

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



VIII SEMESTER

1905808 –High Voltage Direct Current Transmission

Regulation–2019

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Prepared by

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SUBJECT: 1905808–High Voltage Direct Current Transmission

SEM / YEAR: VIII / IV

UNIT I - INTRODUCTION

DC Power transmission technology-Comparison of AC and DC transmission system-Application of DC Transmission- Description of DC Transmission-Planning of HVDC transmission-Modern trends in HVDC technology-DC breakers-Operation problems-HVDC based on VSC-Types and applications of MTDC systems.

PART - A

Q.No.	Questions	BT Level	Competence	Course Outcome
1.	List the different types of power devices for the HVDC Transmission System.	1	Remember	CO1
2.	List the components of HVDC Transmission system.	1	Remember	CO1
3.	Summarize the difference between AC and DC Transmission System.	2	Understand	CO1
4.	Classify the types power losses occurs on thyristor.	3	Apply	CO1
5.	Compare series and parallel MTDC system.	4	Analyze	CO1
6.	Point out the any 4-HVDC projects in India.	4	Analyze	CO1
7.	Define the terms (i) Reliability (ii) Availability of HVDC Transmission System.	1	Remember	CO1
8.	Sketch the diagram and Discuss about Bipolar DC Link.	2	Understand	CO1
9.	Define the terms Economic of power transmission for AC and DC.	1	Remember	CO1
10.	Develop and sketch the diagram for series MTDC System.	6	Create	CO1
11.	Illustrated how to improve the reliability and performance can be improved or HVDC Transmission System.	3	Apply	CO1
12.	Draw and explain the block diagram of HVDC Transmission Systems,	5	Evaluate	CO1
13.	Define the terms stability limit of DC and AC Transmission with suitable sketch.	1	Remember	CO1
14.	List the applications of MTDC Systems.	1	Remember	CO1
15.	List out the two merits of AC and DC Transmission.	2	Understand	CO1
16.	What are the operating problems on HVDC Transmission System?	1	Remember	CO1
17.	List any two applications of DC Transmission.	2	Understand	CO1
18.	Distinguish between AC and DC Transmission.	2	Understand	CO1
19.	Classify the different types of DC Links.	3	Evaluate	CO1
20.	Justify the applications and need of DC Transmission.	6	Create	CO1

21.	Define Voltage Source Converter (VSC) in HVDC systems.	1	Remember	CO1
22.	List the different types of DC links used in HVDC transmission.	1	Remember	CO1
23.	Tell the purpose of DC breakers in HVDC transmission systems.	2	Understand	CO1
24.	Summarize the modern trends in HVDC technology.	2	Understand	CO1
PART – B				
1.	Explain the comparison of AC and DC Transmission System with suitable tabulation. (13)	4	Analyze	CO1
2.	Describe the applications of DC Transmission System. (13)	1	Remember	CO1
3.	Analyze the components of HVDC Transmission System. (13)	4	Analyze	CO1
4.	Examine the choice of voltage level for the planning of HVDC Transmission. (13)	6	Create	CO1
5.	Analyze the modern trends in HVDC Technology. (13)	4	Analyze	CO1
6.	Describe the following terms (i) Filters (ii) Circuit Breakers (iii) Reactive Power Source (iv) Smoothing Reactors. (13)	2	Understand	CO1
7.	With a neat diagram explain the HVDC Transmission based on Voltage Source Converters. (13)	1	Remember	CO1
8.	Discuss the advantages and disadvantages of HVDC transmission. (13)	1	Remember	CO1
9.	Discuss the following types of MTDC Systems (i) Series MTDC Systems (ii) Parallel MTDC Systems. (13)	3	Apply	CO1
10.	Explain the different types and applications of MTDC systems. (13)	2	Understand	CO1
11.	Describe the following operational problems in HVDC Transmission Systems (i) Converter Transformer (ii) Flashover performance of HVDC Converter Stations Insulators (iii) Valve Hall Fires (iv) Problems of Ground Return. (13)	1	Remember	CO1
12.	Mention the applications of High Voltage DC Transmission and also mention the advantages and disadvantages of it. (13)	2	Understand	CO1
13.	Discuss in the following the following terms (i) Power semiconductors and valves (ii) Converter Control (iii) Dc Circuit Breakers (iv) Active DC Filter (v) Capacitor Commutated Converters (vi) Ultra High Voltage DC Transmission. (13)	3	Apply	CO1
14.	How the High Voltage AC Transmission system is distinguished with High Voltage DC Transmission system. (13)	5	Evaluate	CO1
15.	Illustrate the layout of an MTDC system and explain how it can interconnect multiple grids. (13)	3	Apply	CO1
16.	Analyze the operational challenges faced by HVDC systems in harsh environmental conditions. (13)	4	Analyze	CO1
17.	Differentiate between Capacitor Commutated Converters (CCC) and Voltage Source Converters (VSC) in HVDC technology and assess their applications. (13)	4	Analyze	CO1
PART – C				

1.	Explain the following types of HVDC Transmission (i) Monopolar links (ii) Bipolar Links (iii) Homopolar Links (iv) Back to Back Links (v) Multi terminal Links. (15)	2	Understand	CO1
2.	With a neat diagram explain the components of HVDC Converter station. (15)	3	Apply	CO1
3.	Analyse the performance of AC and DC Transmission which depends on the (i) Economic of Power Transmission (ii) Technical performance-Stability and voltage control. (15)	4	Analyze	CO1
4.	Explain the following types of High Voltage Transmission System (i) AC Transmission System (ii) DC Transmission System. (15)	2	Understand	CO1
5.	Assess the role of modern trends in HVDC technology in improving grid stability and interconnection between asynchronous power systems. (15)	5	Evaluate	CO1



UNIT II-ANALYSIS OF HVDC CONVERTERS				
Line commutated converter-Analysis of Graetz circuit with and without overlap-Pulse number-Choice of converter configuration-Converter bridge characteristics-Analysis of a 12 pulse converters-Analysis of VSC topologies and firing schemes.				
PART – A				
Q.No	Questions	BT Level	Competence	Course Outcome
1.	Express the terms (i) Firing angle (ii) Pulse number of Counters.	2	Understand	CO2
2.	Illustrate the symbolic representation of HVDC Converters.	3	Apply	CO2
3.	Define the terms overlap and overlap angle in converters for HVDC Transmission.	1	Understand	CO2
4.	Mention some converters used in HVDC Systems.	1	Remember	CO2
5.	Mention the various mode of operation of rectifier characteristics.	1	Remember	CO2
6.	Differentiate the terms (i) Rectifier (ii) Inverter in converter characteristic of HVDC System in their mode and range.	2	Understand	CO2
7.	Draw the thyristor voltage wave form for inversion for 6-pulse converter.	2	Understand	CO2
8.	Analyze the concept of (i) Peak Inverse Voltage (ii) Utilization factor of HVDC Converters.	4	Analyze	CO2
9.	Mention the merits of 12 or multibrige converters.	1	Remember	CO2
10.	Define the need of snubber circuits in HVDC Transmission systems.	1	Remember	CO2
11.	Difference the terms (i) HVDC Converters (ii)Line Commutated Converters	2	Understand	CO2
12.	Justify for which applications series and parallel operations of thyristors are used in HVDC Transmission.	6	Create	CO2
13.	Explain the term valve rating in converters.	5	Evaluate	CO2
14.	Draw and Compare the Graetz circuit analysis by with and without overlap.	4	Analyze	CO2
15.	Illustrate the equivalent circuit of rectifier for HVDC System.	3	Apply	CO2
16.	Mention the assumption need to consider for the analysis of 6-pulse converter.	2	Understand	CO2
17.	Define and Draw the circuit for Two and Three valve conduction.	1	Remember	CO2
18.	Illustrate the circuit diagram for 12-Pulse Converter for HVDC System.	3	Apply	CO2
19.	Illustrate the star/delta transformer for AC Current Harmonic circuits and equation for 12-pulse converter.	3	Apply	CO2
20.	Justify the formulae for average direct voltage expression for Graetz circuits.	6	Create	CO2
21.	Define a Line Commutated Converter (LCC).	1	Remember	CO2

22.	What is the significance of the pulse number in a converter?	1	Remember	CO2
23.	How does a Line Commutated Converter (LCC) work?	2	Understand	CO2
24.	What happens when there is overlap in a Graetz circuit?	2	Understand	CO2
PART – B				
1.	Illustrate the schematic diagram of 3-phase bridge rectifier and explain its principle of operation without overlap. (13)	3	Apply	CO2
2.	What are the three models of six pulse Graetz converter ? Explain the complete analysis of model operation of converter for overlap angle less than 60 degree. (13)	1	Remember	CO2
3.	Discuss the combine characteristics for the Rectifier and Inverter. (13)	2	Understand	CO2
4.	Describe the six pulse converter bridge characteristics as rectifier and explain the different mode of operation of a 12-pulse converter for rectification. (13)	2	Understand	CO2
5.	Elaborate the 3 and 4-valve mode of conduction using the Graez circuit. (13)	1	Remember	CO2
6.	Explain the analysis of 2 & 3 valve conduction mode using Graez circuit. (13)	1	Remember	CO2
7.	Explain the various modes of operation of rectifier characteristics. (13)	4	Analyze	CO2
8.	Explain the analysis of 12-pulse converter for the Bridge type Rectifier. (13)	4	Analyze	CO2
9.	Explain the analysis of the 12-pulse converter with Bridge rectifier. (13)	1	Remember	CO2
10.	Illustrate the equivalent circuit of a rectifier ? (13)	3	Apply	CO2
11.	Explain the method for obtaining steady state solution of equations for six pulsed converter bridge with filters. (13)	2	Understand	CO2
12.	Explain the choice of converter configuration for any pulse number. (13)	2	Understand	CO2
13.	Draw the schematic circuit diagram of a 3-phase Bridge Rectifier and explain its principle of operation without overlap. (13)	6	Create	CO2
14.	With neat sketch describe the individual characteristics of converter bridge when operating as (i) Rectifier (ii) Inverter.(13)	1	Remember	CO2
15.	Apply the principles of the Graetz circuit in the analysis of Line Commutated Converters, and explain how the overlap impacts the performance of the converter. (13)	3	Apply	CO2
16.	Analyze the advantages and limitations of Voltage Source Converter (VSC)-based HVDC systems compared to Line Commutated Converters (LCC) for renewable energy integration. (13)	3	Apply	CO2
17.	Illustrate the operation of a 12-pulse converter in a HVDC system, and explain how it reduces harmonics compared to a 6-pulse converter. (13)	3	Apply	CO2

PART – C				
1.	(a) Explain the following types of converter bridge circuit characteristics (i) Rectifier (ii) Inverter. (15)	2	Understand	CO2
2.	(a) Illustrate the circuit diagram analysis of a 12-pulse converter. And also calculate (i) Average DC output voltage (ii) Current harmonics with suitable expression and wave forms. (15)	3	Apply	CO2
3.	Explain the analysis of a Voltage Source Converter(VSC) Topologies with suitable firing scheme and also obtain the expression. (15)	1	Remember	CO2
4.	For a 12 pulse converter with $q=4$, $s=3$, $r=1$, calculate the maximum DC power and transformer rating (Valve winding) if PIV rating of the valve is v and rms current rating is 1. Rework the problem if $r=3$, $s=4$, $r=1$. (15)	3	Apply	CO2
5.	Evaluate the impact of converter configurations and firing schemes on the performance of HVDC transmission systems, focusing on efficiency and reliability. (15)	4	Analyze	CO2



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QUESTION BANK



UNIT III - CONVERTERS AND HVDC SYSTEM CONTROL

Principles of DC link control-Converter control characteristics-system control hierarchy-firing angle control- current and extinction angle control-Starting and stopping of DC Link-Power Control-Higher level controllers-Control of VSC based HVDC Link

PART – A

Q.No	Questions	BT Level	Competence	Course Outcome
1.	Mention the function of Higher level controllers.	1	Remember	CO3
2.	Discuss about the modes of Converter Control Characteristics.	2	Understand	CO3
3.	Illustrate the block diagram of Pulse Frequency Control (PFC) System.	3	Apply	CO3
4.	Define the terms (i) Start up long pulse firing (ii) Start up with short pulse firings.	5	Evaluate	CO3
5.	Illustrate the steady state equivalent circuit of a 2-terminal DC link.	3	Apply	CO3
6.	Mention the types 2-types of Firing Schemes.	1	Remember	CO3
7.	What is meant by high level converters?	1	Remember	CO3
8.	Draw and evaluate the starting and stopping of DC link voltage waveform Deenergization, Energization of rectifier and inverter.	5	Evaluate	CO3
9.	Mention the different converter control characteristics?	1	Remember	CO3
10.	Define the Individual Phase Control type of Individual Phase Control.	1	Remember	CO3
11.	Illustrate the block diagram system control of Hierarchy.	3	Apply	CO3
12.	Define Equidistant Pulse Control and also explain the types of EPC.	1	Remember	CO3
13.	Analyze the steady state current equation of DC Link.	4	Analyze	CO3
14.	What are the draw backs of Equidistant Pulse Control (EPL)?	2	Understand	CO3
15.	Summarize the draw backs of Constant Extinction Angle, Negative resistance characteristics of converter.	5	Evaluate	CO3
16.	What are the conditions VSC based HVDC Link?	2	Understand	CO3
17.	Analyse and draw the diagram for Current and Extinction	4	Analyze	CO3

	Angle control.			
18.	Discriminate through the System Control Scheme what are the functions to be performed.	6	Create	CO3
19.	Justify the purpose of Constant Extinction Angle.	6	Create	CO3
20.	Illustrate the expression of transfer function of generic model of VDCOL.	3	Apply	CO3
21.	What is the purpose of firing angle control in HVDC systems?	1	Remember	CO3
22.	Define extinction angle control in the context of DC link control.	1	Remember	CO3
23.	Give the principle of power control in an HVDC system.	2	Understand	CO3
24.	How does the control hierarchy in an HVDC system ensure stable operation?	2	Understand	CO3
PART – B				
1.	Illustrate the principles of DC Link Control (i) Equivalent and Schematic Diagram (ii) Constant Extinction Angle (iii) Current Margin. (13)	3	Apply	CO3
2.	Describe the following Converter Control Characteristics (i) Basics and Modified Control Characteristics. (13)	2	Understand	CO3
3.	Explain the diagram of system control hierarchical structure of HVDC Link. (13)	2	Understand	CO3
4.	Generalize the block diagram of Firing Angle Control (FAC) scheme. (13)	5	Evaluate	CO3
5.	Describe the following types of Firing Angle Control (FAC) scheme (i) Individual Phase Control (IPC) (ii) Equidistant Pulse Control. (13)	2	Understand	CO3
6.	In the Individual Phase Control (IPC) Scheme explain the following schemes (i) Constant alpha control (ii) Inverse Cosine Control. (13)	1	Remember	CO3
7.	Illustrate the block diagram of Power Control Scheme (i) Generic Model of VDCOL (ii) Converter Station (iii) Power Order (iv) Auxiliary Controller . (13)	3	Apply	CO3
8.	Create the following types of High Level Controllers (i) Frequency and Power Control (ii) Emergency Control (iii) Reactive Power Control. (13)	6	Create	CO3
9.	Draw the block diagram of VSC Controller. Explain the control of VSC Based HVDC Link and obtain the mathematical expression. (13)	2	Understand	CO3
10.	In control of VSC based HVDC Link and Explain the following (i) Design of Current Controller (ii) Control Hierarchy and System Control. (13)	1	Remember	CO3
11.	Draw and explain the three level of control of the VSC based HVDC. (13)	1	Remember	CO3

12.	Analyze the following terms (i) Current Controller (ii) DC Link Controller. (13)	4	Analyze	CO3
13.	Design the diagram of (i) System Control Hierarchy (ii) High Level Controller. (13)	6	Create	CO3
14.	Create the diagram of HVDC Hierarchical and System Control (i) Three Level control of VSC Based HVDC Link (ii) Control Characteristics of terminal. (13)	6	Create	CO3
15.	Apply the principles of DC link control to analyze how firing angle and current control work together to regulate power flow in HVDC systems. (13)	3	Apply	CO3
16.	Illustrate the starting and stopping procedures of a DC link with suitable diagrams and explain their importance in system stability. (13)	3	Apply	CO3
17.	Analyze the role of higher-level controllers in the control hierarchy of HVDC systems and evaluate their impact on system performance. (13)	4	Analyze	CO3
PART – C				
1.	Illustrate the following type of Firing angle control scheme and explain (i) Individual Phase Control (IPC) (ii) Equidistant Pulse Control (EPC). (15)	3	Apply	CO3
2.	Analyze the following types of starting and stopping of DC Link (i) Energization and De energization of a Bridge (ii) Voltage wave form of Rectifier and Inverter (iii) Start up with long and short pulse. (15)	4	Analyze	CO3
3.	Draw the block diagram and explain the control of VSC based HVDC Links and also explain (i) Design of Current Controller (ii) Control Hierarchy and System Control. (15)	2	Understand	CO3
4.	With a neat diagram, explain the following Converter Control Characteristics (i) Basic Characteristics (ii) Control Characteristics of Negative Margin (iii) Modification control characteristics (iii) Voltage Dependent Current Limit. (15)	6	Create	CO3
5.	Compare the control mechanisms of VSC-based HVDC systems with Line Commutated Converters (LCC) and discuss their relative advantages and limitations. (15)	4	Analyze	CO3



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QUESTION BANK

UNIT IV - REACTIVE POWER AND HARMONICS CONTROL				
Reactive power requirements in steady state-Sources of reactive power-SVC and STATCOM-Generation of Harmonics-Design of DC and AC Filters-Active Filters				
PART – A				
Q.No.	Questions	BT Level	Competence	Course Outcome
1.	What is meant by Conventional Control Strategies?	1	Remember	CO4
2.	Mention the region bounded by Alternate Control Strategies.	1	Remember	CO4
3.	Define the term Force commutation for HVDC System.	1	Remember	CO4
4.	Point out the advantages of sources of Reactive Power.	4	Analyse	CO4
5.	Mention the sources of Reactive Power requirements of the Converter.	1	Remember	CO4
6.	Express the disadvantages of Source Reactive Power.	2	Understand	CO4
7.	Compare the difference between SVC and STATCOM.	4	Analyse	CO4
8.	Express the control characteristics of STATCOM and SVC.	5	Evaluate	CO4
9.	Compare and differentiate the characteristics and non-characteristics of harmonics.	4	Analyse	CO4
10.	Illustrate the diagram of the variation of Q_d and P_d	3	Apply	CO4
11.	List the sources of harmonics and also effect of trouble caused by harmonics.	1	Remember	CO4
12.	Mention the criteria for the selection of Filters.	2	Understand	CO4
13.	Explain the causes of non-characteristics of harmonics.	2	Understand	CO4
14.	Mention the different types of filters.	1	Remember	CO4
15.	Explain the terms (i) Total Harmonic Distortion (ii) Reduced Harmonics (iii) Short Circuit Ratio (SCR).	2	Understand	CO4
16.	Illustrate the diagram for the control system of TCR.	3	Apply	CO4
17.	What is meant by radio interference?	1	Remember	CO4
18.	List the performance characteristics for the selection of Filter.	1	Remember	CO4
19.	Discuss the criteria for the selection of filter.	2	Understand	CO4
20.	State the ill effects of harmonics injected into AC line?	1	Remember	CO4
21.	What are the sources of reactive power in an HVDC system?	1	Remember	CO4

22.	Define the role of AC filters in HVDC systems.	1	Remember	CO4
23.	Tell how a Static Var Compensator (SVC) supports reactive power management.	2	Understand	CO4
24.	How does harmonic generation affect the performance of HVDC systems?	2	Understand	CO4
PART – B				
1.	Explain the terms SVC and STATCOM with suitable circuit. (13)	1	Remember	CO4
2.	Discuss different sources of Reactive Power and explain it. (13)	2	Understand	CO4
3.	Criteria to create the generation of Harmonics distortion in HVDC System. (13)	6	Create	CO4
4.	Analyze the following terms :Harmonic Distortion (ii) TIF (iii) THFF (iv) IT (v) KIT (13)	4	Analyze	CO4
5.	Explain Reactive Power Requirements in steady state HVDC Systems. (13)	2	Understand	CO4
6.	Discuss about the Harmonics characteristics calculation procedure with suitable expression. (13)	2	Understand	CO4
7.	Explain the characteristics and non-characteristics harmonics in HVDC System. (13)	4	Analyze	CO4
8.	Evaluate the criteria for the design of DC Filter. (13)	3	Apply	CO4
9.	Explain the detail about STATCOM with suitable circuit and represent different characteristics of it. (13)	4	Analyze	CO4
10.	Explain the detail about Static Var Compensator(SVC) with suitable circuit and represent different characteristics of it. (13)	2	Understand	CO4
11.	Explain the criteria for the design of AC Filter. Also mention different circuit configuration and impedance characteristics. (13)	5	Evaluate	CO4
12.	Write short notes and explain the terms (i) Harmonic Distortion (ii) Non-Harmonic Distortion (13)	2	Understand	CO4
13.	What are the types of AC Filter? And also explain the criteria for the selection of filter. (13)	1	Remember	CO4
14.	Illustrate the following terms of (i) Single tuned Filter (8) (ii) Double tuned Filter (5)	3	Apply	CO4
15.	Illustrate the working of STATCOM and analyze how it provides reactive power support during steady-state and dynamic conditions. (13)	3	Apply	CO4
16.	Apply the principles of harmonic mitigation to design an AC filter for an HVDC system and explain its operation. (13)	3	Apply	CO4
17.	Analyze the reactive power requirements in steady-state conditions for HVDC systems and evaluate the use of SVC and STATCOM for fulfilling these requirements. (13)	4	Analyze	CO4
PART – C				

1.	Explain the reactive power requirement in steady state (i) Conventional Control Strategies (ii) Alternative Control. (15)	2	Understand	CO4
2.	Explain the circuit and terminology of in HVDC System : (i) Static Var Compensator(SVC) (5) (ii) STATCOM (5) (iii) Compare SVC with STATCOM (5)	1	Remember	CO4
3.	What is meant by Harmonic? Explain (i) Characteristics of Harmonics (ii) Non-Characteristics Harmonics. (15)	1	Remember	CO4
4.	In the Filter explain the following terms (i) Design of AC Filter (ii) Single Tuned Filter (ii) Double Tuned Filter. (15)	6	Create	CO4
5.	Examine the effects of harmonics generated in HVDC systems and evaluate the role of active filters in improving power quality. (15)	4	Analyze	CO4



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UNIT V - POWER FLOW ANALYSIS IN AC/DC SYSTEMS				
Per unit system for DC Quantity-DC System Models-Inclusion of constraints-Power flow analysis-Case Study.				
PART – A				
Q.No.	Questions	BT Level	Competence	Course Outcome
1.	Define the basic model of converter.	1	Remember	CO5
2.	Create the converter average DC Voltage Equation.	6	Create	CO5
3.	Draw and discuss the Norton's Equivalent circuit for a converter and also write the equation.	1	Remember	CO5
4.	Draw and show the equivalent basic circuit model of converter.	3	Apply	CO5
5.	Evaluate the power factor j^{th} terminal per unit system.	5	Evaluate	CO5
6.	Evaluate the rms AC current phase equation.	3	Apply	CO5
7.	Evaluate the active and reactive power equation of converter terminal.	3	Apply	CO5
8.	Evaluate the per unit voltage equation for a HVDC Converter for Single phase and Three phase.	5	Evaluate	CO5
9.	How to removal of tap violation of HVDC System?	1	Understand	CO5
10.	Discuss the assumption are made in the deviation of the equation representing AC/DC Converter in HVDC System.	2	Understand	CO5
11.	Points out the characteristics for the variation of V with(a'v).	4	Analyse	CO5
12.	Evaluate rms AC current phase equation.	3	Apply	CO5
13.	Evaluate per unit DC-AC Current at the terminal j^{th} equation.	3	Apply	CO5
14.	Mention the use of inclusion constraints in HVDC System.	1	Remember	CO5
15.	Create a diagram of 5-terminal MTDC System.	6	Create	CO5
16.	Analyze the characteristics of Θ -with a'.	4	Analyse	CO5
17.	What is the value of Θ -values for inverter and rectifier and also write down the minimum and maximum value.	1	Remember	CO5
18.	Mention the different methods for power flow analysis.	1	Remember	CO5
19.	Recommend the purpose of inclusion of constraints?	6	Create	CO5
20.	Evaluate the active and reactive power equation of converter terminals.	3	Apply	CO5
21.	Define the per-unit system for DC quantities.	1	Remember	CO5

22.	What are the key components of a DC system model?		1	Remember	C05
23.	Explain the significance of constraints in DC system modeling.		2	Understand	C05
24.	How is power flow analysis used in DC systems?		2	Understand	C05
PART – B					
1.	Derive and Explain per unit system for DC quantity. (13)		5	Evaluate	C05
2.	Create the Basic Model of the Converter. (13)		3	Apply	C05
3.	Analyze the DC System Model with a suitable example. (13)		4	Analyze	C05
4.	Explain the case study of description of the system. (13)		6	Create	C05
5.	Examine any two cases of Power Flow Analysis. (13)		4	Analyze	C05
6.	Explain the Inclusion Constraints of HVDC Systems. (13)		3	Apply	C05
7.	With a neat diagram flowchart and examine the solution methodology for AC-DC Power Flow. (13)		3	Apply	C05
8.	Design the DC Control Equations of HVDC System. (13)		6	Create	C05
9.	Create the mathematical modeling of HVDC Links for Power Flow Analysis. (13)		6	Create	C05
10.	Explain the DC Network Equation for HVDC System. (13)		1	Remember	C05
11.	With sketch explain the DC Model for HVDC System. (13)		2	Understand	C05
12.	Analyze the DC System Model terms (i) Basic Model of Converter (ii) Converter Equation (iii) Basic Converter Model. (13)		4	Analyze	C05
13.	Create the mathematical model for a DC Network Converter and its controllers in the Power flow Analysis. (13)		6	Create	C05
14.	Examine the per unit system for HVDC Systems for DC Power transmission. (13)		6	Create	C05
15.	Apply the per-unit system to a DC power system and demonstrate its use in simplifying calculations with a suitable example.		3	Apply	C05
16.	Develop a power flow analysis for a DC system, including relevant equations and the incorporation of system constraints.		3	Apply	C05
17.	Analyze the inclusion of operational constraints in DC system models and evaluate their impact on system performance.		4	Analyze	C05
PART – C					
1.	With an example explain per unit system for DC quantities. (15)		6	Create	C05

2.	Explain the following DC System Model (i) Basic model of Converter (ii) Converter Equation (iii) A flexible per unit system. (15)	2	Understand	CO5
3.	Examine the following terms : (i) Basic Modeling of HVDC System (ii) DC Network Equation (iii) DC Control Equation (15)	6	Create	CO5
4.	Explain the case study of (i) Description of the system. (ii) Power flow analysis with VSC Based HVDC System. (iii) Power Flow Analysis under Dynamic Conditions. (15)	6	Create	CO5
5.	Critically examine a case study of a real-world DC power flow problem, focusing on the methodology, constraints, and results.	4	Analyze	CO5