

EE 485 :ADVANCED POWER SYSTEM PROTECTION

CREDITS : 6 (L = 4, P = 2)

(Prerequisite : EE 253 : Power System I)

- 1. Digital Relaying:** Advantages of Digital Relaying, Block diagram of Digital Relay, Anti aliasing filters, Data window, Facilities in commercial digital relays, Different relay algorithms such as least square error method, Walsh algorithm, Man and Morrison algorithm, Discrete Full Cycle and Half Cycle Algorithm, communication protocol (IEC 61850), Time Synchronization with Wide Area Measurements
- 2. Advanced Protection of Transmission Line:**
Coordination of overcurrent relays in an interconnected system, LINKNET structure, Concept of Sympathy Trips, Coordination of Distance Relays, Protection of Series Compensated Lines: Problems & Solutions, Teed Line, Carrier Current Protection, Phase Comparison Carrier, Carrier Aided Distance Protection, Blocking Carrier, Carrier Intertripping and Carrier Acceleration, Philosophy of Adaptive Relaying.
- 3. Reclosing and Synchronizing**
Introduction, Reclosing Precautions, Reclosing System Considerations, One-Shot vs. Multiple-Shot Reclosing Relays, Selective Reclosing, Deionizing Times for Three-Pole Reclosing, Synchronism Check, Live-Line/Dead-Bus, Live-Bus/Dead-Line Control, Instantaneous-Trip Lockout, Intermediate Lockout, Compatibility with Supervisory Control, Inhibit Control, Breaker Supervision Functions, Factors Governing Application of Reclosing, Considerations for Applications of Instantaneous Reclosing, Feeders with No-Fault-Power Back-Feed and Minimum Motor Load, Single Ties to Industrial Plants with Local Generation, Lines with Sources at Both Ends, Reclosing Relays and Their Operation, Review of Breaker Operation, Single-Shot Reclosing Relays, Multishot Reclosing Relays, Synchronism Check, Phasing Voltage Synchronism Check Characteristic, Angular Synchronism Check Characteristic, Dead-Line or Dead-Bus Reclosing, Automatic Synchronizing
- 4. Protection against Transients and Surges:**
Introduction, Electrostatic Induction, Electromagnetic Induction, Differential- and Common-Mode Classifications, Transients Originating in the High-Voltage System, Capacitor Switching, Bus Deenergization, Transmission Line Switching, Coupling Capacitor Voltage Transformer (CCVT) Switching, Other Transient Sources, Transients Originating in the Low-Voltage System, Direct Current Coil Interruption, Direct Current Circuit Energization, Current Transformer Saturation, Grounding of Battery Circuit, Protective Measures, Separation, Suppression at the Source, Suppression by Shielding, Suppression by Twisting, Radial Routing of Control Cables, Buffers, Optical Isolators, Increased Energy Requirement.
- 5. Load Shedding and Frequency Relaying:**
Introduction, Rate of Frequency Decline, Load-Shedding, Frequency Relays, KF Induction-Cylinder Under frequency Relay, Digital Frequency Relays, Microprocessor-Based Frequency Relay, Formulating a Load-Shedding Scheme, Maximum Anticipated Overload, Number of Load-Shedding Steps, Size of the Load Shed at Each Step, Frequency Settings, Time Delay, Location of the Frequency Relays, Special Considerations for Industrial Systems.
- 6. Protection of Shunt Reactor & Capacitor Bank:**
Shunt Reactor Applications, Rate-of-Rise-of-Pressure Protection, Overcurrent Protection, Differential Protection, Reactors on Delta System, Turn-to-Turn Faults, Capacitor Bank Protection.

REFERENCE BOOKS :

1. Date, Oza, Nair
Power System Protection
Bharti Prakashan.
2. Walter A. Elmore
Protective Relaying Theory & Applications
Marcel DEXXER Inc., New York
3. P. M. Anderson
Power System Protection
IEEE Press Book
4. J. L. Blackburn
Protective Relaying Fundamentals
John Wiley & Sons.
5. Phadke A.G and Thorpe.J.S
Computer Relaying for Power Systems.
John Wiley and Sons (Newyork).

List of Experiments

1. Testing of Digital overcurrent and earth fault relay
2. Application of Digital overcurrent and earth fault relay
3. Testing of Digital Differential relay
4. Application of Digital Differential relay for protection of transformer
5. Testing of Digital Induction Motor Protection Relay
6. Application of Digital Induction Motor Protection Relay
7. Testing of Digital Generator Protection Relay
8. Application of Digital Generator Protection Relay
9. Testing of Digital Distance Protection Relay
10. Application of Digital Distance Protection Relay