

# **SNS COLLEGE OF ENGINEERING**

Kurumbapalayam (Po), Coimbatore – 641 107

**An Autonomous Institution**

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai



## **DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**COURSE NAME : 19EE605 PROTECTION AND SWITCHGEAR**

III YEAR /VI SEMESTER

Unit 4- STATIC RELAYS AND NUMERICAL PROTECTION

Topic: Numerical Relay



# Principles of Numerical Relay

## Digital Processing

Utilizes digital signal processing for advanced functionality

## Programmable Logic

Allows for custom programming and adaptability

## Automated Diagnostics

Built-in self-monitoring and fault detection capabilities

## Communication Capabilities

Integrated protocols for remote monitoring and control



# Key Components of a Numerical Relay

## Analog Inputs

Measure voltage, current, and other analog signals

## Digital Processor

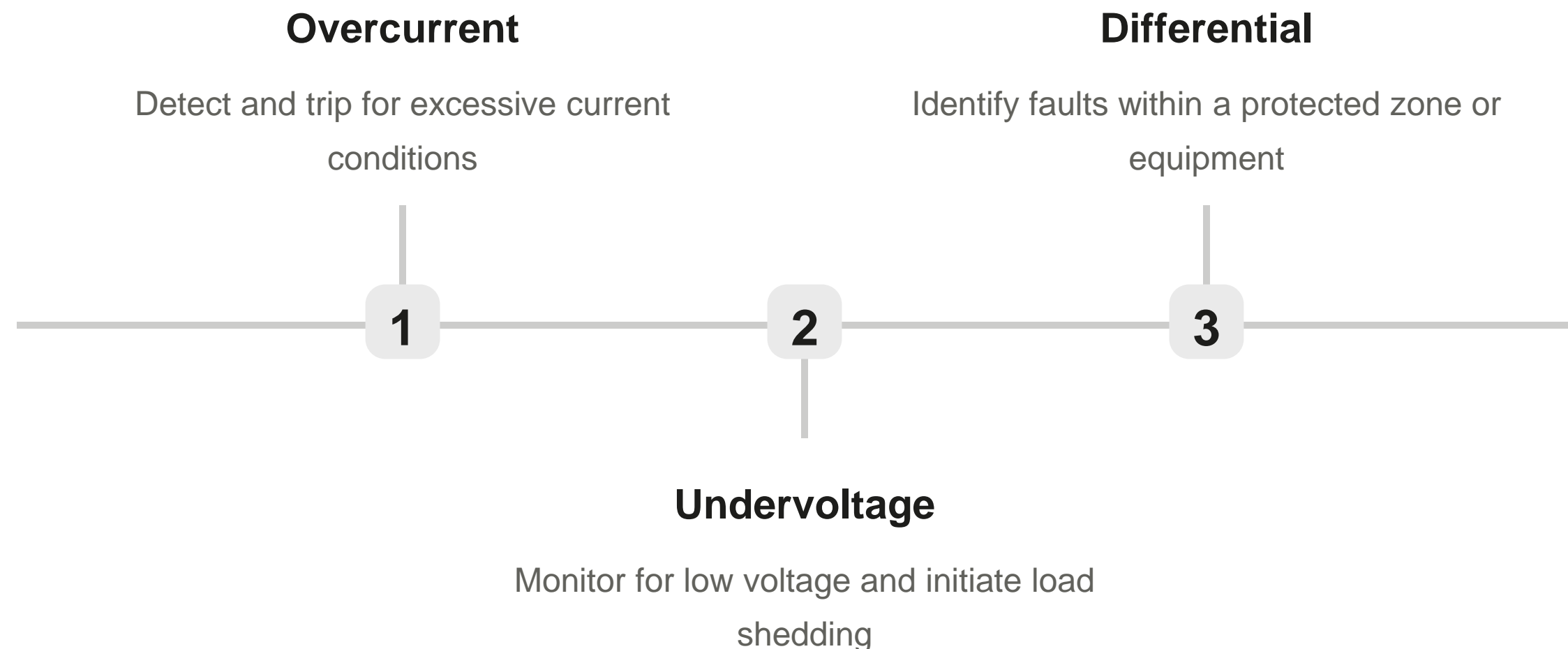
Performs complex calculations and decision-making algorithms

## Input/Output Modules

Interface with circuit breakers and other devices



# Protective Functions of Numerical Relays





# Advantages of Numerical Relays

## 1 Enhanced Accuracy

Digital processing provides precise measurement and tripping

## 2 Flexibility

Easily programmable to adapt to changing system conditions

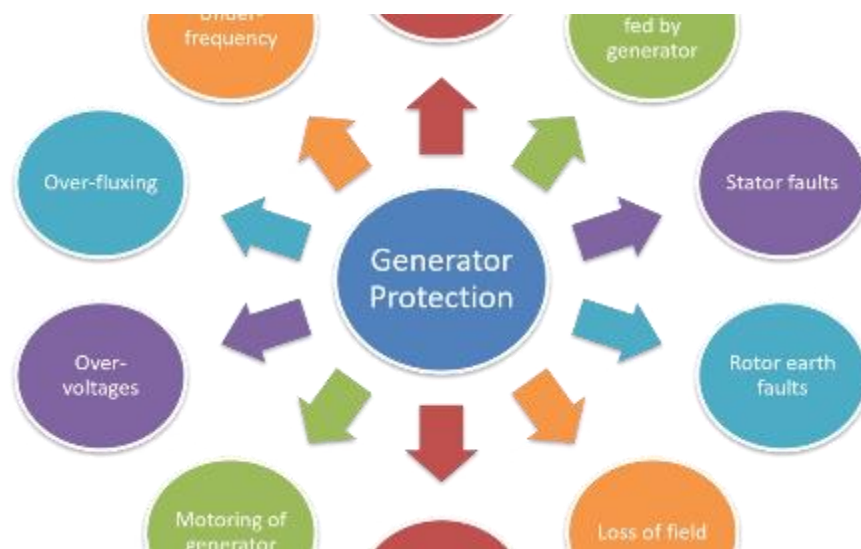
## 3 Improved Reliability

Reduced moving parts and self-monitoring diagnostics

## 4 Remote Access

Enable remote monitoring, control, and data logging

# Numerical Relay Applications



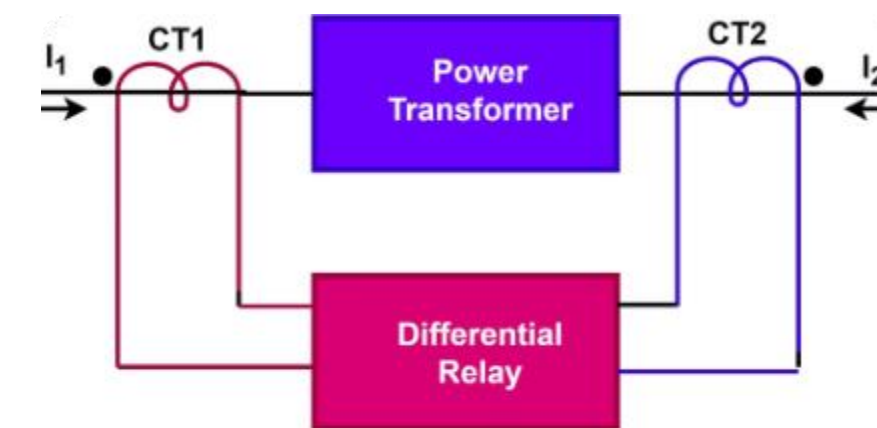
## Generator Protection

Safeguard generators from faults and abnormal conditions



## Transmission Line Protection

Detect and isolate faults on electrical transmission lines

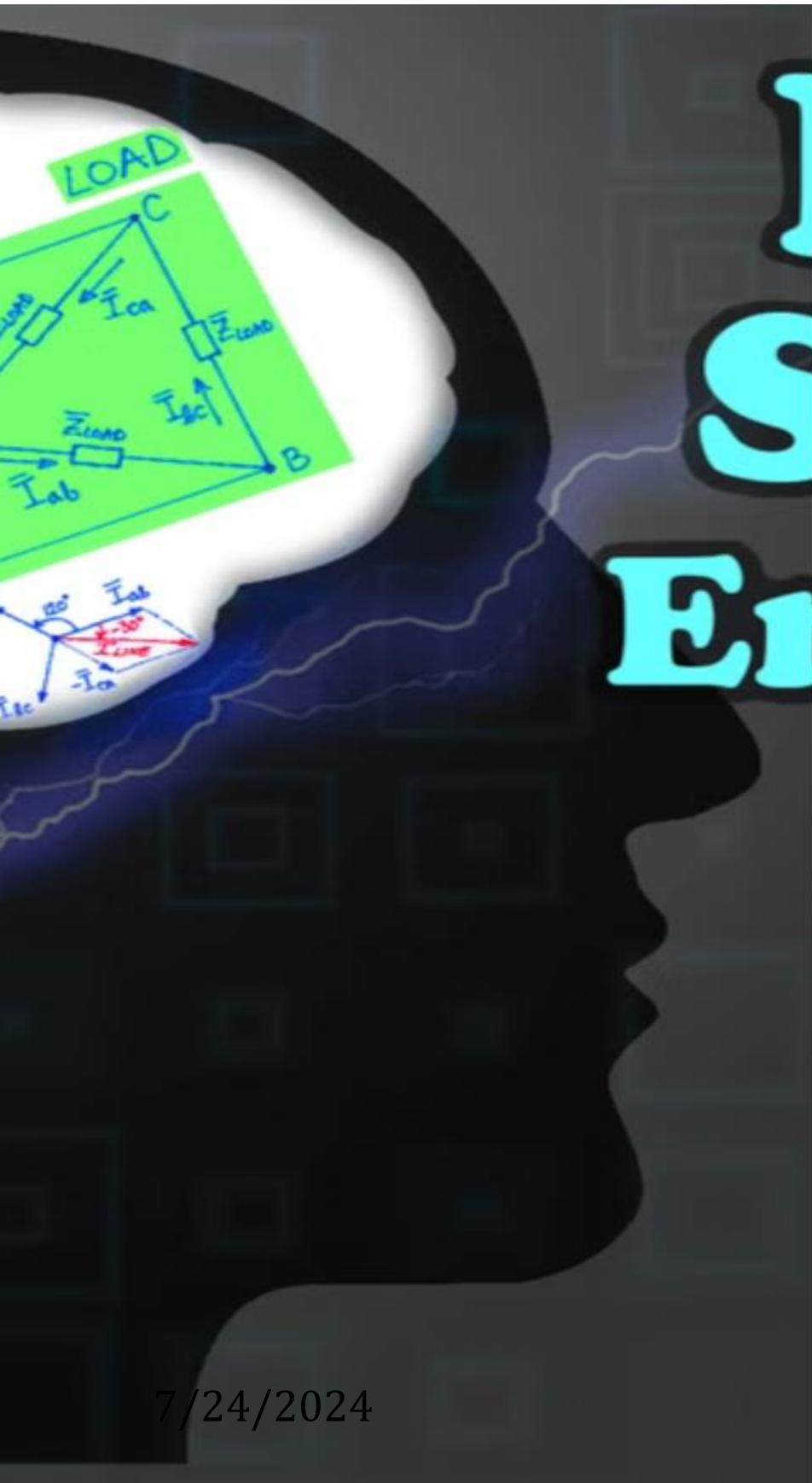


Differential Protection Scheme

## Transformer Protection

Provide differential, overcurrent, and thermal protection for transformers

# Numerical Relay Programming



1

## Characterize System

Analyze network topology and protection requirements

2

## Configure Settings

Customize relay parameters for optimal performance

3

## Test and Validate

Verify relay operation under various fault scenarios



# Communication and Integration



## Network Connectivity

Enable real-time data exchange and remote access



## Data Logging

Record events, faults, and operational data for analysis



## Substation Automation

Integrate with SCADA systems for centralized control





# Maintenance and Lifecycle Management

## Firmware Updates

Leverage latest algorithms and security enhancements

## Periodic Testing

Validate relay performance and protection settings

## Asset Management

Track relay health, age, and replacement planning

## Cybersecurity

Implement access controls and network security measures



# The Future of Numerical Relays

Expanded Functionality

Integrated machine learning for enhanced analytics

Grid Modernization

Support for distributed energy resources and microgrids

Predictive Maintenance

Anticipate issues through advanced condition monitoring

Cybersecurity Advancements

Advanced authentication and resilience against cyber threats



# Assessment



What is the primary function of a numerical relay in power systems?

- a) To regulate voltage levels
- b) b) To control power flow direction
- c) c) To protect electrical equipment from faults.
- d) d) To monitor frequency variations





# References



1. Sunil S Rao, “Switchgear, Protection and Power System (Theory, Practice & Solved Problems)”, Khanna Publishers, New Delhi, 2019.
2. Paithankar Y G, Bhide S R, “Fundamentals of Power System Protection”, Prentice Hall of India Pvt Ltd., New Delhi, 2<sup>nd</sup> Edition, 2014.
3. Badriram, Vishwakarma B.H, “Power System Protection and Switchgear”, New Age International Pvt Ltd Publishers, 2<sup>nd</sup> Edition 2017.

**Thank You**