SRM VALLIAMMAI ENGINEERING COLLEGE

(An 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 2022-23 (ODD)

Prepared by

Dr. S.Malathi, Assistant Professor (Sel.Gr.) / EEE

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**	**Course Outcome**	**BT Level**	**Competence**
1	Show the need for protective schemes in power system?	CO1	BTL 1	Remember
2	Distinguish between a short circuit and an overload.	CO1	BTL 4	Analyze
3	Summarize the role of protective relay in a modern power	CO1	BTL 2	Understand
4	Define switchgear.	CO1	BTL 1	Remember
5	What are the causes of faults in a power system?	CO1	BTL 1	Remember
6	Summarize the functions of isolating switch?	CO1	BTL 2	Understand
7	Explain surge absorber? Differentiate it from surge diverter?	CO1	BTL 5	Evaluate
8	Identify the sources of fault power?	CO1	BTL 3	Apply
9	Identify the different types of faults occurring in power system?	CO1	BTL 3	Apply
10	Examine the consequences of short circuit.	CO1	BTL 4	Analyze
11	Explain the importance of ground wire?	CO1	BTL 2	Understand
12	List the merits of resistance grounded system.	CO1	BTL 4	Analyze
13	Analyze how arcing ground avoided can be avoided?	CO1	BTL 4	Analyze
14	What happen if earth wire is not provided in overhead	CO1	BTL 1	Remember
15	Classify the different types of earthing.	CO1	BTL 2	Understand
16	What is the necessity for earthing?	CO1	BTL 3	Apply
17	Formulate the role of primary protection?	CO1	BTL 6	Create
18	Define protection zone.	CO1	BTL 1	Remember
19	Elaborate the different types of zones of protection.	CO1	BTL 6	Create
20	Show the examples for unit and non unit system of protection.	CO1	BTL 2	Understand
21	Compare symmetrical and unsymmetrical faults?	CO1	BTL 5	Evaluate
22	Build the significance of single line to ground fault.	CO1	BTL 3	Apply

23	Justify the meaning of travelling wave protection?	CO1	BTL 5	Evaluate
24	Name the device to protect the power sytem against travelling waves.	CO1	BTL 1	Remember
	PART – B			
1	(i) Summarize the importance of protective schemes employed in power system. (7) (ii) Show the essential qualities of protection. (6)	CO1	BTL 2	Understand
2	What are the different types of faults? Discuss the consequence of faults on a power system (13)	CO1	BTL 1	Remember
3	List the causes of faults in different equipment's in a sample system (13)	CO1	BTL 1	Remember
4	Explain in detail about the various methods of overvoltage protection of overhead transmission line. (13)	CO1	BTL 4	Analyze
5	Explain in detail about the need and different methods for neutral grounding with suitable diagram. (13)	CO1	BTL 4	Analyze
6	(i) Discuss different types of earthing the neutral point of the power system (7) (ii) Formulate an expression for the reactance of the Peterson coil in terms of capacitance of the protected line. (6)	CO1	BTL 6	Create
7	Exlain in detail about the Peterson coil? List the protective functions performed by this device. (13)	CO1	BTL 5	Evaluate
8	A 132 kV, 3-phase, 50 Hz transmission line 200 km long consists of three conductors of effective diameter 20 mm arranged in a vertical plane with 4 m spacing and regularly transposed. Find the inductance and kVA rating of the arc suppression coil in the system (13)	CO1	BTL 3	Apply
9	(i) Explain the overlapping of protective zones with neat sketch. (7) (ii) Describe the different faults in power system. Which of these are more frequents? (6)	CO1	BTL 5	Evaluate
10	(i) Explain the fundamental requirements of protective Relaying. (7) (ii) Compare surge diverter and surge absorber. Also explain the characteristics of an ideal surge diverter. (6)	CO1	BTL 2	Understand
11	(i)List the causes of over voltage? (4) (ii)What are the protection scheme employed to protect from lighting and switching effects. (9)	CO1	BTL 1	Remember

12	(i) List the causes of short circuits due to failure of insulation on overhead conductors? (4) (ii) Briefly explain about resistance earthing and reactance earthing. (9)	CO1	BTL 4	Analyze
13	A 230 kV, 3-phase, 50 Hz, 200 km transmission line has a capacitance to earth of 0.02 µF/km per phase. Calculate the inductance and kVA rating of the Peterson coil used for earthing the above system (13)	CO1	BTL 3	Apply
14	(i) Draw and explain protective zone diagram for a sample power system networks. (7) (ii)List the causes of faults in different equipment's in a sample system (6)	CO1	BTL 1	Remember
15	Explain the Principles and need for protective schemes. (13)	CO1	BTL 2	Understand
16	In a 3 phase 4 wire system, the currents R,Y and B under abnormal conditions of loading are as under $I_R = 100 \angle 30^o$ A ; $I_Y = 50 \angle 300^o$ A ; $I_B = 30 \angle 180^o$ A. Calculate the positive, negative and zero sequence currents in the R-line and current in the neutral wire. (13)	CO1	BTL 3	Apply
17	Explain the following terminologies used in protective relaying: (i) Relay time and Breaker time. (04) (ii) Pick up and pickup relay (04) (iii) Fault clearing Time (03) (iv) Time delay (02)	CO1	BTL 2	Understand
	PART - C			
1	Formulate why protection scheme is required in power system with suitable example. (15)	CO1	BTL 4	Analyze
2	Explain different types of protection schemes with suitable diagrams. (15)	CO1	BTL 5	Evaluate
3	Justify why neutral grounding is provided and compare different types of neutral grounding. (15)	CO1	BTL 5	Evaluate
4	Estimate the inductance of Peterson coil to be connected between the neutral and ground to neutralize the charging current of overhead line having the line to ground capacitance of 0.15µF. If the supply frequency is 50 HZ and the operating voltage is 132KV. Find the KVA rating of the coil. (15)	CO1	BTL 6	Create
5	Evaluate suitable device for protection against travelling waves in detail. (15)	CO1	BTL 5	Evaluate

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	Course Outcome	BT Level	Competence
1	List the basic requirements of protective relay	CO2	BTL 1	Remember
2	Examine the functions of protective relays.	CO2	BTL 4	Analyze
3	Classify the different types of electromagnetic relays?	CO2	BTL 3	Apply
4	Identify the applications of attracted armature type	CO2	BTL 3	Apply
5	Define time setting multiplier in protective relays.	CO2	BTL 1	Remember
6	Enumerate the importance of time graded relay?	CO2	BTL 5	Evaluate
7	Outline the effects of arc resistance?	CO2	BTL 2	Understand
8	Explain R-X diagram?	CO2	BTL 2	Understand
9	Interpret why shading ring is provided in and induction disc relay.	CO2	BTL 2	Understand
10	What are the applications of over current relay?	CO2	BTL 3	Apply
11	In what way a distance relay is superior to over current protection for protection of transmission line. Justify	CO2	BTL 6	Create
12	List the different types of distance relay.	CO2	BTL 1	Remember
13	Show the merits of mho relay? And also draw its R-X Diagram.	CO2	BTL 2	Understand
14	Explain the principle of differential relay.	CO2	BTL 4	Analyze
15	What are the conditions under which the directional impedance relay will act?	CO2	BTL 1	Remember
16	What is the principle of negative sequence relay?	CO2	BTL 1	Remember
17	Mention the principle of operation of distance relay..	CO2	BTL 4	Analyze
18	Summarize the function of under frequency relay.	CO2	BTL 2	Understand
19	What are the applications of differential relay?	CO2	BTL 1	Remember
20	Show which type of relay is best suited for long distance very high voltage transmission lines.	CO2	BTL 3	Apply
21	Formulate the difficulties of differential protection.	CO2	BTL 6	Create
22	Explain the characteristics of Reactance relay.	CO2	BTL 5	Evaluate
23	Analyze the inverse law characteristics of negative sequence relays.	CO2	BTL 4	Analyze
24	Justify the role of under frequency relays.	CO2	BTL 5	Evaluate

PART – B

1	Develop the different inverse time characteristics of over current relays and mention how the characteristics can be achieved in practice for an EM relay? (13)	CO2	BTL 6	Create

2	Explain the general working of a relay and derive the fundamental torque equation. (13)	CO2	BTL 4	Analyze
3	Outline the construction details and principle of operation of induction type directional over current relay. (13)	CO2	BTL 2	Understand
4	Explain the construction and principle of operation of non- directional induction-disc relay. (13)	CO2	BTL 2	Understand
5	Determine plug setting multiplier of a 5 ampere,3 second over current relay having a current setting of 125% and a time setting multiplier of 0.6 connected to supply circuit through a 400/5 current transformer when the circuit carries a fault current of 4000Athrough a 400/5 current transformer when the circuit carries a fault current of 4000A . (13)	CO2	BTL 5	Evaluate
6	Describe the operating principle, constructional features and area of applications of directional relay. How do you implement directional feature in the over current relay. (13)	CO2	BTL 1	Remember
7	(i) Explain the construction details and principle of operation o f directional induction cup relay. (7) (ii) Explain with the help of neat diagram the construction and working of induction type directional power relay. (6)	CO2	BTL 4	Analyze
8	Construct the MHO relay characteristic on the R-X diagram. Discuss the range setting of various distance relays placed on a particular location. . (13)	CO2	BTL 3	Apply
9	Identify in what way distance protection is superior to over current protection for the protection of transmission line. (13)	CO2	BTL 3	Apply
10	Explain the principle of working of distance relays. Describe with neat sketches the following types of relay (i) Impedance relay (ii) Reactance relay (iii) Mho relay Indicate the difference on RX diagrams and show where each type is suitable. (4+4+5)	CO2	BTL 5	Evaluate
11	Describe the operating principles and characteristic of impedance, admittance and mho relays. (13)	CO2	BTL 1	Remember
12	Describe the principle of percentage biased differential relay with necessary diagrams. Also discuss its applications. (13)	CO2	BTL 1	Remember
13	Explain with suitable diagram the principle of working of transley relay. (13)	CO2	BTL 3	Apply
14	(i) With neat sketch explain negative sequence relay (7) (ii) Explain clearly about current balance differential relays. (6)	CO2	BTL 4	Analyze
15.	(i) Compare Various distance relays. (7) (ii) List out advantages and applications of distance relays. (6)	CO2	BTL 1	Remember

16.	Explain in detail about the negative sequence relay. (13)	CO2	BTL 2	Understand
17.	Describe in detail about the construction and working of Under frequency relays. (13)	CO2	BTL 2	Understand
PART - C				
1	Elaborate the various types of electromagnetic relays. (15)	CO2	BTL 6	Create
2	Describe the construction and principle of operation of non directional induction type over current relay. (15)	CO2	BTL 5	Evaluate
3	Explain impedance relay with suitable R-X diagrams (15)	CO2	BTL 5	Evaluate
4	Formulate the torque equation of mho relay from universal torque equation. (15)	CO2	BTL 6	Create
5.	On a R-X diagram show a line having an impedance of 3+j4Ω. On the same diagram show the operating characteristics of (1)Impedance relay (2) Reactance relay (3) Mho relay. (5+5+3) Assume that those relays are adjusted to just operate for a zero impedance short circuit at the end of the line section. If an arcing short circuit fault having ab arc impedance of 1+j0Ω occurs anywhere on the line, find for each tye of distance relay, the maximum portion of the line that can be protected.	CO2	BTL 5	Evaluate

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	Course Outcome	BT Level	Competence
1	Justify, Why secondary of transformer should not be opened?	CO3	BTL 6	Create
2	For a 132KV system, the reactance and capacitance up to the location of circuit breaker is 3Ω and 0.015μf respectively the frequency of oscillation?	CO3	BTL 1	Remember
3	Contrast the difference between CTs used for protection	CO3	BTL 4	Analyze
4	Define the term burden on CT.	CO3	BTL 1	Remember
5	List the application of potential transformer.	CO3	BTL 1	Remember
6	Discuss the short comings of differential protection scheme as applied to power transformer.	CO3	BTL 2	Understand
7	Define the term pilot with reference to power line	CO3	BTL 1	Remember
8	Show the applications of Buchholz's relay.	CO3	BTL 3	Apply
9	Identify the problems arising in differential protection in power transformer and how are they overcome?	CO3	BTL 1	Remember
10	Explain current grading of relays?	CO3	BTL 5	Evaluate
11	Examine over fluxing protection of a transformer?	CO3	BTL 4	Analyze
12	List the common faults that occur in a generator.	CO3	BTL 1	Remember
13	Infer the causes of over speed and how alternators are protected from it?	CO3	BTL 2	Understand
14	Discuss the type of relay is best suited for generation.	CO3	BTL 2	Understand
15	What are the protection methods used for transmission line?	CO3	BTL 3	Apply
16	Explain the secondary of CT should not be open.	CO3	BTL 4	Analyze
17	Outline the type of relays are used to protect transmission	CO3	BTL 2	Understand
18	Compose the common methods used for line protection?	CO3	BTL 6	Create
19	Classify the types of bus bar protection.	CO3	BTL 2	Understand
20	Explain time-graded system protection?	CO3	BTL 5	Evaluate
21	Identify the limitations of Buchholz's relay.	CO3	BTL 3	Apply
22	Discuss the causes of bus zone faults.	CO3	BTL 3	Apply
23	Explain the faults associated with a transformer?	CO3	BTL 5	Evaluate
24	List out the main safety devices available with transformer?	CO3	BTL 4	Analyze

PART - B

1	(i) Compare CT & PT. What are the applications of CT & PT. (7) (ii) An 11 kV, 200MVA alternator is provided with differential protection. The % of winding to be protected against phase to ground fault is 85 %.The relay is set to operate when there is 20% out of balance current. Determine the value of the resistance to be placed in the neutral to ground connection. (6)	CO3	BTL 5	Evaluate
2	A 3 phase transformer having line voltage ratio of 0.4 kV/11 kV is connected in star delta and protective transformer on 400 v side have a current ratio of 500/5.what must be the ratio of the protective transformer on the 11kV side? (13)	CO3	BTL 4	Analyze
3	Classify different protection schemes normally used for protection of a power transformer from internal faults? Discuss one of them in brief. (13)	CO3	BTL 2	Understand
4	(i) Make use of Merz-price circulation current scheme for protection used in power transformer. (7) (ii) A three phase transformer of 220/11000 line volts is connected in star/delta. The protective transformers on 220V side have a current ratio of 600/5. Calculate the current transformer ratio on 11000V side. (6)	CO3	BTL 3	Apply
5	A 3 phase transformer having line voltage ratio of 440 V / 11 kV is connected in star – delta. The protection transformer on the LV side has a ratio of 500 / 5. Estimate the ratio of the protection transformer connected on HV side? (13)	CO3	BTL 2	Understand
6	(i) Describe the differential protective scheme of transformer. (7) (ii) Show the protective scheme employed for the bus bar. (6)	CO3	BTL 1	Remember
7	(i) Examine clearly the role of Buchholz relay for the protection of incipient faults in transformers (7) (ii) A star connected, 3 phase, 10 MVA, 6.6KV alternator has a per phase reactance of 10%. It is protected by Merz- price circulating current principle which is set to operate for fault currents not less than 175A. Calculate the value of earthing resistance to be provided in order to ensure that only 10% of the alternator winding remains unprotected. (6)	CO3	BTL 4	Analyze
8	Explain the principle of percentage biased differential protection with necessary diagrams. Also discuss its applications (13)	CO3	BTL 2	Understand
9	Describe the differential pilot wire method of protection of feeder (13)	CO3	BTL 3	Apply

10	A star connected 3-phase,20MVA,11KV Alternator has a per phase reactance of 0.75 ohms/phase .It is protected by Merz price circulating current principle which is to operate for fault currents not less than 175A. Formulate the value of earthing resistance to be provided in order to ensure only 10% of the alternator winding remains unprotected (13)	CO3	BTL 6	Create
11	What are the types of protective schemes employed for the protection of field winding and loss excitation of alternator. Explain in detail. (13)	CO3	BTL 1	Remember
12	Describe the types of protective schemes employed for the protection of Busbar. (13)	CO3	BTL 1	Remember
13	(i) Explain the non- directional time graded, current protection of feeders. (08) (ii) Explain the directional time and current protection of feeders. (05)	CO3	BTL 2	Understand
14	Identify the different types of feeder and the protective schemes employed for the protection of feeder (13)	CO3	BTL 3	Apply
15	Justify the ways of protection in AC motor. (13)	CO3	BTL 5	Evaluate
16	(i) Classify the types of protective schemes employed for the protection of Transmission line. (04) (ii) Describe the protection of Parallel feeders and Ring mains. (09)	CO3	BTL 1	Remember
17	A generator ratings are 13.3 KV, 12 MVA,15% of the winding unprotected. The relay setting is 30% out of balance. Calculate the neutral resistance to be added. (13)	CO3	BTL 4	Analyze
	PART - C			
1	Discuss in detail about the protection of generator using differential and biased differential protection scheme. (15)	CO3	BTL 6	Create
2	Elaborate the occurrence of on the faults and protection of transformer in detail. (15)	CO3	BTL 6	Create
3	A star connected 3 phase, 12 MVA, 11 KV alternator has a phase reactance of 10%. It is protected by Merz-price circulating current scheme which is set to operate for fault current not less than 200A. Calculate the value of earthing resistance to be provided in order to ensure that only 15% of the alternator winding remains unprotected. (15)	CO3	BTL 5	Evaluate

4	A 500 KVA, 6.6 KV star connected alternators has a synchronous reactance of 1.0Ω per phase and negligible resistance. The different relay operates if the out of balance current through it exceeds 30% of the normal full load current of the alternator. The star point of the alternator is earthed through a resistance of 5Ω. What percent of the stator winding is left unprotected? Show that the effect of the alternator reactance can be neglected. (15)	CO3	BTL 5	Evaluate
5	Current transformer of current ratio of 1000/5 are used for protection of a star connected 3 phase, 10MVA, 6.6KV alternator. If the relay is set to operate for a minimum current of 0.5 A. Calculate the percentage of each phase stator winding which is unprotected against earth fault when the machine operates at normal voltage. Assume that star point of alternator is earthed through a resistance of 7.5Ω. (15)	CO3	BTL 5	Evaluate

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	Course Outcome	BT Level	Competence
1	What are the basic circuits used in static relays?	CO4	BTL-6	Create
2	Summarize the advantages of static relays	CO4	BTL-2	Understand
3	Compose the problems arising in differential protection in power transformer and how are they overcome?	CO4	BTL-6	Create
4	Show the Duality between Amplitude and Phase Comparators	CO4	BTL-1	Remember
5	Explain Comparator and its type	CO4	BTL-1	Remember
6	Explain the function of Synthesis of Mho Relay Using Static Phase Comparator	CO4	BTL-1	Remember
7	Define static relay	CO4	BTL-4	Analyze
8	Explain the function of Synthesis of Simple Impedance Relay using Amplitude Comparator	CO4	BTL-5	Evaluate
9	Compare Amplitude Comparator and Phase Comparator	CO4	BTL-2	Understand
10	Distinguish the Synthesis of Various Distance Relays Comparators	CO4	BTL-3	Apply
11	List out the general characteristics of numerical protection.	CO4	BTL-1	Remember
12	Define the Over Current Protection	CO4	BTL-1	Analyze
13	Give the Different over current protection relays	CO4	BTL-4	Analyze
14	Define the definite time over-current relay	CO4	BTL-3	Apply
15	Define the Inverse Time Over-current Relay	CO4	BTL-1	Remember
16	Explain the Instantaneous OC Relay	CO4	BTL-2	Understand
17	Interpret the advantages of over current relays over electromagnetic types	CO4	BTL-2	Understand
18	Explain the Phase Comparators and write its type	CO4	BTL-5	Evaluate
19	Illustrate with neat Block diagram of Numerical Transformer Differential Protection	CO4	BTL-3	Apply
20	Identify the different methods of Numerical distant protection of transmission lines	CO4	BTL-3	Apply
21	Summarize the principle of duality.	CO4	BTL-2	Understand
22	What are the advantages of digital relay?	CO4	BTL-5	Evaluate
23	Draw the static inverse time-current characteristics.	CO4	BTL-4	Analyze

24	List the functions of numerical relays.	CO4	BTL-4	Analyze
PART - B				
1	Describe the construction, working principle and operation of static over current relay. (13)	CO4	BTL-1	Remember
2	i) Define the Duality Between Amplitude and Phase Comparators. (7) ii) Define the type of Amplitude and Phase Comparators (6)	CO4	BTL-4	Analyze
3	Discuss the Synthesis of Various Distance Relays Using Static Comparators (13)	CO4	BTL-6	Create
4	Explain with neat block diagram of the function of Synthesis of Mho Relay Using Static Phase Comparator (13)	CO4	BTL-1	Remember
5	Explain with neat block diagram of the function of Synthesis of Reactance Relay Using Cosine-type Phase Comparator (13)	CO4	BTL-3	Apply
6	Distinguish briefly about the Various Comparators in detail. (13)	CO4	BTL-4	Analyze
7	i) Compare static relay with electromagnetic relays. (7) ii) Explain the advantages of Numerical relays. (6)	CO4	BTL-4	Analyze
8	Compose the problems arising in differential protection in power transformer and how are they overcome? (13)	CO4	BTL-2	Understand
9	Explain with neat block diagram of the function of Synthesis of Simple Impedance Relay Using Amplitude Comparator (13)	CO4	BTL-1	Remember
10	Discuss the various semiconductor devices used in the static relay. (13)	CO4	BTL-2	Understand
11	Illustrate with neat Block diagram of Numerical Transformer Differential Protection (13)	CO4	BTL-2	Understand
12	Discuss with Neat Block diagram of different methods of Numerical Distance Protection of Transmission Line.(13)	CO4	BTL-1	Remember
13	Define the Over Current Protection and Explain its types Briefly (13)	CO4	BTL-3	Apply
14	Define i) definite time over-current relay (7) ii) Inverse Time Over-current Relay (6)	CO4	BTL-5	Evaluate
15	(i) Contrast the differences between numerical relay and electromechanical relay. (7) (ii) Outline the limitations of Numerical relay. (6)	CO4	BTL-2	Understand
16.	(i) Explain the steps involved in algorithm development for fault diagnosis. (7) (ii) Summarize the synthesis of various relays using static comparators. (6)	CO4	BTL-3	Apply
17.	Explain comparators? Explain the duality between phase and amplitude comparator. (13)	CO4	BTL-5	Evaluate
PART - C				

1	Explain with neat block diagram the operation of static relay and list the advantages and disadvantages (15)	CO4	BTL-5	Evaluate
2	Assess the factors cause spill current on external fault in case of transformer differential protection? (15)	CO4	BTL-5	Evaluate
3	Discuss the coincidence principle used in phase comparators. (15)	CO4	BTL-6	Create
4	Derive the characteristics equation for the phase comparator and amplitude comparator. (15)	CO4	BTL-5	Evaluate
5	With the flow chart, explain the numerical over current protection. (15)	CO4	BTL-6	Create

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, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

PART - A

Q.No	Questions	Course Outcome	BT Level	Competence
1	What is meant by MCB?	CO5	BTL-1	Remember
2	Differentiate A.C. and D.C. circuit breaking	CO5	BTL-2	Understand
3	Discuss the arc phenomenon in a circuit breaker.	CO5	BTL-6	Apply
4	State the slepian theory for arc interruption.	CO5	BTL-1	Remember
5	Define the term “rate of rise of recovery voltage”.	CO5	BTL-1	Remember
6	Explain recovery voltage?	CO5	BTL-4	Analyze
7	Explain resistance switching	CO5	BTL-4	Analyze
8	Explain current chopping	CO5	BTL-5	Evaluate
9	What are the factors responsible for the increase of arc resistance?	CO5	BTL-2	Understand
10	Discuss the different methods of arc extinction	CO5	BTL-3	Apply
11	Define restriking voltage.	CO5	BTL-4	Analyze
12	Assess the problems encountered in the interruption of capacitive currents	CO5	BTL-3	Apply
13	Explain the ratings of a circuit breaker	CO5	BTL-4	Analyze
14	Define symmetrical breaking capacity	CO5	BTL-3	Apply
15	Show the making capacity of a circuit breaker	CO5	BTL-1	Remember
16	Classify the circuit breakers	CO5	BTL-2	Understand
17	A circuit breaker is rated as 1500 A, 1000 MVA, 3 second, 3 phase oil circuit breaker. Find rated making current.	CO5	BTL-6	Create
18	Give the advantage of SF6 circuit breaker over Air blast circuit breaker	CO5	BTL-5	Evaluate
19	Compose Peterson coil? What protective functions are performed by this device?	CO5	BTL-2	Understand
20	Illustrate the disadvantages of an Air blast circuit breaker	CO5	BTL-2	Understand
21	Define the term “breaking capacity” in a circuit breaker.	CO5	BTL-3	Apply
22	What is RRRV?	CO5	BTL-1	Remember
23	Define rupturing capacity.	CO5	BTL-1	Remember
24	Compare re-striking voltage and recovery voltage.	CO5	BTL-5	Evaluate

PART - B				
1	Define the principle of arc extinction. What are the methods of arc extinction? Describe them in detail. (13)	CO5	BTL-1	Remember
2	i) Explain the arc interruption methods used in circuit breakers (7) ii) Explain Resistance switching for arc extinction in circuit breakers (6)	CO5	BTL-4	Analyze
3	Give the reason of using SF_6 circuit breaker. (13)	CO5	BTL-6	Create
4	i) Explain how arc initiated and sustained when the circuit breaker contacts break (7) ii) Explain in detail the various methods of arc extinction in circuit breaker (6)	CO5	BTL-3	Apply
5	i) Show an expression for Restriking voltage and rate of rise of restriking voltage (RRRV) in a C.B. (7) ii) Illustrate the current chopping? Explain how can the effect of current chopping be minimized? (6)	CO5	BTL-3	Apply
6	Describe the construction and principle of operation of Air Blast circuit breaker. (13)	CO5	BTL-4	Analyze
7	i) With neat sketch explain resistance switching. (7) ii) Explain current chopping with suitable diagrams. (6)	CO5	BTL-4	Analyze
8	Discuss with neat sketch, the construction and working of minimum oil circuit breaker. Also gives its merits and demerits. (13)	CO5	BTL-2	Understand
9	Describe the constructional details of SF6 circuit breaker and its operation. Give its advantages and disadvantages (13)	CO5	BTL-1	Remember
10	A 50 Hz, 11 KV, 3 phase alternator with earthed neutral has a reactance of 5 ohms per phase and is connected to bus bar through a CB. The distributed capacitance up to CB between phase and neutral is 0.01µf.determine (i) peak restriking voltage across the contacts of the breaker. (ii) Frequency of oscillation. (iii) The average rate of rise of re striking voltage up to the first peak. (5+4+4)	CO5	BTL-1	Remember
11	Describe the principle constructional features of all types of air blast CB. Give its advantages and disadvantages. (13)	CO5	BTL-2	Understand
12	Explain the construction, working principle, operation and application of Vaccum circuit breakers. (13)	CO5	BTL-1	Remember
13	Explain rupturing capacity, making capacity and short time rating and rated current of the circuit breaker. (13)	CO5	BTL-2	Understand
14	Explain working principle and construction of MCB and MCCB (13)	CO5	BTL-5	Evaluate
15	Describe (i) Interruption of capacitive current (7) (ii) Current zero interruption theories (6)	CO5	BTL-3	Apply

16	(i) Discuss the selection of circuit breakers for different ranges of operating voltages. (7) (ii) Discuss how the breaking capacity and making capacity of a circuit breaker are tested in laboratory type testing station. (6)	CO5	BTL-5	Evaluate
17	Describe the operating principle of DC circuit breaker. (13)	CO5	BTL-2	Understand
	PART – C			
1	i) Solve the RRRV of 132 kV circuit breaker with neutral earthed circuit breaker data as: broken current is symmetrical, restriking voltage has frequency of 20 kHz, and power factor is 0.15. Assume fault is also earthed. (7) ii) Illustrate the selection of circuit breakers for different ranges of system voltages (8)	CO5	BTL-6	Create
2	A generator connected through 5 cycle CB to a transformer is rated 8000KVA with the reactance of X''_d=10 % , X''_d=16% and X_d=100%. It is operating at no load and rated voltage when 3 phase short circuit occurs between breaker and transformer. Find i) Sustained short circuit in circuit breaker ii) The initial symmetrical r.m.s current in breaker iii) Maximum possible D.C component of short circuit in breaker iv) The momentary current rating of breaker v) Current to be interrupted by breaker vi) The interrupting KVA (15)	CO5	BTL-5	Evaluate
3	Compare the different types of circuit Breaker used for power system protection (15)	CO5	BTL-5	Evaluate
4	Formulate the different methods of testing of circuit breaker? Describe the method which is more suitable for testing the large capacity circuit breakers. Also discuss the merits and demerits of the method. (15)	CO5	BTL-5	Evaluate
5	(i) Enumerate the various types of ratings of a circuit breaker. (04) (ii)Discuss symmetrical and asymmetrical breaking capacity. (05) (iii)Making capacity. (03) (iv)Short-time current capacity. (03)	CO5	BTL-5	Evaluate