

<b>6<sup>th</sup> Semester</b>	<b>REL6D001</b>	<b>Electric Power System Protection</b>	<b>L-T-P 3-0-0</b>	<b>3 Credits</b>
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**Digital Learning Resources:**

Course Name:	Foundations of Optimization
Course Link:	<a href="https://nptel.ac.in/courses/111/104/111104071/">https://nptel.ac.in/courses/111/104/111104071/</a>
Course Instructor:	Dr. Joydeep Dutta, IIT Kanpur

**Module-I: (10 hours)**

Introduction: Principle and need for protective schemes, Nature and causes of faults, Zones of protection, Primary and back-up protection, Basic principle of operation of protective system, Components of Protection System. Sequence Components and Fault Analysis: sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with  $Z_f$ , Faults in Power systems, Concept of short circuit capacity of a Bus.

**Module-II: (10 hours)**

Operating Principles and Relay Construction: Relay design and construction, Relay classification, Types of Electromagnetic relays, Theory of Induction relay torque, General Equations of Comparators and Electromagnetic Relays, Over Current relays, Directional relays, Distance relays, Differential relays. Feeder Protection: Over current, Distance and Pilot Protection. Static Relays: (Comparators and different relays) Amplitude comparator, Phase Comparator, Coincidence type phase comparator, Basic elements of a static relay, Over Current Relays, Differential Protection, Static distance Protection.

**Module-III: (10 hours)**

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection, Bus bar protection schemes. Numerical relays: Block Diagram of Numerical Relay, Signal Sampling & Processing, Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line.

**Module-IV: (12 hours)**

Switchgears: Auto reclosing, Theory of Circuit interruption, Circuit constants in relation to Circuit breaking, Re-striking voltage transient, characteristics of Re-striking Voltage, Interaction between breaker and circuit, Current chopping. Circuit Breakers: Types of circuit breakers (air blast, air break, oil, vacuum, SF<sub>6</sub>, DC circuit breaker), advantages and testing of circuit breaker.

**Books:**

- [1] Power System Protection and Switchgear – B.Ravindranath & M.Chander–New Age International Publishers (Second Edition).
- [2] Bhavesh Bhalja, R P Maheshwari, Nilesh G.Chothani, Oxford University Press
- [3] Fundamentals of Power System Protection – Y.G.Paithankar and S.R.Bhide, PHI Publication.(Second Edition)
- [4] Electrical Power System - C.L.Wadhwa New Age International Publishers. (Sixth Edition).

- [5] Power System Engineering - M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, Dhanpat Rai & Co. (P) Ltd.
- [6] Protection and Switchgear - B.Bhalja, R.P.Maheshwari, N.G. Chothani, OXFORD University Press.
- [7] Power System Protection and Switchgear - Badri Ram, Vishwakarma, Tata McGraw hill.
- [8] Switchgear and Protection – Sunil S Rao , Khanna Publishers, New Delhi.
- [9] Power System relaying by Horwitz, Phadke, Research Press.

***Digital Learning Resources:***

Course Name: Power System Protection  
Course Link: <https://nptel.ac.in/courses/108/105/108105167/>  
Course Instructor: Prof. Ashok Kumar Pradhan, IIT Kharagpur

Course Name: NOC:Power System Protection and Switchgear  
Course Link: <https://nptel.ac.in/courses/108/107/108107167/>  
Course Instructor: Prof. Bhaveshkumar R. Bhalja, IIT Roorkee

Course Name: Power System Protection  
Course Link: <https://nptel.ac.in/courses/108/101/108101039/>  
Course Instructor: Prof. S.A. Soman, IIT Bombay