



Module 1

**Chapter 1 : Substation Equipments
and Switching Devices 1-1 to 1-32**

Syllabus : Substation Equipment : Instrument Transformers - Role of instrument transformers in measuring and protection, difference between measuring and protection CTs, selection of technically suitable instrument transformers; **Switchgear :** Definition, Types, Location of switchgear in typical power system, single line diagram to show the measuring and protection scheme. **Switching Devices :** Isolator & Earthing switch (Requirements & definitions, types and construction, Pantograph Isolators, Ratings), Load break switches - Ratings and applications; Contactors - Basic working principle, Terms & Definitions, applications.

1.1	Sub-Station and Sub-Station Equipment.....	1-1
1.1.1	Sub-station equipment	1-1
1.1.2	Different Types of Sub-stations	1-3
1.2	Switching Devices.....	1-7
1.2.1	Isolators	1-7
1.2.1(A)	Classification of Isolators.....	1-7
1.2.2	Earthing Switch	1-10
1.2.2(A)	Installation and Function of Earthing Switch.....	1-10
1.2.3	Switch Gear-Definition (Duty)	1-11
1.3	Contactors.....	1-11
1.4	Low Voltage Control Gear and Contactors.....	1-11
1.4.1	L.V. Control Gear	1-11
1.5	More about Contactors	1-11
1.5.1	Electro-Magnetic Contactors	1-12
1.5.2	Electro-Pneumatic Contactor	1-12
1.6	Different Circuits.....	1-12
1.6.1	Main Circuit.....	1-12
1.6.2	Auxiliary Circuit.....	1-12
1.6.3	Control Circuit.....	1-12
1.7	Different Contacts.....	1-12

1.7.1	Main Contact.....	1-12
1.7.2	Make Contact.....	1-12
1.7.3	Break Contact.....	1-12
1.7.4	Testing of Contactors	1-12
1.8	Contactors as Starters for Motor	1-15
1.8.1	Starter for Squirrel Cage Induction Motor	1-15
1.8.2	Reversing Contactor Starter	1-15
1.9	For Induction Motors Generally Following Starters are used.....	1-15
1.10	Some Important Terms/ Definitions	1-16
1.11	Utilization Categories of Contactors.....	1-16
1.11.1	Various Tests on Contactor (as per Rule, IEC-158.1)	1-17
1.12	Operation of Contactors in Various Starting/ Controlling Mechanisms of m/c Starters.....	1-17
1.13	More about Contactors	1-20
1.13.1	About Contact Material.....	1-20
1.14	Introduction	1-20
1.14.1	Instrument Transformers (Metering CT/PT).....	1-20
1.14.2	CT/PT as Protection Transformers.....	1-21
1.14.3	Magnetising Properties of CT	1-21
1.15	Difference between Measurement and Protective CT	1-21
1.15.1	Comparison between Measurement CT and Protection CT.....	1-22
1.16	CT Errors.....	1-23
1.17	Design Features of CT and Method to Reduce Errors	1-25
1.18	Construction of CT.....	1-26
1.19	Selection of Technically suitable Transformers	1-28
1.19.1	Requirements of CTs used for Protection	1-28
1.19.2	Selection of CT	1-28
1.19.3	Calculation of CT Accuracy Class	1-28
1.19.4	CT Requirements for Differential Protection.....	1-28
1.19.5	Specifications of CT	1-29



1.20	Min. Acceptable Specification of Voltage Transformer for Metering.....	1-30
1.20.1	Specification of PT.....	1-31
1.20.2	Types of PT.....	1-31
1.21	Comparison between Electromagnetic type PT and Capacitive type (CVT).....	1-32
1.22	University Questions with Answers.....	1-32

Module 2

Chapter 2 : Circuit Breakers and Fuses 2-1 to 2-58

Syllabus : Circuit Breaker : Arc initiation, arc quenching principles, Re-striking voltage, RRRV, Recovery voltage, Types of Circuit Breakers : For LV application- MCB, MCCB, ELCB, air circuit breakers. For HV application- SF6 circuit breakers, vacuum circuit breakers (working principle, Construction, operating mechanisms, ratings & applications), Mechanical life, Electrical life and testing of circuit breakers. Principle and applications of LV and HV DC circuit breakers.

Fuses & their applications : Introduction, classification, working principle and applications of re-wirable and HRC fuses, Expulsion and drop out fuses, Fusing factor, selection of fuse link and cut off characteristics.

2.1	Concept of Circuit Breakers	2-1
2.1.1	Operating Principle	2-1
2.1.2	Classification of Circuit Breaker.....	2-2
2.1.3	Medium used for Arc Extinguishing.....	2-2
2.1.3(A)	Properties of C.B. Contacts.....	2-2
2.1.4	Contact Materials.....	2-2
2.1.4(A)	Operating Mechanism of C.B.s.....	2-2
2.1.5	Expected Properties of Operating Mechanism of CBs	2-3
2.1.6	Advantages and Disadvantages of Oil as an Arc Quenching Medium	2-3
2.2	General Information of Circuit Breaker	2-4
2.2.1	Difference between Isolator and Circuit Breaker ...	2-5
2.3	Trip Circuit of Circuit Breaker	2-6
2.4	Circuit Interruption	2-6
2.4.1	Arcing Phenomenon.....	2-6

2.4.1(A)	Ionisation	2-7
2.4.1(B)	Deionisation.....	2-8
2.4.1(C)	Diffusion Process.....	2-9
2.4.1(D)	Heat Conduction Process.....	2-9
2.4.1(E)	Losses from Plasma.....	2-9
2.4.2	Electric Arc Formation.....	2-9
2.4.3	Arc Interruption Methods (Quenching)	2-9
2.4.3(A)	High Resistance Interruption	2-9
2.4.3(B)	Low resistance or Current Zero Interruption or Current Interruption in AC Circuit Breaker	2-10
2.5	Different Methods of Arc Interruption.....	2-10
2.5.1	Slepian Theory.....	2-11
2.5.2	Cassie's Theory/Energy Balance Theory	2-12
2.5.3	Prince's Theory	2-12
2.6	Introduction to Rating of Circuit Breaker	2-12
2.6.1	Different Ratings of C.B. as defined by IEC.....	2-13
2.6.1(A)	Rated Voltage	2-13
2.6.1(B)	Rated Current or Rated Normal Current	2-13
2.6.1(C)	Rated Frequency.....	2-14
2.6.1(D)	Rated Breaking Capacity.....	2-14
2.6.1(E)	Symmetrical Breaking Capacity or Symmetrical Breaking Current.....	2-14
2.6.1(F)	Unsymmetrical Breaking Capacity or Unsymmetrical Breaking Current	2-15
2.6.1(G)	Breaking Capacity Expressed in MVA	2-15
2.6.1(H)	Symmetrical Breaking Capacity in MVA	2-15
2.6.1(I)	Unsymmetrical Breaking Capacity in MVA.....	2-15
2.6.2	Rated Making Capacity or Making Capacity	2-15
2.6.3	Rated Interrupting Duties	2-15
2.6.3(A)	Short Time Rating	2-16
2.7	Restriking Voltage and Other Terms	2-17
2.7.1	Arc Voltage	2-17
2.7.2	Restriking Voltage (Transient).....	2-17
2.7.2(A)	Characteristics of Restriking Voltage	2-17
2.7.3	Recovery Voltage.....	2-17
2.7.4	RRRV (Rate of Rise of Restriking Voltage).....	2-17
2.7.4(A)	Derivation of Restriking Voltage	2-18



2.7.5	Maximum Value of RRRV and Time for Maximum RRRV.....	2-19	2.8.10	Selection of Circuit Breaker	2-35
2.8	Detailed Study of Different Types of Circuit Breakers (LT) (Working Principle, Construction, Operating Mechanisms, Ratings & Applications).....	2-23	2.8.11	Comparative Merits and De-merits of Different Types of C.B.s	2-36
2.8.1	Air Break Circuit Breaker	2-23	2.9	Testing of Circuit Breakers	2-38
2.8.1(A)	Merits of L.T. Circuit Breakers	2-24	2.9.1	No load Mechanical Operation Tests on C.B.....	2-38
2.8.1(B)	Demerits of L.T. Circuit Breakers.....	2-25	2.9.2	D.C. Resistance Measurement Test.....	2-38
2.8.2	Air Blast Circuit Breakers (ABCB) (OR Compressed Air Circuit Breaker)	2-25	2.9.3	Milivolt-Drop Test.....	2-38
2.8.2(A)	Cross Blast ABCB	2-26	2.10	Mechanical Endurance Test on Circuit Breaker	2-38
2.8.2(B)	Axial Blast Circuit Breaker	2-26	2.10.1	Measurement of Breaker Time	2-39
2.8.3	Circuit Breakers used for HT	2-27	2.11	Temperature Rise Test of Circuit Breaker	2-39
2.8.3(A)	Bulk Oil Circuit Breaker	2-27	2.12	Miniature Circuit Breakers (MCB)	2-40
2.8.3(B)	Plain Oil Circuit Breaker	2-27	2.13	Molded Case Circuit Breaker (MCCB)	2-41
2.8.3(C)	Arc Controlled Oil Circuit Breaker	2-28	2.13.1	Basics of MCCB	2-42
2.8.4	Minimum Oil Circuit Breaker (MOCB)	2-29	2.14	Earth Leakage Circuit Breaker (ELCB)	2-43
2.8.4(A)	Advantages and Disadvantages of Minimum Oil Circuit Breaker	2-30	2.15	Residual Current Circuit Breaker (RCCB)	2-45
2.8.4(B)	Maintenance of Oil Circuit Breakers (OCBs)	2-30	2.16	HRC Fuse and Their Applications.....	2-47
2.8.5	Comparison of Bulk Oil Circuit Breaker with Air Blast Circuit Breaker	2-31	2.16.1	Fuses.....	2-47
2.8.6	SF ₆ Circuit Breaker (Sulphur Hexafluoride Circuit Breaker).....	2-31	2.16.1(A)	Materials of Fuse	2-47
2.8.6(A)	Properties of SF ₆ Gas	2-31	2.16.1(B)	Important Terms Related to Fuses.....	2-47
2.8.7	Types of SF ₆ Circuit Breaker	2-32	2.16.1(C)	Desirable Characteristics of a Fuse Element.....	2-48
2.8.7(A)	Puffer Type SF ₆ Circuit Breaker	2-32	2.16.1(D)	Advantages and Disadvantages of a General Fuse	2-48
2.8.7(B)	Double Pressure Dead Tank Type SF ₆ Circuit Breaker.....	2-33	2.16.1(E)	Time-current Characteristics of a Fuse	2-48
2.8.8	Comparison of SF ₆ Circuit Breaker with Air Blast Circuit Breaker	2-34	2.16.1(F)	Types of Fuses	2-49
2.8.9	Vacuum Circuit Breaker	2-34	2.16.1(G)	Fuse Link and Fuse Element.....	2-50
2.8.9(A)	Principle.....	2-34	2.17	HRC Fuses.....	2-50
2.8.9(B)	Construction	2-34	2.17.1	Advantages and Disadvantages of HRC Fuse.....	2-50
2.8.9(C)	Working	2-35	2.17.2	HRC Fuse with Tripping Device	2-51
			2.17.3	Advantages of HRC with Tripping Device over HRC without Tripping Type.....	2-51
			2.17.4	HRC Fuse with Indicator.....	2-51
			2.17.5	Applications of HRC Fuse	2-52
			2.18	Specification of Fuse Link.....	2-52
			2.19	Classifications and Categories.....	2-52
			2.20	Selection of Fuse Links	2-52



2.21 Protective Arrangements 2-53	3.2.3 Open Circuit Faults or Series Faults 3-5
2.21.1 Fuse for Protection of Motor..... 2-53	3.3 Protective Relaying..... 3-5
2.22 Discrimination..... 2-55	3.3.1 Evolution of Protective Relaying 3-6
2.23 Protection of Radial Lines	3.4 Protective Zones 3-7
Discrimination between Two Fuses 2-55	3.5 Primary and Backup Protection 3-7
2.24 Protection of Meshed Feeders 2-55	3.6 Backup Protection by Time Grading
2.25 Equipment Incorporating Fuses 2-56	Principle..... 3-8
2.26 High Voltage Current Limiting “Fuses” 2-56	3.7 The Methods of Backup Protection 3-9
2.27 Expulsion Type High Voltage Fuses 2-56	3.8 Requirements and Qualities of
2.28 Drop Out Fuse Link 2-56	Protective Relaying..... 3-9
2.29 Comparison of Fuse with Circuit Breaker 2-57	3.9 Some Important Other Terms in
2.30 University Questions with Answers..... 2-58	Relaying..... 3-10
	3.10 Trip Circuit of Circuit Breaker..... 3-11
	3.11 Distinction between Relay Unit, Protective
	Scheme and Protective System..... 3-11
	3.11.1 Actuating Quantities 3-12
	3.12 Classification of Relays..... 3-12
	3.13 Electromechanical Relays, Static Relays..... 3-13
	3.14 Power Line Carrier Channel..... 3-13
	3.14.1 Coupling and Trapping the Carrier into the
	Desired Line Section and Single
	Line to Ground Coupling..... 3-13
	3.14.2 Advantages of Carrier Current Protection
	or PLCC Protection 3-14
	3.15 Programmable Relays 3-14
	3.16 System Security 3-15
	3.17 Role of Engineers..... 3-15
	3.18 Electromagnetic Relays..... 3-15
	3.18.1 Introduction..... 3-15
	3.18.2 Basic Connections of Relay..... 3-15
	3.18.3 Auxiliary Switch..... 3-15
	3.18.4 Sealing and Auxiliary Relays..... 3-15
	3.18.5 Measurement in Relays..... 3-16
	3.18.6 Pickup, Drop off Terms in Relays 3-16
	3.19 Electromagnetic Relay..... 3-16
	3.20 Balanced Beam Relay (Electromagnetic) 3-17
	3.21 Induction Relays 3-18
	3.22 Shaded Pole Structure
	[Induction Disc Relay] 3-19

Module 3

Chapter 3 : Introduction to Protective

Relaying

3-1 to 3-41

Syllabus : Shunt & Series Faults, causes and Effects of faults, Importance of protective relaying, Protective zones, primary & Back-up protection, Different types of backup protection, desirable qualities of protective relaying, PSM & TSM(Importance, Different types of Time current characteristics and application), working principle of Electromagnetic Induction disc Relays, Thermal, bimetal relays, Frequency relays, under/over voltage relays, DC relays,

Different Principles of protection : Over current & earth fault (non- directional & directional types), differential protection(current and voltage type), distance protection (Working Principle and application of Impedance relay, Causes and remedies of Over reach-under reach, Reactance and Mho relay, Power swing blocking relay).

3.1 Introduction..... 3-1
3.1.1 Need for Protective System..... 3-1
3.1.2 Normal and Abnormal Conditions 3-2
3.1.3 Causes of Fault..... 3-2
3.2 Shunt and Series Faults 3-3
3.2.1 Shunt Faults or Short Circuit Faults 3-3
3.2.2 Effects of Shunt Faults or Short Circuit Faults 3-4



3.23	IDMT Relays (Inverse Definite Minimum Time)	3-19
3.23.1	Pickup Current.....	3-20
3.23.2	Current Setting or Plug Setting.....	3-20
3.23.3	Plug Setting Multiplier (PSM).....	3-22
3.23.4	Time/P.S.M. Curve	3-24
3.23.5	Time Setting Multiplier or Time Setting.....	3-25
3.24	Induction Type Over Current Relay (Non Directional)	3-26
3.24.1	Induction Type Directional Power Relay.....	3-26
3.24.2	Induction Cup Type Relay.....	3-27
3.24.3	Distance or Impedance Relays.....	3-28
3.24.3(A)	Definite Distance Relay.....	3-28
3.24.3(B)	Time Distance Impedance Relay.....	3-29
3.25	Thermal and Bimetal Relays	3-29
3.26	Frequency Relay.....	3-30
3.27	Under Voltage Fault Over Voltage Relay	3-30
3.27.1	Under Voltage Relays	3-31
3.28	D. C. Relay.....	3-31
3.29	All or Nothing Relay	3-31
3.30	Different Principles of Protection	3-31
3.30.1	Time Graded Protection.....	3-31
3.31	Over Current Protection	3-32
3.31.1	Applications of Over Current Relays.....	3-32
3.31.1(A)	Directional Over Current Protection.....	3-32
3.32	Earth Fault Protection.....	3-32
3.32.1	Directional Earth fault Protection.....	3-32
3.33	Differential Protection Scheme	3-32
3.33.1	Current Differential Relay.....	3-33
3.34	Introduction to Distance Protection.....	3-33
3.34.1	Principle of Distance Relay	3-34
3.35	Impedance Relay.....	3-35
3.35.1	Characteristics of Impedance Relay	3-35
3.35.2	Effects of Arc Resistance on Performance of Impedance Relay	3-36
3.35.3	Effect of Power Swing on Performance of Impedance Relay	3-37
3.36	MHO Relay	3-38
3.36.1	Torque Equation	3-38

3.37	Reactance Relay	3-39
3.38	University Questions with Answers	3-41

Module 4

Chapter 4 :	Protection Schemes Provided for Major Apparatus	4-1 to 4-44
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Syllabus : Generators : Stator side (Differential, Restricted Earth fault, protection for 100% winding, Negative phase sequence, Reverse power, turn-turn fault), Rotor side (Field suppression, field failure, Earth fault, turn to turn fault)

Transformers : Differential protection for star delta Transformer, Harmonic restraint relay, REF protection, Protection provided for incipient faults (Gas actuated relay).

Induction motors : Protection of motor against over load, short circuit, earth fault, single phasing, unbalance, locked rotor, phase reversal, under voltage, winding temperature, Protection co-ordination.

4.1	Alternator Protection	4-1
4.1.1	Faults in Alternator	4-2
4.1.1(A)	Phase to Phase Fault	4-2
4.1.1(B)	Phase to Earth or Phase to Ground Fault.....	4-2
4.1.1(C)	Interturn Fault.....	4-3
4.2	Rotor Winding Faults.....	4-3
4.2.1	Interturn Faults.....	4-3
4.2.2	Ground Faults	4-3
4.3	Abnormal Working Conditions in Alternator... 4-3	
4.4	Stator Side Faults.....	4-6
4.4.1	Differential Fault (Longitudinal Percentage Differential Protection).....	4-6
4.4.2	Restricted Earth Fault Protection for Alternator....	4-7
4.4.2(A)	Issues Related to Restricted Earth Fault Protection by Differential System	4-8
4.4.2(B)	Numerical Examples.....	4-9
4.4.3	Negative Phase Sequence Protection (Against Unbalanced Load).....	4-11
4.4.4	Overheating Protection.....	4-12
4.4.5	Reverse Power Protection (Protection against Unbalance Loading)	4-12



4.4.6	Turn to Turn (Inter Turn) Fault (Against Unbalance).....	4-13	4.5.8	Incipient Fault.....	4-31
4.4.6(A)	Transverse Differential Protection for Inter-turn Fault.....	4-13	4.5.9	Gas Actuated Relay (Buchholz Relay) for Protection Against Incipient Faults.....	4-32
4.4.6(B)	100% Stator Earth Fault Protection of Winding.....	4-13	4.5.10	Protection against Over Fluxing.....	4-33
4.4.7	Rotor Side Faults.....	4-14	4.6	Introduction	4-34
4.4.7(A)	Protection against Loss of Field (Field Failure) or Loss of Excitation.....	4-14	4.6.1	General Information of 3-Phase Induction Motor	4-34
4.4.7(B)	Over Current Protection.....	4-15	4.6.2	Permissible Limits of Variation of Supply Voltage to Motor and Variation of Frequency	4-34
4.4.7(C)	Protection against Loss of Excitation using Offset 'MHO Relay'	4-15	4.6.3	Behaviour of 3-Phase Induction Motor Under Abnormal Voltage.....	4-34
4.4.7(D)	Protection against Over speeding (Loss of Load).....	4-16	4.6.4	Effect of Unbalanced Voltage.....	4-35
4.4.8	Field Suppression.....	4-16	4.6.5	The Changes for 10 % Increase or 10 % Decrease of Voltage.....	4-35
4.4.9	Rotor Earth Fault	4-17	4.6.6	Protection Systems for Induction Motor	4-36
4.4.9(A)	Rotor Earth Fault Protection	4-17	4.7	Direct "ON-LINE" Starter (DOL) (Which Protects Motor from Overload).....	4-36
4.4.10	Abnormalities and Faults of Transformer.....	4-19	4.7.1	Overload (RTD Base Overload Protection).....	4-37
4.4.10(A)	Information Needed for Protective Scheme Selection for Transformer.....	4-19	4.8	Short Circuit Phase Faults, Earth Faults (Phase to Ground Faults).....	4-38
4.4.10(B)	Differential Protection Scheme.....	4-20	4.8.1	Short Circuit Protection by HRC Fuse	4-38
4.4.10(C)	Current Differential Relay	4-20	4.8.2	Short Circuit Protection by Differential Protection	4-38
4.4.10(D)	Biased or % Differential Relay	4-21	4.8.3	Phase Fault and Ground Fault Protection	4-39
4.4.10(E)	Voltage Balanced Differential Relay	4-22	4.8.4	Phase to Ground Fault.....	4-39
4.5	Differential Protection Scheme for Transformer	4-22	4.9	Under Voltage Fault	4-39
4.5.1	Differential Protection Scheme/ Merz-Price Protection Scheme for Delta - Delta ($\Delta - \Delta$) Power Transformer.....	4-23	4.9.1	Under Voltage Relays	4-39
4.5.2	Differential Protection Scheme / Merz-Price Protection Scheme for Delta-Star ($\Delta - Y$) Power Transformer.....	4-23	4.10	Unbalance Voltage.....	4-40
4.5.3	Difficulties in Differential Protection Scheme	4-28	4.11	Phase Reversals (Reverse Phase Sequence Fault Protection)	4-40
4.5.4	Percentage Differential Scheme for Transformer.....	4-28	4.12	Single Phasing.....	4-41
4.5.5	Over Current Protection.....	4-29	4.12.1	Thermal Overload Relays.....	4-41
4.5.6	Inrush Current in Transformer	4-30	4.12.2	Single Phasing Preventer.....	4-41
4.5.6(A)	Protection Against Inrush Current (Harmonic Restraint)	4-30	4.13	Faults in Rotor Winding.....	4-42
4.5.7	Restricted Earth Fault Protection.....	4-31	4.14	Winding Temperature.....	4-42
			4.15	Protection Co-ordination	4-42
			4.15.1	Coordination of Protection Concept	4-42
			4.15.2	Steps involved in Protection co-ordination.....	4-42



4.15.3	Benefits of Protection coordination	4-43
4.16	University Questions with Answers.....	4-44

Module 5

Chapter 5 : Protection of Transmission Lines 5-1 to 5-25

Syllabus : Feeder protection : Time grading, current grading, combined time and current grading protection provided for Radial, Ring Main, Parallel, T- Feeder.

Bus Zone Protection : Differential protection provided for different types of bus zones.

LV, MV, HV Transmission Lines : Protection provided by over current, earth fault, Differential and Stepped distance protection.

EHV and UHV Transmission lines : Need for auto-reclosure schemes, Carrier aided distance protection (Directional comparison method), Power Line Carrier Current protection (Phase comparison method).

5.1	Transmission Line Protection	5-1
5.1.1	Time Grading Protection for Feeder (For Radial Feeder Line)	5-2
5.1.1(A)	Inverse Time Relay for Radial Feeder Lines	5-3
5.1.1(B)	Time Graded Protection for Parallel Feeders.....	5-3
5.1.1(C)	Time Graded Protection for Ring Main System	5-4
5.1.1(D)	Time Graded Protection for Tee'd Parallel Feeders.....	5-4
5.1.2	Current Graded Over Current Protection (For Feeder Line)	5-5
5.1.2(A)	Combined Time and Current Grading For Feeder Lines	5-5
5.2	Bus-bars, Bus-zone Protection	5-6
5.2.1	Introduction	5-6
5.2.2	Abnormalities and Faults	5-6
5.3	Busbar Protection by Over Current Relays.....	5-6
5.3.1	Busbar Protection by Differential Protection.....	5-7
5.3.2	Fault Bus Protection.....	5-7
5.3.3	Frame Leakage Protection	5-7
5.4	Phase Fault Protection.....	5-8
5.5	Ground (Earth) Fault Protection.....	5-10

5.6	Introduction to Distance Protection	5-10
5.6.1	Principle of Distance Relay.....	5-10
5.6.2	Factors to be Considered while Selecting Distance Protection Scheme	5-12
5.7	Three Stepped Distance Protection.....	5-12
5.7.1	Trip Contact Configuration of Three Stepped Protection.....	5-13
5.7.2	Three Stepped Protection of Double End Fed Line	5-13
5.8	Need of Auto-reclosing Schemes.....	5-14
5.8.1	Types of Fault.....	5-14
5.8.1(A)	Permanent Faults	5-14
5.8.1(B)	Temporary Faults.....	5-15
5.9	Various Options for Carrier	5-16
5.9.1	Telephone Lines.....	5-16
5.9.2	Microwave Communication Channels.....	5-16
5.9.3	Satellite Communication.....	5-16
5.9.4	Power Line Carrier Communication (PLCC)	5-17
5.9.5	Comparison between Various Carriers / Carrier Systems.....	5-17
5.10	Power Line Carrier Current Protection	5-18
5.10.1	Coupling and Trapping the Carrier into the Desired Line Section and Single Line to Ground Coupling.....	5-19
5.10.2	Advantages of Carrier Current Protection or PLCC Protection.....	5-19
5.11	Unit Type Carrier-Aided Directional Comparison Relaying.....	5-20
5.11.1	Carrier Aided Distance Scheme for Acceleration of Zone II	5-21
5.12	Phase Comparison Relaying (Unit Scheme)	5-21
5.13	Other Important Protective Methods for Feeders/Transmission Line	5-22
5.13.1	Pilot Wire Protection Scheme	5-22
5.13.1(A)	Merz-Price Differential Voltage Balance System (For Feeder Line)	5-22
5.14	Introduction to the Concept of Islanding	5-23
5.14.1	The Objective of Islanding are as follows	5-23
5.14.2	Functional Requirement.....	5-23



5.14.3	Advantage of islanding	5-24
5.14.4	Problems caused by Islanding.....	5-24
5.14.5	Islanding Detection Methods.....	5-24
5.15	University Questions with Answers.....	5-25

Module 6

Chapter 6 : Introduction to Static & Numerical Relays 6-1 to 6-27

Syllabus : Static Relays : Introduction, Definition, Advantages and Disadvantages, Application of op-amps, logic gates, DSP, in static/digital Relays. Relays as comparators (Amplitude and phase).

Numerical Relays : Introduction, Block diagram of numerical relay, Signal sampling, Anti - Aliasing Filter, Introduction to the concept of Phase Measurement Unit.

6.1	Introduction to Static Relay	6-1
6.1.1	Definition (or Function) of Static Relay.....	6-1
6.1.2	Block Diagram of Static Relay.....	6-1
6.1.3	Operating Principle of Static Relay	6-2
6.1.4	Classifications of Static Relays	6-2
6.1.5	Advantages and Disadvantages of Static Relays.....	6-2
6.1.6	Comparison between Static and Electro-Mechanical Relays.....	6-3
6.1.7	Block Diagram of a Simple Microprocessor Based Digital Static Relay	6-4
6.2	Introduction : Applications of OP-AMAPs.....	6-4
6.2.1	741 Op amp Based Unity Gain Amplifier or Voltage Follower	6-4
6.2.2	Integrator using OP-AMP 741	6-4
6.2.3	Differentiator Circuit using Op-amp	6-5
6.2.4	Op-amp Based Adder Circuit	6-5
6.2.5	Op amp Based Subtractor or Difference Amplifier	6-6
6.2.6	Opamp Based Inverting Amplifier Circuit or Inverter	6-6
6.2.7	V to I Converter Circuit using Op-amp	6-6
6.2.8	Op-amp Based I to V Converter	6-7

6.2.9	V to F Converter	6-7
6.2.10	Filters	6-7
6.3	Logic Gates	6-10
6.3.1	OR Gate.....	6-10
6.3.2	AND Gate	6-10
6.3.3	NOT Gate.....	6-11
6.4	DSP in Static/Digital Relays.....	6-11
6.5	Relay as Comparators.....	6-12
6.5.1	Relay Comparator Classification.....	6-12
6.5.2	Amplitude Comparator.....	6-12
6.6	Classification of Amplitude Comparators	6-13
6.6.1	Integrating Comparators.....	6-13
6.6.2	Instantaneous Comparators	6-13
6.6.3	Sampling Comparators	6-14
6.7	Phase Comparators.....	6-15
6.7.1	Vector Product Comparator.....	6-15
6.7.2	Coincidence Type Phase Comparator Basics.....	6-16
6.7.3	Phase Comparator Based on Coincidence of Sinewave Inputs	6-16
6.7.4	Block Spike Coincidence Type Phase Comparator	6-17
6.7.5	Phase Splitting Type Phase Comparator.....	6-18
6.8	Hybrid Comparator	6-19
6.9	Distance Relays as Comparators	6-19
6.10	Numerical Relays.....	6-20
6.10.1	Introduction - Evolution of Relay	6-20
6.10.2	Definition of Numerical Relays (What is a Numerical Relay?)	6-20
6.10.3	Block Diagram of Numerical Relay	6-20
6.10.4	Advantages of Numerical Relays	6-21
6.10.5	Signal Sampling (Theorem).....	6-22
6.10.6	Anti Aliasing Filter	6-23
6.10.7	Waveform Analysis	6-23
6.10.8	Phasor and its Measurement.....	6-24
6.10.9	Phasor Network.....	6-25
6.10.10	Phasor Monitoring Unit (PMU).....	6-25
6.11	University Questions with Answers	6-27