B.Tech III Year II Semester
JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA
19AEE63- SWITCHGEAR AND PROTECTION

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Course Objectives: The objectives of the course are to make the students learn about
- The technical aspects involved in the operation of circuit breaker
- The different types of electromagnetic relays and microprocessor based relays
- The protection of Generators
- The protection of Transformers
- The protection of feeders and lines
- Generation of over voltages and protection from them

UNIT – I: FUSES AND CIRCUIT BREAKERS   10 Hrs
Fuses: Definitions, characteristics, types, HRC fuses.
Circuit Breakers: Elementary Principles of Arc Interruption, Re-striking Voltage and Recovery Voltage – Re-striking Phenomenon, Average and Max. RRRV, Current Chopping and Resistance Switching - CB Ratings and Specifications: Types and Numerical Problems. – Auto Re-closures. Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers.
Learning Outcomes:
At the end of this unit, the student will be able to
- Learn about different types of fuses and circuit breakers   **L1**
- Learn about arc ionization and deionization   **L2**

UNIT – II: RELAYS   10 Hrs
Electromagnetic Relays - Basic Requirements of Relays – Primary and Backup Protection - Construction Details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays – Universal Torque Equation – Characteristics of Over Current, Direction and Distance Relays. Static Relays – Advantages and Disadvantages – Definite Time, Inverse and IDMT. Static Relays – Comparators – Amplitude and Phase Comparators. Microprocessor Based Relays – Advantages and Disadvantages – Block Diagram for Over Current (Definite, Inverse and IDMT) and Distance Relays and Their Flow Charts. Basics of Digital / Numerical Relays.
Learning Outcomes:
At the end of this unit, the student will be able to
- Learn about basic principle of relay operation   **L1**
- Learn about all types of relays   **L2**

UNIT – III: PROTECTION OF GENERATORS & TRANSFORMERS   10 Hrs
Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection – calculation of percentage winding unprotected. Protection of Transformers: Percentage Differential Protection, Numerical Problems on Design of CT Ratio, Buchholz Relay Protection, Numerical Problems.
Learning Outcomes:
At the end of this unit, the student will be able to
- Learn about total protection of generator and transformer   **L1**
- learn about concepts of protection with numerical analysis   **L2**

UNIT – IV: PROTECTION OF FEEDERS & LINES   10 Hrs
Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of Transmission Line – 3 Zone Protection Using Distance Relays. Carrier Current Protection. Protection of Bus Bars.

Learning Outcomes:
At the end of this unit, the student will be able to

- Learn about total protection of FEEDERS & LINES   **L1**
- learn about concepts of protection with numerical analysis   **L2**

UNIT – V: OVER VOLTAGES IN POWER SYSTEMS   10 Hrs

Generation of Over Voltages in Power Systems-Protection against Lightning over Voltages - Valve Type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand the generation of over voltages in power system and its protection   **L1**
- Understand the basic insulation coordination   **L2**

Text Books:
1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.
2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

Reference Books:
1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009
3. Power system protection and switch gear, BhuvaneshOza, TMH, 2010.

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

- Solve numerical problems for arc interruption and recovery in circuit breakers   **L1**
- Distinguish between the principles of operation of electromagnetic relays, static relays and microprocessor based relays   **L2**
- Determine the unprotected percentage of generator and transformer winding under fault occurrence   **L3**
- Identify various types of the relays in protecting feeders, lines and bus bars   **L4**
- Demonstrate the protection of a power system from over voltages   **L5**