SRM VALLIAMMAI ENGINEERING COLLEGE

(Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

VII SEMESTER

1905703- Protection and Switchgear

Regulation – 2019

Academic Year 2025-2026 ODD

Prepared by

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SUBJECT & SUBJECT CODE: 1905703 Protection & Switchgear SEM / YEAR: VII / IV

UNIT-I PROTECTION SCHEMES				
Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme. - Protection against travelling waves.				
PART-A				
Q. No	**Questions**	**BT Level**	**Competence**	**CO**
1.	Define protective scheme in a power system.	BTL1	Remembering	CO1
2.	List the major types of faults in electrical networks.	BTL2	Understanding	CO1
3.	Recall the nature of faults occurring in power systems.	BTL1	Remembering	CO1
4.	Identify the common causes of short circuits.	BTL2	Understanding	CO1
5.	Define symmetrical and unsymmetrical faults.	BTL3	Applying	CO1
6.	List the different grounding techniques.	BTL3	Applying	CO1
7.	Recall the effects of improper system grounding.	BTL1	Remembering	CO1
8.	State the importance of earthing in protection.	BTL5	Evaluating	CO1
9.	Identify different zones of protection in a power system.	BTL2	Understanding	CO1
10.	Mention two essential features of a protection scheme.	BTL4	Analyzing	CO1
11.	Describe the function of a relay in fault detection.	BTL1	Remembering	CO1
12.	Explain the need for backup protection.	BTL4	Analyzing	CO1
13.	Describe unit protection and its application.	BTL2	Understanding	CO1
14.	Explain the role of selectivity in protection.	BTL4	Analyzing	CO1
15.	Summarize the purpose of primary protection.	BTL3	Applying	CO1
16.	Distinguish between reliability and sensitivity in protection.	BTL1	Remembering	CO1
17.	Explain how speed impacts the effectiveness of protection.	BTL1	Remembering	CO1
18.	Describe the operating principle of zone protection.	BTL6	Creating	CO1
19.	Identify any two factors influencing protection coordination.	BTL6	Creating	CO1
20.	Define travelling waves in a power system.	BTL5	Evaluating	CO1

21.	List sources that generate travelling waves.		BTL1	Remembering	CO1
22.	Explain how travelling waves are mitigated in transmission lines.		BTL2	Understanding	CO1
23.	Describe the function of lightning arresters.		BTL3	Applying	CO1
24.	Illustrate the importance of insulation coordination.		BTL4	Analyzing	CO1
PART-B					
1.	Explain the nature and causes of faults in detail.	(13)	BTL1	Remembering	CO1
2.	Describe the different types of faults in a power system.	(13)	BTL2	Understanding	CO1
3.	Discuss various methods of grounding.	(13)	BTL3	Applying	CO1
4.	With neat sketches, explain zones of protection.	(13)	BTL2	Understanding	CO1
5.	What are the essential qualities of a protection scheme?	(13)	BTL1	Remembering	CO1
6.	Describe the principle of a protective scheme.	(13)	BTL3	Applying	CO1
7.	Explain protection against traveling waves.	(13)	BTL4	Analyzing	CO1
8.	Differentiate between primary and backup protection.	(13)	BTL1	Remembering	CO1
9.	Discuss the importance and objectives of power system protection.	(13)	BTL2	Understanding	CO1
10.	Explain the need for system protection with examples.	(13)	BTL1	Remembering	CO1
11.	Describe unit and non-unit protection schemes.	(13)	BTL4	Analyzing	CO1
12.	How does resistance grounding differ from reactance grounding?	(13)	BTL3	Applying	CO1
13.	Describe the behavior of traveling waves in transmission lines.	(13)	BTL5	Evaluating	CO1
14.	What are the merits and demerits of various grounding methods?	(13)	BTL6	Creating	CO1
15.	Explain the classification of faults with examples.	(13)	BTL1	Remembering	CO1
16.	Write short notes on: (i) Zone of protection (ii) Pilot relaying schemes.	(13)	BTL2	Understanding	CO1
17.	Explain the fault clearing process.	(13)	BTL3	Applying	CO1
PART-C					
1.	Explain in detail the need and principles of power system protection.	(15)	BTL5	Evaluating	CO1
2.	Describe in detail the types of faults and their impact on power systems.	(15)	BTL5	Evaluating	CO1
3.	Explain the different methods of system grounding with suitable diagrams.	(15)	BTL6	Creating	CO1

4.	Illustrate the concept of zones of protection and protective schemes.	(15)	BTL6	Creating	CO1
5.	Explain protection against traveling waves in detail.	(15)	BTL4	Analyzing	CO1

UNIT-II ELECTROMAGNETIC RELAYS

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

PART-A

Q. No	Questions	BT Level	Competence	CO
1.	Define a relay.	BTL1	Remembering	CO2
2.	Define pickup value and drop-off ratio in a relay.	BTL2	Understanding	CO2
3.	Mention the meaning of a universal relay.	BTL1	Remembering	CO2
4.	State the purpose of plug setting in protection relays.	BTL2	Understanding	CO2
5.	Write the torque equation used in a relay.	BTL3	Applying	CO2
6.	Describe how the R-X diagram is useful in power system protection.	BTL3	Applying	CO2
7.	List the types of electromagnetic relays.	BTL1	Remembering	CO2
8.	Give the definition of an overcurrent relay.	BTL5	Evaluating	CO2
9.	Illustrate the time-current relationship in relays.	BTL2	Understanding	CO2
10.	Interpret how an inverse-time overcurrent relay works.	BTL4	Analyzing	CO2
11.	Mention two areas where directional relays are applied.	BTL1	Remembering	CO2
12.	State the working principle of a distance relay.	BTL4	Analyzing	CO2
13.	Clarify the concept of a mho relay.	BTL2	Understanding	CO2
14.	Define a percentage differential relay.	BTL4	Analyzing	CO2
15.	Point out the use of a negative sequence relay.	BTL3	Applying	CO2
16.	Identify where under-frequency relays are used.	BTL1	Remembering	CO2
17.	Differentiate between electromagnetic and static relays.	BTL1	Remembering	CO2
18.	Give the meaning of relay burden.	BTL6	Creating	CO2
19.	State the meaning of the reach of a relay.	BTL6	Creating	CO2
20.	Mention the role of a restraining coil in relays.	BTL5	Evaluating	CO2
21.	List why directional control is required in relays.	BTL1	Remembering	CO2
22.	Give a brief idea of an offset mho relay.	BTL2	Understanding	CO2
23.	Describe relay sensitivity.	BTL3	Applying	CO2
24.	Define a relay.	BTL4	Analyzing	CO2

PART-B

1.	Derive the torque equation of an electromagnetic relay.	(13)	BTL1	Remembering	CO2

2.	With a neat sketch, explain the working of a universal relay.	(13)	BTL2	Understanding	CO2
3.	Draw and explain the R-X diagram of distance protection.	(13)	BTL3	Applying	CO2
4.	Describe the construction and working of overcurrent relays.	(13)	BTL2	Understanding	CO2
5.	Explain the types of overcurrent relays with characteristics.	(13)	BTL1	Remembering	CO2
6.	Explain the working of a directional relay with necessary diagrams.	(13)	BTL3	Applying	CO2
7.	Describe the operation of distance relays and their applications.	(13)	BTL4	Analyzing	CO2
8.	Explain the operation of mho and reactance relays.	(13)	BTL1	Remembering	CO2
9.	Differentiate between mho relay and reactance relay.	(13)	BTL2	Understanding	CO2
10.	Explain the working of a differential relay with a schematic.	(13)	BTL1	Remembering	CO2
11.	Describe percentage differential protection with suitable examples.	(13)	BTL4	Analyzing	CO2
12.	Write short notes on negative sequence relay and its applications.	(13)	BTL3	Applying	CO2
13.	Explain the use of under-frequency relays in power system protection.	(13)	BTL5	Evaluating	CO2
14.	Compare the performance of overcurrent and distance relays.	(13)	BTL6	Creating	CO2
15.	Explain how the operating characteristic of a distance relay is plotted.	(13)	BTL1	Remembering	CO2
16.	What are the key differences between electromagnetic and static relays?	(13)	BTL2	Understanding	CO2
17.	Explain relay classification based on input and response.	(13)	BTL3	Applying	CO2
PART-C					
1.	Discuss in detail the operating principles, characteristics, and applications of overcurrent, directional, and distance relays.	(15)	BTL5	Evaluating	CO2
2.	Derive the torque equation of a universal relay and explain how it determines relay operation.	(15)	BTL5	Evaluating	CO2
3.	Explain in detail the construction, working	(15)	BTL6	Creating	CO2

	principle, and types of electromagnetic relays.				
4.	With neat diagrams, explain the types and characteristics of distance relays using R-X diagrams.	(15)	BTL6	Creating	CO2
5.	Describe the working of differential, negative sequence, and under-frequency relays with their industrial applications.	(15)	BTL4	Analyzing	CO2

UNIT-III APPARATUS PROTECTION

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

PART-A

Q. No	Questions	BT Level	Competence	CO
1.	State the function of a current transformer (CT).	BTL1	Remembering	CO3
2.	Explain the burden of a CT.	BTL2	Understanding	CO3
3.	Describe the function of a potential transformer (PT).	BTL1	Remembering	CO3
4.	List two applications of CT and PT in protection.	BTL2	Understanding	CO3
5.	Define the transformation ratio of a CT.	BTL3	Applying	CO3
6.	Differentiate between measuring and protection class CT.	BTL3	Applying	CO3
7.	Mention two errors that may occur in CT.	BTL1	Remembering	CO3
8.	Describe the protection zone in apparatus protection.	BTL5	Evaluating	CO3
9.	Identify common faults occurring in a transformer.	BTL2	Understanding	CO3
10.	List two protection schemes for generators.	BTL4	Analyzing	CO3
11.	Explain the principle of differential protection.	BTL1	Remembering	CO3
12.	Clarify the concept of percentage differential protection.	BTL4	Analyzing	CO3
13.	State the reason for using a Buchholz relay in transformer protection.	BTL2	Understanding	CO3
14.	Identify the causes of faults in alternators.	BTL4	Analyzing	CO3
15.	Explain the significance of inter-turn fault protection.	BTL3	Applying	CO3
16.	Describe the protection used for motors.	BTL1	Remembering	CO3
17.	Define a restricted earth fault.	BTL1	Remembering	CO3
18.	List two types of protection used for busbars.	BTL6	Creating	CO3
19.	Explain backup protection in transmission lines.	BTL6	Creating	CO3
20.	State why generator protection is complicated.	BTL5	Evaluating	CO3
21.	Describe the principle of busbar differential protection.	BTL1	Remembering	CO3
22.	List the types of faults that can occur in transmission lines.	BTL2	Understanding	CO3

23.	Define end zone protection.		BTL3	Applying	CO3
24.	Explain the importance of transformer protection.		BTL4	Analyzing	CO3
PART-B					
1.	Explain the construction, working, and errors of CTs and PTs.	(13)	BTL1	Remembering	CO3
2.	Compare the operation and protection class of CTs and PTs.	(13)	BTL2	Understanding	CO3
3.	Discuss the different types of protection used for power transformers.	(13)	BTL3	Applying	CO3
4.	Describe percentage differential protection scheme for transformers.	(13)	BTL2	Understanding	CO3
5.	With neat diagram, explain Buchholz relay operation.	(13)	BTL1	Remembering	CO3
6.	Explain the protection methods for large generators.	(13)	BTL3	Applying	CO3
7.	Describe the common faults in alternators and their protection schemes.	(13)	BTL4	Analyzing	CO3
8.	Discuss the various protection schemes used for motors.	(13)	BTL1	Remembering	CO3
9.	Explain the protection of busbars using differential protection.	(13)	BTL2	Understanding	CO3
10.	Discuss the backup protection methods used in transmission lines.	(13)	BTL1	Remembering	CO3
11.	Describe the distance and carrier current protection of transmission lines.	(13)	BTL4	Analyzing	CO3
12.	Explain the working of restricted earth fault protection in detail.	(13)	BTL3	Applying	CO3
13.	Discuss the use of CTs and PTs in a transformer differential protection scheme.	(13)	BTL5	Evaluating	CO3
14.	Compare generator protection and motor protection.	(13)	BTL6	Creating	CO3
15.	Describe the protection of transmission lines against overcurrent and distance faults.	(13)	BTL1	Remembering	CO3
16.	With a neat diagram, explain busbar protection scheme.	(13)	BTL2	Understanding	CO3
17.	Explain inter-turn and earth fault protection in generators.	(13)	BTL3	Applying	CO3
PART-C					
1.	Describe in detail the role of CTs and PTs in	(15)	BTL5	Evaluating	CO3

	protection and metering applications with diagrams.				
2.	Explain the differential protection scheme of a transformer and discuss the use of Buchholz relay.	(15)	BTL5	Evaluating	CO3
3.	Explain the different protection schemes for generators and their associated faults.	(15)	BTL6	Creating	CO3
4.	Describe the types of faults in motors and explain the suitable protection schemes.	(15)	BTL6	Creating	CO3
5.	Explain the protection of busbars and transmission lines with neat schematics and relay coordination.	(15)	BTL4	Analyzing	CO3

UNIT-IV STATIC RELAYS AND NUMERICAL PROTECTION

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.

PART-A

Q. No	Questions	BT Level	Competence	CO
1.	State the definition of a static relay.	BTL1	Remembering	CO4
2.	List two advantages of static relays over electromagnetic relays.	BTL2	Understanding	CO4
3.	Explain the concept of a phase comparator.	BTL1	Remembering	CO4
4.	Describe the function of an amplitude comparator.	BTL2	Understanding	CO4
5.	Clarify the meaning of a dual-input comparator.	BTL3	Applying	CO4
6.	Identify the inputs to a static distance relay.	BTL3	Applying	CO4
7.	Mention the different types of static relays.	BTL1	Remembering	CO4
8.	State the importance of a logic gate in static relays.	BTL5	Evaluating	CO4
9.	Describe the need for numerical protection.	BTL2	Understanding	CO4
10.	Define a numerical relay.	BTL4	Analyzing	CO4
11.	Explain the process of sampling in numerical relays.	BTL1	Remembering	CO4
12.	Describe the analog to digital conversion process.	BTL4	Analyzing	CO4
13.	State the function of a microprocessor in numerical relays.	BTL2	Understanding	CO4
14.	List two features of numerical relays.	BTL4	Analyzing	CO4
15.	Explain the concept of relay coordination.	BTL3	Applying	CO4
16.	State the role of signal conditioning in numerical protection.	BTL1	Remembering	CO4
17.	Define aliasing in signal processing.	BTL1	Remembering	CO4

18.	Describe the block diagram of a static relay.		BTL6	Creating	CO4
19.	Explain transformer differential protection in numerical relays.		BTL6	Creating	CO4
20.	List two differences between static and numerical relays.		BTL5	Evaluating	CO4
21.	What are digital filters?		BTL1	Remembering	CO4
22.	Describe one application of distant protection in numerical relays.		BTL2	Understanding	CO4
23.	Explain the function of a memory circuit in static relays.		BTL3	Applying	CO4
24.	Mention two real-time applications of numerical relays.		BTL4	Analyzing	CO4
	PART-B				
1.	Explain with diagrams the working of static phase and amplitude comparators.	(13)	BTL1	Remembering	CO4
2.	Describe the synthesis of various types of relays using static comparators.	(13)	BTL2	Understanding	CO4
3.	Compare electromagnetic, static, and numerical relays.	(13)	BTL3	Applying	CO4
4.	Draw and explain the block diagram of a static relay.	(13)	BTL2	Understanding	CO4
5.	Explain the advantages and disadvantages of static relays.	(13)	BTL1	Remembering	CO4
6.	Describe the operating principle of static distance relay.	(13)	BTL3	Applying	CO4
7.	Explain the overcurrent protection scheme using static relays.	(13)	BTL4	Analyzing	CO4
8.	With block diagram, explain transformer differential protection using static relays.	(13)	BTL1	Remembering	CO4
9.	Explain the distant protection scheme using static or numerical relays.	(13)	BTL2	Understanding	CO4
10.	Draw and explain the block diagram of a numerical relay.	(13)	BTL1	Remembering	CO4
11.	Describe the construction and operation of microprocessor-based numerical relays.	(13)	BTL4	Analyzing	CO4
12.	Discuss the functional blocks involved in numerical protection.	(13)	BTL3	Applying	CO4
13.	Explain overcurrent relay implementation in a numerical relay system.	(13)	BTL5	Evaluating	CO4
14.	Describe the need for analog and digital signal	(13)	BTL6	Creating	CO4

	processing in numerical relays.				
15.	Discuss the use of A/D converters and digital filters in numerical protection.	(13)	BTL1	Remembering	CO4
16.	Compare the performance of static and numerical relays for distance protection.	(13)	BTL2	Understanding	CO4
17.	Explain relay testing and programming in numerical relay systems.	(13)	BTL3	Applying	CO4
PART-C					
1.	With a neat diagram, explain the working of a numerical relay and its application in power system protection.	(15)	BTL5	Evaluating	CO4
2.	Discuss the phase and amplitude comparators used in static relays and show how various characteristics are synthesized.	(15)	BTL5	Evaluating	CO4
3.	Explain overcurrent, transformer differential, and distance protection schemes using numerical relays.	(15)	BTL6	Creating	CO4
4.	Describe the architecture, working, and signal processing elements in numerical relays.	(15)	BTL6	Creating	CO4
5.	Compare and contrast electromagnetic, static, and numerical relays based on construction, working, and application.	(15)	BTL4	Analyzing	CO4

UNIT-V CIRCUIT BREAKERS

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – restriking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching -current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF_6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

PART-A

Q. No	**Questions**	**BT Level**	**Competence**	**CO**
1.	State the definition of a circuit breaker.	BTL1	Remembering	CO5
2.	Clarify the process of arc interruption.	BTL2	Understanding	CO5
3.	Identify the cause of an arc in a circuit breaker.	BTL1	Remembering	CO5
4.	Define recovery voltage in the context of circuit breakers.	BTL2	Understanding	CO5
5.	Elucidate the meaning of restriking voltage.	BTL3	Applying	CO5
6.	Define RRRV (Rate of Rise of Recovery Voltage).	BTL3	Applying	CO5
7.	Outline the phenomenon of current chopping.	BTL1	Remembering	CO5

8.	Indicate the need for resistance switching in circuit breakers.		BTL5	Evaluating	CO5
9.	Discuss the effect of interrupting capacitive current.		BTL2	Understanding	CO5
10.	List four types of circuit breakers.		BTL4	Analyzing	CO5
11.	Point out the main difference between AC and DC circuit breaking.		BTL1	Remembering	CO5
12.	Mention two applications of SF_6 circuit breakers.		BTL4	Analyzing	CO5
13.	State two advantages of vacuum circuit breakers.		BTL2	Understanding	CO5
14.	Describe an air blast circuit breaker.		BTL4	Analyzing	CO5
15.	Clarify the making capacity of a circuit breaker.		BTL3	Applying	CO5
16.	Define an MCB and identify where it is used.		BTL1	Remembering	CO5
17.	Compare MCB and MCCB.		BTL1	Remembering	CO5
18.	Outline dielectric recovery in circuit breakers.		BTL6	Creating	CO5
19.	State the role of the arc quenching medium in a circuit breaker.		BTL6	Creating	CO5
20.	List two properties of SF_6 gas.		BTL5	Evaluating	CO5
21.	Define the breaking capacity of a circuit breaker.		BTL1	Remembering	CO5
22.	Discuss the significance of arc voltage in circuit breakers.		BTL2	Understanding	CO5
23.	Describe the concept of energy balance in arc interruption.		BTL3	Applying	CO5
24.	List two criteria used to select a circuit breaker.		BTL4	Analyzing	CO5
PART-B					
1.	Explain the process of arc formation and methods of arc extinction in detail.	(13)	BTL1	Remembering	CO5
2.	Describe DC and AC circuit breaking with waveforms and analysis.	(13)	BTL2	Understanding	CO5
3.	Explain restriking voltage and recovery voltage with relevant equations and waveform.	(13)	BTL3	Applying	CO5
4.	Describe the phenomena of current chopping and resistance switching.	(13)	BTL2	Understanding	CO5
5.	Explain the interruption of capacitive and inductive currents in circuit breakers.	(13)	BTL1	Remembering	CO5
6.	With neat diagram, explain the construction and working of an air blast circuit breaker.	(13)	BTL3	Applying	CO5
7.	Explain the working and application of oil circuit breakers.	(13)	BTL4	Analyzing	CO5
8.	Compare bulk oil and minimum oil circuit breakers.	(13)	BTL1	Remembering	CO5

9.	Explain the construction and operation of SF_6 circuit breakers.	(13)	BTL2	Understanding	CO5
10.	Discuss the advantages and limitations of vacuum circuit breakers.	(13)	BTL1	Remembering	CO5
11.	Explain the construction and working of miniature circuit breakers (MCB).	(13)	BTL4	Analyzing	CO5
12.	Describe the features and operation of moulded case circuit breakers (MCCB).	(13)	BTL3	Applying	CO5
13.	Compare various circuit breakers based on arc quenching medium.	(13)	BTL5	Evaluating	CO5
14.	With neat diagram, explain the rating parameters of a circuit breaker.	(13)	BTL6	Creating	CO5
15.	Explain the selection criteria of circuit breakers for high-voltage applications.	(13)	BTL1	Remembering	CO5
16.	Discuss arc quenching in oil, vacuum, and SF_6 circuit breakers.	(13)	BTL2	Understanding	CO5
17.	Explain the mechanism of energy dissipation in various types of circuit breakers.	(13)	BTL3	Applying	CO5
PART-C					
1.	Explain in detail the physics of arc formation and interruption with reference to AC circuit breakers.	(15)	BTL5	Evaluating	CO5
2.	Compare and contrast different types of circuit breakers: oil, air blast, SF_6, and vacuum breakers.	(15)	BTL5	Evaluating	CO5
3.	With diagrams, explain the interruption of capacitive current and its effect on circuit performance.	(15)	BTL6	Creating	CO5
4.	Describe the working principles, construction, and applications of MCBs and MCCBs in modern power systems.	(15)	BTL6	Creating	CO5
5.	Explain the factors to be considered for rating and selection of circuit breakers for power systems with examples.	(15)	BTL4	Analyzing	CO5

Course Outcome:

To impart knowledge on Causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.

To impart knowledge on Characteristics and functions of relays and protection schemes.

To impart knowledge on Apparatus protection using Current transformers and Potential transformers.

To impart knowledge on the characteristics and functions of relays and protection schemes.
To impart knowledge on Functioning of circuit breaker