ADVANCED POWER SYSTEM PROTECTION

Course Code: 15EE2102 **L P C**
3 0 3

Pre requisites: Switchgear and Protection.

Course Outcomes: At the end of the course, the student will be able to

CO1: Describe the classification of protective schemes, basic construction of static relays and different types of comparators.

CO2: Describe and characterize different types of static over current and Distance relays.

CO3: Describe various types of pilot relaying schemes.

CO4: Describes the protection schemes of an AC machine and Bus zone for different faults.

CO5: Describe, implement and test on Numerical relaying algorithms for a MP and DSP based protective relays.

UNIT-I (10-Lectures)

STATIC RELAYS:

Basic construction of static relays, Classification of protective schemes, Comparison of Static relays with electromagnetic relays, Amplitude comparator, Phase comparator, Principle of Duality.

AMPLITUDE AND PHASE COMPARATORS (2-INPUT):

Rectifier bridge circulating and opposed Voltage type- Averaging - phase splitting type -Sampling type of amplitude Comparison. Block spike type-Phase splitting type- Transistor integrating type-Rectifier bridge type- Vector product type Phase comparison.

UNIT-II (10-Lectures)

STATIC OVER CURRENT RELAYS:

Instantaneous- Definite time – Inverse time- Directional- IDMT- Very inverse Time-Extremely inverse time over current relays. Time current characteristics of over current relays-applications.

DISTANCE PROTECTION:

Impedance Relay: operating principle- relay Characteristic-Protective Schemes-Static Impedance Relay- Static reactance relay- static MHO relay-effect of arc resistance, effect of power surges, effect of line length and source impedance on performance of distance relays-Quadrilateral relay – Elliptical relay - selection of distance relays.

UNIT-III (10-Lectures)

PILOT RELAYING SCHEMES:

Wire pilot protection: circulating current scheme- balanced voltage scheme-translay scheme-half wave comparison scheme- Carrier current protection: phase comparison type-carrier aided distance protection-operational comparison of transfer trip and blocking schemes-optical fiber channels.

UNIT-IV (10-Lectures)

AC MACHINES AND BUS ZONE PROTECTION: Protection of Alternators: stator protection-rotor protection-over voltage protection-over speed protection-Transformer protection: earth faults in transformers-percentage differential protection-protection against magnetic inrush current-generator and transformer unit protection-Bus zone protection: differential current protection-high impedance relay scheme-frame leakage protection.

UNIT-V (10-Lectures)

NUMERICAL PROTECTION

Introduction, numerical relay, Comparison of Numerical relays with static relays Data acquisition System, Numerical relaying algorithms-Mann-Morrison technique, differential equation technique, Discrete Fourier transform technique:

MP based: Introduction-over current relays-Impedance relay-Directional relay-Reactance relay.

DSP based: Digital signal processing –digital filtering in protection relays- – digital data transmission– relay hardware. Concepts of modern coordinated control system.

TEXT BOOKS:

1. Badri Ram & D. N. Vishwakarma, "*Power System Protection & Switchgear*", 2nd edition, Tata McGraw – Hill, 2011(Unit-I to V)
2. The Electricity Training Association, "*Power System Protection*", Vol1-4, The IEE, U.K., 1995. (part of Unit-V)

REFERENCE BOOKS:

1. MadhavaRao T.S, "*Power System Protection, Static Relays with Microprocessor and Applications*", 2nd edition, TMH, 2008.
2. Lewis Blackburn, J., "*Protective Relaying – Principles and Applications*", Marcel Dekkar, INC, New York, 2006.
3. Stanley, H.Horowitz (ED), "*Protective relaying for power systems-II*", IEEE Press, 1992.
4. Warrington and Coll, "*Protective Relays*". Vol I & II.