
CONTENTS

1. Introduction 1–8

Importance of Electrical Energy—
Generation of Electrical Energy—
Sources of Energy—Comparison of
Energy Sources—Units of Energy—
Relationship among Energy Units—
Efficiency—Calorific value of Fuels—
Advantages of Liquid Fuels Over Solid
Fuels—Advantages of Solid Fuels Over
Liquid Fuels.



2. Generating Stations 9–40



Generating Stations—Steam
Power Station—Schematic Arrange-
ment of Steam Power Station—
Choice of Site for Steam Power
Stations—Efficiency of Steam Power
Station—Equipment of Steam Power
Station—Hydroelectric Power
Station—Schematic Arrangement
of Hydroelectric Power Station—
Choice of Site for Hydroelectric

Power Stations—Constituents of Hydroelectric Plant—Diesel Power Station—
Schematic Arrangement of Diesel Power Station—Nuclear Power Station—
Schematic Arrangement of Nuclear Power Station—Selection of Site for
Nuclear Power Station—Gas Turbine Power Plant—Schematic Arrangement
of Gas Turbine Power Plant—Comparison of the Various Power Plants.

3. Variable Load on Power Stations **41—68**

Structure of Electric Power System—Load Curves—Important Terms and Factors—Units Generated per Annum—Load Duration Curves—Types of Loads—Typical demand and diversity factors—Load curves and selection of Generating Units—Important points in the selection of Units—Base load and Peak load on Power Station—Method of meeting the Load—Interconnected grid system.



4. Economics of Power Generation **69—86**



Economics of Power Generation—Cost of Electrical Energy—Expressions for Cost of Electrical Energy—Methods of determining Depreciation—Importance of High Load Factor.

5. Tariff **87—100**

Tariff—Desirable characteristics of a Tariff—Types of Tariff.



6. Power Factor Improvement **101—126**

Power Factor—Power Triangle—Disadvantages of Low Factor—Causes of Low Power Factor—Power Factor Improvement—Power Factor Improvement Equipment—Calculations of Power Factor Correction—Importance of Power Factor improvement—Most Economical Power Factor—Meeting the Increased kW demand on Power Stations.

7. Supply Systems 127—158

Electric Supply System—Typical A.C. Power Supply Scheme—Comparison of D.C. and A.C. Transmission—Advantages of High Transmission Voltage—Various Systems of Power Transmission—Comparison of Conductor Material in Overhead System—Comparison of Conductor Material in Underground System—Comparison of Various Systems of Transmission—Elements of a Transmission Line—Economics of Power Transmission—Economic Choice of Conductor Size—Economic Choice of Transmission Voltage—Requirements of satisfactory electric supply.



8. Mechanical Design of Overhead Lines 159—201



Main components of Overhead Lines—Conductor Materials—Line Supports—Insulators—Type of Insulators—Potential Distribution over Suspension Insulator String—String Efficiency—Methods of Improving String Efficiency—Important Points—Corona—Factors affecting Corona—Important Terms—Advantages and Disadvantages of Corona—Methods of Reducing Corona Effect—Sag in Overhead Lines—Calculation of Sag—Some Mechanical principles.

9. Electrical Design of Overhead Lines 202—227

Constants of a Transmission Line—Resistance of a Transmission Line—Skin effect—Flux Linkages—Inductance of a Single Phase Overhead Line—Inductance of a 3-Phase Overhead Line—Concept of self-GMD and mutual GMD—Inductance Formulas in terms of GMD—Electric Potential—Capacitance of a Single Phase Overhead Line—Capacitance of a 3-Phase Overhead Line.



10. Performance of Transmission Lines 228—263

Classification of overhead Transmission Lines—Important Terms—Performance of Single Phase Short Transmission Lines—Three-Phase Short Transmission Lines—Effect of load p.f. on Regulation and Efficiency—Medium Transmission Lines—End Condenser Method—Nominal T Method—Nominal π Method—Long Transmission Lines—Analysis of Long Transmission Line—Generalised Constants of a Transmission Line—Determination of Generalised Constants for Transmission Lines.



11. Underground Cable 264—299



Underground Cables—Construction of Cables—Insulating Materials for Cables—Classification of Cables—Cables for 3-Phase Service—Laying of Underground Cables—Insulation Core Cable—Dielectric Stress in a Single Core Cable—Most Economical Conductor Size in a Cable—Grading of Cables—Capacitance Grading—Intersheath Grading—Capacitance of 3-Core Cables—Measurement of C_c and C_e —Current carrying capacity of underground cables—Thermal resistance—Thermal resistance of dielectric of single-core cable—Permissible current loading—Types of cable faults—Loop tests for location of faults in underground cables—Murray loop test—Varley loop test.

(x)

12. Distribution Systems— General **300—309**

Distribution System—Classification of Distribution Systems—A.C. Distribution—D.C. Distribution—Methods of obtaining 3-wire D.C. System—Overhead *versus* Underground System—Connection Schemes of Distribution System—Requirements of a Distribution System—Design Considerations in Distribution System.



13. D.C. Distribution **310—355**



Types of D.C. Distributors—D.C. Distribution Calculations—D.C. distributor fed at one end (concentrated loading)—Uniformly loaded distributor fed at one end—Distributor fed at both ends (concentrated loading)—Uniformly loaded distributor fed at both ends—Distributor with both concentrated and uniform loading—Ring Distributor—Ring main distributors with Interconnector—3-wire D.C. system—Current distribution in 3-wire D.C. System—Balancers in 3-wire D.C. system—Boosters—Comparison of 3-wire and 2-wire d.c. distribution—Ground detectors.

14. A.C. Distribution **356—373**

A.C. Distribution Calculations—Methods of solving A.C. Distribution Problems—3-phase unbalanced loads—4-wire, star-connected unbalanced loads—Ground detectors.



15. Voltage Control 374—386

Importance of Voltage Control—Location of Voltage Control Equipment—Methods of Voltage Control—Excitation Control—Tirril Regulator—Brown-Boveri Regulator—Tap Changing Transformers—Autotransformer tap changing—Booster Transformer—Induction Regulators—Voltage control by Synchronous Condenser.



16. Introduction to Switchgear 387—395

Switchgear—Essential features of Switchgear—Switchgear Equipment Bus-bar Arrangements—Switchgear Accommodation—Short circuit—Short circuit currents—Faults in a Power System.

17. Symmetrical Fault Calculations 396—421

Symmetrical Faults on 3-phase system—Limitation of Fault current—Percentage Reactance—Percentage reactance and Base kVA—Short circuit kVA—Reactor control of short circuit currents—Location of Reactors—Steps for symmetrical fault calculations.



18. Unsymmetrical Fault Calculations **422—459**

Unsymmetrical Faults on 3-phase System—Symmetrical Components Method—Operator 'a'—Symmetrical Components in terms of Phase currents—Some Facts about Sequence currents—Sequence impedances—Sequence Impedances of Power System Elements—Analysis of Unsymmetrical Faults—Single Line-to-Ground Fault—Line-to-line Fault—Double Line-to-Ground Fault—Sequence Networks—Reference Bus for Sequence Networks.



19. Circuit Breakers **460—486**



Circuit Breakers—Arc Phenomenon—Principles of arc extinction—Methods of arc extinction—Important Terms—Classification of circuit breakers—Oil circuit breakers—Types of oil circuit breakers—Plain break oil circuit breakers—Arc control oil circuit breakers—Low oil circuit breakers—Maintenance of oil circuit breakers—Air blast circuit breakers—Types of air blast circuit breakers—SF₆ Circuit Breaker—Vacuum circuit breakers—Switchgear Components—Problems of circuit interruption—Resistance Switching—Circuit Breaker Ratings.

20. Fuses **487—496**

Fuses—Desirable Characteristics of Fuse Elements—Fuse element materials—Important Terms—Types of Fuses—Low voltage fuses—High voltage fuses—Current carrying capacity of fuse element—Difference between a fuse and circuit breaker.



21. Protective Relays 497—520

Protective Relays—Fundamental requirements of Protective Relaying—Basic Relays—Electromagnetic Attraction Relays—Induction Relays—Relay timing—Important terms—Time P.S.M. curve—Calculation of relay operating time—Functional relay types—Induction type Over-current Relay—Induction type directional power Relay—Distance or Impedance relays—Definite distance type impedance relays—Time-distance impedance relays—Differential relays—Current differential relays—Voltage balance differential relay—Translay System—Types of Protection.



22. Protection of Alternators and Transformers 521—540



Protection of Alternators—Differential Protection of Alternators—Modified Differential Protection for Alternators—Balanced Earth Fault Protection—Stator Interturn Protection—Protection of Transformers—Protective systems for transformers—Buchholz Relay—Earth fault or leakage Protection—Combined leakage and overload Protection—Applying Circulating current system to transformers—Circulating Current scheme for Transformer Protection.

23. Protection of Bus-bars and Lines 541—551

Bus-bar Protection—Protection of Lines—Time Graded Overcurrent Protection—Differential pilot-wire Protection—Distance Protection.



24. Protection Against Overvoltages 552—568

Voltage Surge—Causes of Overvoltages—Internal causes of overvoltages—Lightning—Mechanism of Lightning Discharge—Types of Lightning strokes—Harmful effects of lightning—Protections against lightning—The Earthing Screen—Overhead Ground wires—Lightning Arresters—Types of lightning arresters—Surge Absorber.



25. Sub-Stations 569—585



Sub-station—Classification of Sub-stations—Comparison between Outdoor and Indoor Sub-stations—Transformer Sub-stations—Pole mounted Sub-stations—Underground Sub-station—Symbols for equipment in Sub-stations—Equipment in a transformer sub-station—Bus-bar Arrangements in Sub-stations—Terminal and Through Sub-stations—Key diagram of 66/11 kV Sub-station—Key diagram of 11 kV/400 V indoor Sub-station.

26. Neutral Grounding 586—603

Grounding or Earthing—Equipment Grounding—System Grounding—Ungrounded Neutral System—Neutral Grounding—Advantages of Neutral Grounding—Methods of Neutral Grounding—Solid Grounding—Resistance Grounding—Reactance Grounding—Arc Suppression Coil Grounding (or Resonant Grounding)—Voltage Transformer Earthing—Grounding Transformer



Index 605—608