IV Year B.Tech. EEE I-Semester

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Power System Protection

Prerequisites: Power Systems, Microprocessors

Course Objectives:

1. To introduce all kinds of circuit breakers and relays
2. Protection of Generators, Transformers and feeder bus bars from Over voltages and other hazards.
3. To understand microprocessor based protective relays.
4. To understand system protection schemes.

UNIT – I: Circuit Breakers: (~9 Lecture hours)

Types of fuses, fuse characteristics, Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Maximum RRRV, Numerical Problems – Current Chopping and Resistance Switching – CB ratings and Specifications: Types and Numerical Problems.Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum, and SF6 circuit breakers.

UNIT – II: Relays: (~9 Lecture hours)

Induction type relays. Types of Over Current Relays: Instantaneous, DMT and IDMT types. Application of relays: Over current/ under voltage relays, Directional relays. Universal torque equation, Distance relays: Impedance, Reactance, and Mho and Off-Set Mho relays, Characteristics of Distance Relays. Static Relays verses Electromagnetic Relays-comparison.

UNIT – III: Protection of Power Equipment: (~10 Lecture hours)

Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on % Winding Unprotected.

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz relay Protection.

Protection of Lines: Over Current, Carrier Current and Three-zone distance relay protection using Impedance relays. Translay Relay.

Protection of Bus bars – Differential protection.

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UNIT IV: Neutral Grounding: (~10 Lecture hours)
Grounded and Ungrounded Neutral Systems. – Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance – Arcing Grounds and Grounding Practices.
Microprocessor Based Protective Relays: Over Current Relay, Impedance Relay, Reactance Relay, Mho Relay, Offset Mho Relay and Directional Relay.

UNIT V: System Protection: (~7 Lecture hours)

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

TEXT BOOKS:

- Badri Ram , D. N Viswakarma, "Power System Protection and Switchgear", TMH Publications, 2nd edition 2018
- Sunil S Rao, "Switchgear and Protection", Khanna Publishers, 10th edition 2018.
- J.B. Gupta, "Switchgear and Protection", S. K. Kataria & Sons, 3rd edition 2019

REFERENCE BOOKS:

- J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 3rd edition 2007.
- A.G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", 2008 by Springer science+Business Media. LLC
- D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006 by CRC Press.

Course Outcomes: After Completion of this course student will be able to

1. Understand the types of fuses and Circuit breakers
2. Understand choice of Relays for appropriate protection of power system equipment.
3. Understand various types of Protective devices in Electrical Power Systems.
4. Interpret the existing transmission voltage levels and various means to protect the system against over voltages.
5. Understand various digital protection relays.
6. Analyze various system protection schemes.

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