	CO2

**UNIT III - THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)
AND APPLICATIONS**

SYLLABUS: Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variability reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

PART-A

Q.No	Questions	BT Level	Competence	COs
1	Describe how the series compensation can be used for power oscillation damping?	1	Create	CO3
2	Draw the V-I characteristic of TCSC.	1	Arrange	CO3
3	Draw the schematic representation of TCSC.	3	Analyze	CO3
4	Give the limitation of series capacitor	3	Remember	CO3
5	Give the range of firing angle in inductive and capacitive mode of operation of TCSC.	3	Apply	CO3
6	Mention the disadvantages of fixed series compensation of transmission lines	4	Remember	CO3
7	What do you mean by variable impedances type switching converter type FACTS devices?	1	Remember	CO3
8	What are the synchronous voltage reversal (SVR) control scheme?	1	Understand	CO3
9	List the various Auxiliary signals for TCSC modulation.	4	Understand	CO3
10	List the TCSC losses.	4	Remember	CO3
11	Give the various modes of operation of TCSC.	5	Apply	CO3
12	Discuss the various limits which define the capability characteristics of TCSC.	2	Remember	CO3
13	State any two advantages of TCSC.	5	Remember	CO3
14	Define SSR.	2	Analyze	CO3
15	How voltage stability at load bus can be achieved using series compensator?	6	Understand	CO3
16	What are the effect of TCSC in SSR Problem?	6	Understand	CO3
17	Describe the various needs for variable series compensation.	1	Evaluate	CO3
18	Give the condition for transient free switching for the TSC for different residual voltage?	2	Evaluate	CO3
19	Write down the expression for equivalent impedance of a TCSC.	2	Apply	CO3
20	Define V-I capability characteristics of multi module TCSC.	1	Create	CO3
21	Define constant angle control of TCSC.	2	Apply	CO3
22	List the functions of damping control of a TCSC	1	Understand	CO3
23	What are the functions of damping control of a TCSC?	2	Analyze	CO3
24	Discus the applications of TCSC.	5	Analyze	CO3

PART-B

1	Explain fixed series compensation.	1	Analyze	CO3
2	Describe the advantages of TCSC.	2	Apply	CO3
3	Explain the need for variable series compensation.	1	Analyze	CO3
4	With neat diagram explain the Basic principle of operation of TCSC.	1	Remember	CO3
5	Explain the different modes of operation of TCSC.	2	Understand	CO3
6	Demonstrate the constant current control strategy in TCSC application.	2	Understand	CO3
7	Write short notes on Enhanced Current control & Constant Power Control of TCSC application.	2	Understand	CO3
8	Write short notes on SSR.	3	Analyze	CO3
9	Explain with a neat block diagram the closed loop control of TCSC.	2	Understand	CO3
10	Describe in detail about the sub synchronous resonance.	6	Evaluate	CO3
11	Propose the mathematical modelling of TCSC for power flow analysis	4	Remember	CO3
12	Classify the various modes of operation of TCSC.	5	Remember	CO3
13	Briefly explain voltage collapse prevention in TCSC.	4	Analyze	CO3
14	Discuss the modelling of TCSC for load flow studies.	4	Remember	CO3
15	Demonstrate the analysis of TCSC with neat sketch.	2	Understand	CO3
16	Discuss how the system damping is enhanced with the help of TCSC.	4	Analyze	CO3
17	With power angle curve explain how transient stability is improved with the series controllers.	4	Analyze	CO3
PART-C				
1.	Derive the expression of X_{TCSC} for the time interval $(-\beta \leq \omega t \leq \beta)$.	5	Analyze	CO3
2.	Discuss why present transmission system with capacitive series compensation is prone to SSR.	4	Evaluate	CO3
3	Describe the capabilities of TCSC in improving transient stability, power oscillation damping, and voltage stability applications?	5	Create	CO3
4	Discuss the modelling of the TCSC for various power system studies in detail.	4	Evaluate	CO3
5	Describe the capabilities of TCSC Firing Schemes and Synchronization.	5	Analyze	CO3

UNIT IV - VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS

SYLLABUS: Static Synchronous Compensator (STATCOM)–Principle of operation– V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load flow and transient stability studies- Dynamic voltage restorer (DVR).

PART-A

Q.No	Questions	BT Level	Competence	COs
1.	Define STATCOM.	2	Remember	CO4
2.	State the performance criteria for STATCOM.	2	Understand	CO4
3.	Draw the V-I Characteristic of STATCOM.	6	Evaluate	CO4
4.	Draw the power circuit & equivalent circuit of STATCOM.	1	Apply	CO4
5.	Mention the dynamic characteristic of STATCOM.	2	Remember	CO4
6.	Define SSSC.	1	Evaluate	CO4
7.	List the various control schemes of line compensated SSSC.	1	Remember	CO4
8.	Draw the diagram of an elementary 6 pulse VSC STATOM.	1	Remember	CO4
9.	Define Linear loads.	5	Understand	CO4
10.	List any two power system performances that can be improved by STATCOM.	1	Understand	CO4
11.	Define Non-Linear loads.	1	Understand	CO4
12.	Evaluate the functions of STATCOM.	2	Remember	CO4
13.	Analyse the various functions of SSSC.	3	Apply	CO4
14.	Discuss the applications of SSSC.	2	Analyze	CO4
15.	Construct the basic control scheme of SSSC.	6	Analyze	CO4
16.	Draw the model of SSSC for load flow studies.	1	Analyze	CO4
17.	Compare SSSC and DVR.	3	Apply	CO4
18.	Define DVR.	4	Understand	CO4
19.	Define voltage sag in distribution system.	4	Create	CO4
20.	Give the difference between the voltage sag and low voltage.	5	Remember	CO4
21.	Define voltage swell.	3	Apply	CO4
22.	Compare STATCOM and DVR.	3	Apply	CO4
23.	List any two power system performances that can be improved by SSSC.	1	Remember	CO4
24.	Compare over voltage with voltage swell.	3	Apply	CO4
PART-B				
1.	Obtain the steady state concept of STATCOM.	2	Remember	CO4
2.	Explain the basic control scheme of STATCOM.	1	Remember	CO4

3.	Explain with a neat sketch, the operating principle, V-I characteristic & application of static synchronous compensator.	1	Remember	CO4
4.	Discuss modeling of SSSC for transient stability studies.	1	Remember	CO4
5.	Describe the principle and operation of SSSC.	3	Understand	CO4
6.	With neat diagram describe the power exchange mechanism of STATCOM.	3	Understand	CO4
7.	Explain the multi-level VSC based STATCOM.	2	Apply	CO4
8.	Explain the V-I characteristics of STATCOM.	2	Apply	CO4
9.	Describe the harmonic performance of STATCOM.	4	Understand	CO4
10.	Draw and explain the steady state model of a STATCOM.	1	Evaluate	CO4
11.	Discuss the STATCOM controller for mitigating the SSR.	1	Analyze	CO4
12.	Explain the real and reactive power exchange capability of S ³ C.	6	Analyze	CO4
13.	Draw and explain the typical control system of SSSC.	4	Analyze	CO4
14.	With neat diagram explain the basic principle of operation of DVR.	5	Create	CO4
15.	Explain How the sensitive equipment's are protected against voltage sag or swell using DVR.	1	Remember	CO4
16.	With case study explain the effectiveness of the SSSC to provide a line power control.	5	Analyze	CO4
17.	Explain How SSR is mitigated using SSSC.	5	Analyze	CO4
PART-C				
1.	Explain the different operating modes of SSSC for real and reactive power exchange.	5	Analyze	CO4
2.	Draw the typical diagram of three phase dynamic voltage restorer and explain how it is mitigating the sag or swell in distribution system.	4	Evaluate	CO4
3	Consider an SMIB system in which synchronous machine is 0.95 p.u MW and 0.35 p.u MVAR at terminal voltage of	5	Create	CO4
4	Describe the operation of the SSSC and also any one of the applications.	4	Evaluate	CO4
5	Explain how the sensitive equipment is protected against induction motor starting swell using DVR.	5	Analyze	CO4

UNIT V - DVANCED FACTS CONTROLLERS				
SYLLABUS: Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC).				
PART-A				
Q.No	Questions	BT Level	Competence	Cos
1.	Draw the schematic diagram of IDVR.	2	Remember	CO5
2.	Draw the vector diagram of the DVR2 of IDVR for real power exchange.	1	Remember	CO5
3.	Define IDVR.	1	Analyze	CO5
4.	Draw the Vector diagram for pre-sag supply voltage boosting.	1	Remember	CO5
5.	Explain the basic principle of IDVR.	1	Understand	CO5
6.	Mention the role of dc link in UPFC.	2	Apply	CO5
7.	State the constraint in UPFC	2	Remember	CO5
8.	List the application of UPFC	2	Apply	CO5
9.	Draw the power transfer capability with UPFC.	3	Analyze	CO5
10	Draw the diagram of UPFC Back to back VSC with a common DC terminal capacitor.	4	Understand	CO5
11	What are the various control design issues in a FACTS controller.	4	Create	CO5
12	Define UPFC.	3	Understand	CO5
13	State the basic UPFC power flow control functions.	3		CO5
14	Draw the basic structure of IPFC.	1	Understand	CO5
15	Compare UPFC and IPFC.	1	Apply	CO5
16	Draw the real and reactive power exchange if IPFC.	4	Evaluate	CO5
17	State the salient features of UPFC.	5	Remember	CO5
18	List the advanced FACTS controllers.	6	Analyze	CO5
19	Define UPQC.	5	Understand	CO5
20	List the custom power devices.	6	Analyze	CO5
21	Is any difference in structure of UPFC and UPQC? Justify.	2	Apply	CO5
22	Define the term point of common coupling(PCC).	5	Analyze	CO5
23	Draw the left shunt UPQC configuration.	2	Apply	CO5
24	Draw the right shunt UPQC configuration.	2	Apply	CO5
PART-B				
1.	Explain the reference voltage generation for	1	Remember	CO5

	power flow control of IDVR.			
2.	Explain the control system design for power flow control mode of IDVR.	3	Remember	CO5
3.	With neat diagram explain the basic operating principle of an Interline DVR.	3	Understand	CO5
4.	What is UPFC? Draw its circuit diagram and explain the working principle as well as control principle in detail.	4	Apply	CO5
5.	Explain the constraints on the variables on which the UPFC operates.	4	Understand	CO5
6.	Explain the operation of IPFC.	4	Remember	CO5
7.	Compare the control capabilities of UPFC with IPFC.	4	Remember	CO5
8.	Compare the control capabilities of UPFC with IDVR.	2	Understand	CO5
9.	Compare the control capabilities of IPFC with IDVR.	2	Apply	CO5
10.	Explain any one of the advanced FACTS controllers.	1	Analyze	CO5
11.	Describe about the UPQC.	1	Analyze	CO5
12.	List the advanced FACTS controllers and explain.	1	Analyze	CO5
13.	Compare FACTS devices and Custom power devices.	5	Create	CO5
14.	Explain Right shunt UPQC and its characteristics.	6	Evaluate	CO5
15.	Explain about harmonic elimination using right shunt UPQC.	2	Apply	CO5
16.	Explain Left shunt UPQC and its characteristics.	6	Evaluate	CO5
17.	Discuss the left shunt UPQC control.	6	Evaluate	CO5
PART-C				
1.	Discuss the control system for voltage sag compensation of IDVR.	5	Analyze	CO5
2.	Explain the modeling procedure of UPFC in power flow studies.	4	Evaluate	CO5
3.	Draw and explain the basic control scheme of IPFC.	5	Create	CO5
4.	Compare IDVR, UPFC and IPFC.	4	Evaluate	CO5
5.	Discuss with neat sketch, the basic operating principle of UPQC.	6	Evaluate	CO5

Course Outcomes:

COs	Course Outcome
CO1	Ability to acquire the knowledge on Concepts of the start-of-art of the power system.
CO2	Ability to acquire the knowledge on Performance of VAR Compensators and its applications.
CO3	Ability to acquire the knowledge on Modeling of Thyristor Controlled Series Compensators and Power Flow analysis.
CO4	Ability to acquire the knowledge on Performance of Different FACTS Controller and Load flow analysis.
CO5	Ability to acquire the knowledge on Operation of various configurations of Advanced FACTS Controllers.

