ADVANCED POWER SYSTEM PROTECTION

Course Code:13EE2102 **L P C**
4 0 3

Pre requisites: Switchgear and Protection.

Course Educational Objectives:

1. To study different types of static over current and distance relays characteristics.
2. To study principles and algorithms of digital relaying for protection of power systems.

Course Outcomes: At the end of the course**,** the student will be able to have knowledge in

1. Static relays and comparison of static and electromagnetic relays.
2. Various types of static distance relays and characteristics.
3. Protection of alternator and transformer.
4. Various types of microprocessor based protective relays.
5. Various types of DSP based protective relays.

UNIT-I 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

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 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 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

MICROPROCESSOR AND DSP BASED PROTECTIVE RELAYS:

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

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:

DSP based: Digital signal processing –digital filtering in protection relays- – digital data transmission– relay hardware – relay algorithms. 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. Madhava Rao 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.