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 2024–2025 (Even)

Prepared by

Mr.V.Sudhagar, Assistant Professor (Sr.G) / EEE

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

SUBJECT: 1905801 FLEXIBLE AC TRANSMISSION SYSTEMS

SEM / YEAR: VIII / IV

Academic Year: 2024 – 2025 (Even)

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 ($-\beta \leq wt \leq \beta$).	**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.	Analise 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^3C.	**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 wich 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.