SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

III SEMESTER

ME-Power Systems Engineering

1916309-DESIGN OF SUBSTATIONS

Regulation – 2019

Academic Year 2022-20223

Prepared by

Ms.A.Dhivya, AP(O.G)/EEE

SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

SUBJECT : 1916309 DESIGN OF SUBSTATIONS

SEM / YEAR: III/II

UNIT I - INTRODUCTION TO AIS AND GIS

Introduction – characteristics – comparison of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS) – main features of substations, Environmental considerations, Planning and installation- GIB / GIL

PART – A

Q.No	Questions		CO	BT Level	Competence
1.	List the GIS configurations can be applied to any type of bus bar arrangements**.**		CO 5	BTL1	Remember
2.	Draw the layout of a GIS substation based on single line diagram.		CO 5	BTL 2	Understand
3.	What are the desirable features to apply GIS design?		CO 5	BTL 1	Remember
4.	What are the Life Cycle Cost comparison of AIS and GIS?		CO 5	BTL 2	Understand
5.	Define substation.		CO 5	BTL 5	Evaluate
6.	What are the bus schemes used for substation?		CO 5	BTL 3	Apply
7.	What is the need of GIS.		CO 5	BTL 6	Create
8.	List the components used in of GIS		CO 5	BTL 1	Remember
9.	Write the disadvantages of GIS.		CO 5	BTL 3	Apply
10.	Give the advantages of AIS.		CO 5	BTL 1	Remember
11.	Interpret the disadvantages of GIS.		CO 5	BTL 1	Remember
12.	List the properties of SF_6.		CO 5	BTL 1	Remember
13.	Analyze the design challenges of GI substation.		CO 5	BTL 1	Remember
14.	Define hybrid switchgear.		CO 5	BTL 4	Analyse
15.	Give short note on SF_6.		CO 5	BTL 1	Remember
16.	What are the essential parts of GIS		CO 5	BTL 1	Remember
17.	Write the benefits of Gas insulated substation.		CO 5	BTL 5	Evaluate
18.	Predict the single line diagram of Gas insulated substation.		CO 5	BTL 2	Understand
19.	Write short note on the desirable features to apply Gas insulated substation.		CO 5	BTL 1	Remember
20.	Write the advantages of conventional outdoor substation.		CO 5	BTL 2	Understand
21.	List the main features of substations.		CO 5	BTL 1	Remember
22.	Compare AIS and GIS.		CO 5	BTL 3	Remember
23.	What are the different Site Evaluation criteria?		CO 5	BTL 1	Remember

24.	Define commissioning		CO 5	BTL 4	Analyse
	PART – B				
1.	Explain the characteristics of GIS	(13)	CO 5	BTL 1	Remember
2.	Compare Air Insulated Substation and Gas Insulated Substation.	(13)	CO 5	BTL 5	Evaluate
3.	Interpret the main features of substations.	(13)	CO 5	BTL 5	Evaluate
4.	Briefly explain the types of substations.	(13)	CO 5	BTL 2	Understand
5.	Explain the characteristics of AIS.	(13)	CO 5	BTL 5	Evaluate
6.	Explain the parts and equipment's of substation.	(13)	CO 5	BTL 2	Understand
7.	Summarise the Function of Substations.	(13)	CO 5	BTL 4	Analyse
8.	List factors influence the selection of the proper type of substation.	(13)	CO 5	BTL 5	Evaluate
9.	Explain about conventional outdoor substation.	(13)	CO 5	BTL 4	Analyse
10.	Briefly explain the advantages of GIS over AIS.	(13)	CO 5	BTL 1	Remember
11.	Summarize the design requirements and salient features of GIS.	(13)	CO 5	BTL 2	Understand
12.	Explain the components of GIS.	(13)	CO 5	BTL 4	Analyse
13.	Distinguish between GIS and AIS.	(13)	CO 5	BTL 6	Create
14.	Give details about the classifications of substation.	(13)	CO 5	BTL 1	Remember
15.	Explain the Economics of GIS.	(13)	CO 5	BTL 4	Analyse
16.	Write in detail about grounding, testing and installation of GIS.	(13)	CO 5	BTL 2	Understand
17.	Explain about Air Insulated Substation.	(13)	CO 5	BTL 4	Analyse
	PART-C				
1.	Interpret the main features of Gas Insulated Substation.	(15)	CO 5	BTL 5	Evaluate
2.	Summarize the design requirements and salient features of AIS.	(15)	CO 5	BTL 6	Create
3.	Explain the parts and equipment's of AIS.	(15)	CO 5	BTL 5	Evaluate
4.	Briefly explain the Life Cycle Cost comparison of AIS and GIS?	(15)	CO 5	BTL 4	Analyse
5.	Explain in detail about Grounding, testing, Installation, operation, Interlocks and maintenance of GIS.	(15)	CO 5	BTL 4	Analyse

UNIT II - MAJOR EQUIPMENT AND LAYOUT OF AIS AND GIS

Major equipment – design features – equipment specification, types of electrical stresses, mechanical aspects of substation design- substation switching schemes- single feeder circuits; single or main bus and sectionalized single bus- double main bus-main and transfer bus- main, reserve and transfer bus-breaker-and-a- half scheme-ring bus

PART – A

Q.No	Questions		CO	BT Level	Competence
1.	Which gas is used in GIS substation?		CO 1	BTL 1	Remember
2.	What is the function of gas insulated switchgear?		CO 1	BTL 3	Apply
3.	What is gas insulated substation?		CO 1	BTL 3	Apply
4.	What are the types of substations?		CO 1	BTL 1	Remember
5.	Classify electrical stress.		CO 1	BTL 5	Evaluate
6.	What is a feeder circuit?		CO 1	BTL 3	Apply
7.	What is a single branch circuit?		CO 1	BTL 4	Analyse
8.	What is feeder in substation?		CO 1	BTL 3	Apply
9.	What is the difference between feeder and bus bar?		CO 1	BTL 4	Analyse
10.	Define single bus bar?		CO 1	BTL 3	Apply
11.	Define Main and Transfer Bus Arrangement.		CO 1	BTL 1	Remember
12.	Highlight the requirements of substation.		CO 1	BTL 6	Create
13.	Predict the limitations of AIS.		CO 1	BTL 6	Create
14.	Define breaker and a half scheme?		CO 1	BTL 2	Understand
15.	Give the different classifications of bus bar arrangements?		CO 1	BTL 2	Understand
16.	List the types of electrical stresses.		CO 1	BTL 2	Understand
17.	Why do we need substations?		CO 1	BTL 2	Understand
18.	What is the major equipment's of a substation?		CO 1	BTL 1	Remember
19.	What are the components of switchgear?		CO 1	BTL 3	Apply
20.	List the classifications of substations.		CO 1	BTL 5	Evaluate
21.	What are the design features of substation?		CO 1	BTL 1	Remember
22.	Which busbar arrangement is generally employed in distribution system?		CO 1	BTL 6	Create
23.	What is the use of a bus coupler circuit breaker in substation?		CO 1	BTL 6	Create
24.	How the bus bars in the substation can be rated?		CO 1	BTL 2	Understand

PART – B

1.	Draw and explain the typical layout of GIS.	(13)	CO 1	BTL 3	Apply
2.	Explain the design features of GIS.	(13)	CO 1	BTL 5	Evaluate
3.	Explain the schematic diagram of AIS.	(13)	CO 1	BTL 4	Analyse
4.	Explain the types of electrical stresses.	(13)	CO 1	BTL 3	Apply

5.	Explain the design features of AIS.	(13)	CO 1	BTL 3	Apply
6.	Draw and explain the typical layout of AIS.	(13)	CO 1	BTL 3	Apply
7.	Briefly explain about the switching schemes of GIS.	(13)	CO 1	BTL 3	Apply
8.	Explain the types of bus-bar arrangements.	(13)	CO 1	BTL 4	Analyse
9.	Analyze the mechanical aspects of substation design.	(13)	CO 1	BTL 6	Create
10.	Elaborate the limitations of AIS.	(3)	CO 1	BTL 2	Remember
11.	Analyse the classification of bus-bar arrangements.	(13)	CO 1	BTL 5	Evaluate
12.	Briefly explain about the switching schemes of AIS.	(13)	CO 1	BTL3	Apply
13.	Explain the schematic diagram of GIS.	(13)	CO 1	BTL 4	Analyse
14.	Explain the Design Considerations of AIS.	(13)	CO 1	BTL 4	Analyse
15.	What are the steps to be followed in the installation of substation?	(13)	CO 1	BTL 3	Apply
16.	Explain in detail about the various types of equipment's in substation.	(13)	CO 1	BTL 4	Analyse
17.	Explain the Environment impact comparison of AIS and GIS.	(13)	CO 1	BTL 6	Create
	PART-C				
1.	Analyse the drawbacks and disadvantages of AIS.	(15)	CO 1	BTL 3	Apply
2.	Evaluate the operation of breaker-and-a- half scheme.	(15)	CO 1	BTL 4	Analyse
3.	Elaborate the major equipment and layout of AIS.	(15)	CO 1	BTL 5	Evaluate
4.	Elaborate the major equipment and layout of GIS.	(15)	CO 1	BTL 2	Knowledge
5.	Explain design characteristics of GIS and AIS	(15)	CO 1	BTL 5	Evaluate

UNIT III - INSULATION COORDINATION OF AIS AND GIS

Introduction – stress at the equipment – insulation strength and its selection – standard BILs – Application of simplified method – Comparison with IEEE and IEC guides

PART – A

Q.No	Questions		CO	BT Level	Competence
1.	What is insulation coordination?		CO 2	BTL 5	Evaluate
2.	What is BIL?		CO 2	BTL 1	Remember
3.	Define External Insulation.		CO 2	BTL 2	Understand
4.	Distinguish between SR and NSR.		CO 2	BTL 3	Apply
5.	List the major parts of insulation coordination.		CO 2	BTL 2	Understand
6.	How will you describe insulation strength of air?		CO 2	BTL 4	Analyse
7.	What is meant by LI insulation strength?		CO 2	BTL 1	Remember
8.	Write short note on phase-phase insulation strength.		CO 2	BTL 2	Understand
9.	List the methods of determining phase-phase insulation strength.		CO 2	BTL 1	Remember
10.	Discuss about BIL in power system insulation coordination?		CO 2	BTL 1	Remember
11.	State the importance of insulation coordination in Power system.		CO 2	BTL 1	Remember
12.	List out the standards for testing bushing, CB, insulators and transformer.		CO 2	BTL 4	Analyse
13.	Explore the concept of insulation coordination.		CO 2	BTL 2	Understand
14.	Examine the concept of one minute dry/wet withstand test.		CO 2	BTL 3	Apply
15.	State the various test conducted on bushing.		CO 2	BTL 2	Understand
16.	How will you show the insulation strength for short duration impulses?		CO 2	BTL 2	Understand
17.	Define internal Insulation.		CO 2	BTL 2	Understand
18.	List the types of insulation.		CO 2	BTL 3	Apply
19.	What is Standard Deviation of Flashover?		CO 2	BTL 5	Evaluate
20.	Define CFO.		CO 2	BTL 5	Evaluate
21.	Define station insulation coordination?		CO 2	BTL 2	Understand
22.	Write the types of insulation coordination.		CO 2	BTL 3	Apply
23.	Define BSL.		CO 2	BTL 2	Understand
24.	Mention the Tests to be done to "Prove" the BIL and BSL.		CO 2	BTL 2	Understand

PART – B

1.	Briefly explain about various stress at the equipment.	(13)	CO 2	BTL 3	Apply
2.	Analyse about insulation strength.	(13)	CO 2	BTL 4	Analyse
3.	Elaborate the characteristics of insulation strength.	(13)	CO 2	BTL 3	Apply
4.	List the standard values of BILS as per IEC and explain.	(13)	CO 2	BTL 2	Understand
5.	Explain switching impulse strength of towers.	(13)	CO 2	BTL 1	Remember
6.	Analyse the insulation strength of towers.	(13)	CO 2	BTL 1	Remember
7.	Analyse the insulation strength comparison with IEEE and IEC guides.	(13)	CO 2	BTL 4	Analyse
8.	Explain the two methods of insulation coordination.	(13)	CO 2	BTL 5	Evaluate
9.	Describe about line and station insulation coordination.	(13)	CO 2	BTL 5	Evaluate
10.	List the steps involved in selection of the strength of the insulation.	(13)	CO 2	BTL 4	Analyse
11.	Compare Statistical Vs. Conventional BIL/BSL.	(13)	CO 2	BTL 3	Apply
12.	Elaborate the simplified method of insulation coordination.	(13)	CO 2	BTL 3	Apply
13.	Evaluate the selection of insulating material and its strength.	(13)	CO 2	BTL 6	Create
14.	Write in detail about different stress at the equipment.	(13)	CO 2	BTL 2	Understand
15.	Explain about the insulation strength characteristics.	(13)	CO 2	BTL 5	Evaluate
16.	Write in detail about the phase-phase switching over voltages.	(13)	CO 2	BTL 5	Evaluate
17.	Discuss about phase -ground insulation coordination.	(13)	CO 2	BTL 4	Analyse
	PART-C				
1.	Evaluate the need and type of opened circuit breaker protection.	(15)	CO 2	BTL 4	Analyse
2.	Explain about the selection of insulating material and its strength.	(15)	CO 2	BTL 4	Analyse
3.	Describe the factors to be considered for the selection of the strength of the insulation.	(15)	CO 2	BTL 5	Evaluate
4.	Write the definitions of apparatus strength, the BIL and the BSL.	(15)	CO 2	BTL 4	Analyse
5.	Write in detail about insulation strength of towers.				

UNIT IV GROUNDING AND SHIELDING

Definitions – soil resistivity measurement – ground fault currents – ground conductor – design of substation grounding system – shielding of substations – Shielding by wires and masts.

	PART – A				
Q.No	**Questions**		**CO**	**BT Level**	**Competence**
1.	What is shielding and grounding?		CO 3	BTL 2	Understand
2.	What is the purpose of using shielding techniques?		CO 3	BTL 1	Remember
3.	Does shielding need to be grounded?		CO 3	BTL 1	Remember
4.	Define single point grounding.		CO 3	BTL 4	Analyse
5.	Draw the Isolated ground configuration.		CO 3	BTL 2	Understand
6.	Write the need for an SRS.		CO 3	BTL 1	Remember
7.	Calculate shielding effectiveness (S) in dB.		CO 3	BTL2	Understand
8.	Assuming the electromagnetic wave propagates perpendicular to the shield surface, how will you calculate the absorption and reflection losses (in dB)?		CO 3	BTL 1	Remember
9.	Highlight the advantages of the SRS.		CO 3	BTL 1	Remember
10.	How soil resistivity is measured?		CO 3	BTL 1	Remember
11.	What is a Ground Fault?		CO 3	BTL 5	Evaluate
12.	How can soil resistivity be improved?		CO 3	BTL 3	Apply
13.	List the causes a ground fault.		CO 3	BTL 5	Evaluate
14.	When the Ground Fault Protection is Required?		CO 3	BTL 4	Analyse
15.	What is meant by soil resistivity?		CO 3	BTL 2	Understand
16.	Define Shielding.		CO 3	BTL 4	Analyse
17.	Give the schematic of Single point grounding.		CO 3	BTL 4	Analyse
18.	List the principal purposes of the SRS.		CO 3	BTL 2	Understand
19.	Analyze Isolated grounding.		CO 3	BTL 2	Understand
20.	Define the term equipment grounding.		CO 3	BTL 5	Evaluate
21.	List the reasons for substation grounding systems		CO 3	BTL 4	Analyse
22.	State the importance of high-speed fault clearing.		CO 3	BTL 2	Understand
23.	Write the design methods to protect substations from direct lightning.		CO 3	BTL 4	Analyse
24.	Define CFO.		CO 3	BTL 4	Analyse
	PART – B				
1.	Explain Grounding for fault and personnel protection.	(13)	CO 3	BTL 2	Understand
2.	Elaborate High frequency grounding configuration	(13)	CO 3	BTL 6	Create

3.	Write in brief about Multipoint and single point grounding connections	(13)	CO 3	BTL 3	Apply
4.	Analyse about Soil Resistivity Measurement.	(13)	CO 3	BTL 6	Create
5.	Evaluate the effects and Requirements of Fault Calculation.	(13)	CO 3	BTL 3	Apply
6.	Explain about shielding of substations.	(13)	CO 3	BTL 5	Evaluate
7.	Give detail about soil resistivity testing procedure.	(13)	CO 3	BTL 4	Analyse
8.	Describe the Types of Fault on a Three-Phase System.	(13)	CO 3	BTL 3	Apply
9.	Describe the effects of direct stroke on substation.	(13)	CO 3	BTL 6	Create
10.	Elaborate Shielding by wires and masts.	(13)	CO 3	BTL 1	Remember
11.	Describe the Grounding methods of distribution networks.	(13)	CO 3	BTL 1	Knowledge
12.	Discuss about the design of substation grounding system.	(13)	CO 3	BTL 4	Analyse
13.	Explain Types & Applications of Wire & Cable Shielding.	(13)	CO 3	BTL 6	Create
14.	Analyse the classification of Fault on a Three-Phase System.	(13)	CO 3	BTL 6	Create
15.	Discuss about striking distance equations	(13)	CO 3	BTL 4	Analyse
16.	Explain about shielding using masts.	(13)	CO 3	BTL 3	Apply
17.	Write in detail about shielding by wires.	(13)	CO 3	BTL 6	Create
	PART-C				
1.	Discuss in detail about Soil Resistivity Measurement.	(15)	CO 3	BTL 6	Create
2.	Narrate the design procedure of substation grounding system.	(15)	CO 3	BTL 6	Create
3.	Discuss the various ground fault currents.	(15)	CO 3	BTL 6	Create
4.	Write in brief about the shielding of substations.	(15)	CO 3	BTL 6	Create
5.	Discuss the need for grounding and shielding in substation.	(15)	CO 3	BTL 6	Create

UNIT V - FAST TRANSIENTS PHENOMENON IN AIS AND GIS

Introduction – Disconnector switching in relation to very fast transients – origin of VFTO – propagation and mechanism of VFTO – VFTO characteristics – Effects of VFTO.

PART – A

Q.No	Questions		CO	BT Level	Competence
1.	List the main problems associated with VFTO.		CO 4	BTL 4	Analyse
2.	Why VFTOS generated in a GIS should be considered as an important factor in the insulation design.		CO 4	BTL 1	Remember
3.	List the main problems associated with the VFTOS in GIS.		CO 4	BTL 1	Remember
4.	Draw the EMTP model of transmission line.		CO 4	BTL 1	Remember
5.	Draw the EMTP model of resistor.		CO 4	BTL 3	Apply
6.	Outline the concept behind EMTP.		CO 4	BTL 4	Analyse
7.	Write the network equation to model a transmission network for EMTP calculation.		CO 4	BTL 1	Remember
8.	Identify any two advantages of EMTP software packages.		CO 4	BTL 2	Understand
9.	What is very fast transient overvoltage?		CO 4	BTL 4	Analyse
10.	List the cause of overvoltage.		CO 4	BTL 5	Evaluate
11.	How to mitigate VFTO?		CO 4	BTL 3	Apply
12.	What does VFTO stand for?		CO 4	BTL 3	Apply
13.	Define Ferranti effect.		CO 4	BTL 1	Remember
14.	What is meant by voltage surge.		CO 4	BTL 2	Understand
15.	List the devices used for over voltage protection.		CO 4	BTL 1	Remember
16.	State Ferro resonance.		CO 4	BTL 6	Create
17.	List the classifications of over voltage based on duration.		CO 4	BTL 2	Understand
18.	Draw the EMTP model of inductor and capacitor.		CO 4	BTL 5	Evaluate
19.	Give the applications of EMTP.		CO 4	BTL 2	Understand
20.	Write short note on EMTP.		CO 4	BTL 6	Create
21.	Draw the characteristics of VFTO		CO 4	BTL 3	Apply
22.	What do you mean by disconnector?		CO 4	BTL 3	Apply
23.	Write down the effects of VFTO		CO 4	BTL 1	Remember
24.	State the advantages of using disconnector.		CO 4	BTL 2	Understand

PART – B

1.	Explain origin of VFTO.	(13)	CO 4	BTL 6	Create
2.	Give an introduction about fast transients phenomenon in AIS.	(13)	CO 4	BTL 2	Understand
3.	Elaborate the characteristics of VFTO.	(13)	CO 4	BTL 2	Understand

4.	Discuss the Effects of VFTO.	(13)	CO 4	BTL 4	Analyse
5.	Explain in detail about Disconnector switching in relation to very fast transients.	(13)	CO 4	BTL 1	Remember
6.	Explain the generation of very fast transient over voltages in a gas insulated substation.	(13)	CO 4	BTL 2	Understand
7.	Elaborate VFTOS across disconnector switch.	(13)	CO 4	BTL 1	Remember
8.	Discuss in detail about EMTP for the applications of transient computation.	(13)	CO 4	BTL 5	Evaluate
9.	Give a review of Analysis of Very Fast Transient Overvoltage in Gas Insulated Substation	(13)	CO 4	BTL 3	Apply
10.	Elaborate the Classification of VFTO In Gas-Insulated Substations.	(13)	CO 4	BTL 3	Apply
11.	Explain the mechanism of generation of VFTO.	(13)	CO 4	BTL 2	Understand
12.	Describe the Effects of VFTO.	(13)	CO 4	BTL 2	Understand
13.	Describe the propagation and mechanism of VFTO.	(13)	CO 4	BTL 4	Analyse
14.	Elaborate about fast transients phenomenon in GIS.	(13)	CO 4	BTL 4	Analyse
15.	Write in detail about the classification of VFTO'S.	(13)	CO 4	BTL 1	Remember
16.	Discuss in detail about modelling of GIS.	(13)	CO 4	BTL 5	Evaluate
17.	Explain the steps involved in calculation of very fast transients in GIS.	(13)	CO 4	BTL 1	Remember
	PART-C `				
1.	Analyze the computation of Transients in power system using EMTP.	(15)	CO 4	BTL 6	Create
2	Describe the characteristics of VFTO.	(15)	CO 4	BTL 5	Evaluate
3	Discuss about the launch of VFTO.	(15)	CO 4	BTL 6	Create
4	Summarize the Effects of VFTO.	(15)	CO 4	BTL 6	Create
5	Describe the Fast Transients Phenomenon in AIS.	(15)	CO 4	BTL 6	Create

COURSE OUTCOMES:

CO 1	Ability to apply Awareness towards substation equipment and their arrangements.
CO 2	Ability to design the substation for present requirement with proper insulation coordination and protection against fast transients.
CO 3	Ability to design grounding systems.
CO 4	Ability to apply fast transients' phenomenon in AIS and GIS.
CO 5	Ability to provide in-depth knowledge on design criteria of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS).