

Table of Contents

1. **Introduction to Power Systems**
 - Structure and operation of power systems
 - Computer applications in power systems
 - Numerical simulation of power networks
2. **Network Formulation**
 - Representation of electrical networks
 - Graph theory
 - Incidence matrices
 - Impedance and admittance matrices
 - Formation of the **Y-bus matrix**
 - **Z-bus matrix**
3. **Power System Components and Their Representation**
 - Synchronous generators
 - Transformers
 - Transmission lines
 - Induction motors
 - Composite loads
 - Component modeling
4. **Short-Circuit Studies**
 - Three-phase faults
 - Symmetrical and unsymmetrical faults
 - Symmetrical components
 - Fault-current calculations
 - Network analysis under fault conditions
5. **Numerical Solution of Mathematical Equations**
 - Algebraic equations
 - Differential equations
 - Numerical methods
 - Iterative methods
 - Digital simulation
6. **Load-Flow Analysis**
 - Load-flow problem formulation
 - Gauss-Seidel method
 - Newton-Raphson method
 - Decoupled load-flow methods
 - Voltage, power-flow and loss calculations
7. **Economic Load Scheduling**
 - Economic dispatch
 - Generator scheduling
 - Transmission losses
 - Loss-coefficient methods
 - Dynamic programming
 - Optimization of power-system operation
8. **Sparsity Techniques**
 - Sparse matrices
 - Matrix storage techniques
 - Optimal ordering
 - Computational efficiency

- Application to large power systems
- 9. Dynamic Modeling of Machines**
 - Synchronous-machine modeling
 - Induction-machine modeling
 - Load modeling
 - Dynamic equations
 - Transient simulation
- 10. Power-System Stability**
 - Stability concepts
 - Steady-state stability
 - Transient stability
 - Dynamic stability
 - Numerical stability analysis
 - Simulation of disturbances
- 11. Polyphase and Six-Phase Systems**
 - Multiphase system modeling
 - Six-phase systems
 - Coordinate transformations
 - Analysis of multiphase networks
- 12. Power-System Protection**
 - Protection principles
 - Electromechanical relays
 - Transmission-line protection
 - Generator and transformer protection
 - Protection coordination
- 13. Digital Protection**
 - Digital relays
 - Signal acquisition and processing
 - Protection algorithms
 - Digital protection schemes
 - Relay simulation
- 14. Load Forecasting**
 - Load-forecasting principles
 - Short-term forecasting
 - Medium- and long-term forecasting
 - Demand modeling
 - Applications in power-system operation