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System Relaying

Power System Relaying

*This book
discusses the
development of
novel
protective
relaying
algorithms
using
Mathematical*

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System Relaying

***Morphology, a
nonlinear
signal
processing
technique
derived from
set theory and
geometry.
Power outages
have
considerable
social and
economic***

impacts, and effective protection schemes are crucial to avoiding them. While most textbooks focus on the transmission and distribution aspects of

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System Relaying

***protective
relays,
Protective
Relaying for
Power
Generation
Systems is the
first to focus
on protection
of motors and
generators from
a power
generation***

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perspective. It also includes workbook constructions that allow students to perform protection-related calculations in Mathcad® and Excel®. This text provides both a general

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overview and in-depth discussion of each topic, making it easy to tailor the material to students' needs. It also covers topics not found in other texts on the subject,

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*including
detailed time
decrement
generator fault
calculations
and minimum
excitation
limit. The
author clearly
explains the
potential for
damage and
damaging*

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mechanisms related to each protection function and includes thorough derivations of complex system interactions. Such derivations underlie the various rule-of-

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***thumb setting
criteria,
provide insight
into why the
rules-of-thumb
work and when
they are not
appropriate,
and are useful
for post-
incident
analysis. The
book's flexible***

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***approach
combines
theoretical
discussions
with example
settings that
offer quick how-
to information.
Protective
Relaying for
Power
Generation
Systems***

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***integrates
fundamental
knowledge with
practical tools
to ensure
students have a
thorough
understanding
of protection
schemes and
issues that
arise during or
after abnormal***

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operation.

The previous two editions of Power System Relaying offer comprehensive and accessible coverage of the theory and fundamentals of relaying and have been widely adopted

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*on university
and industry
courses
worldwide. With
the third
edition, the
authors have
added new and
detailed
descriptions of
power system
phenomena such
as stability,*

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***system-wide
protection
concepts and
discussion of
historic
outages. Power
System
Relaying, 3rd
Edition
continues its
role as an
outstanding
textbook on***

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***power system
protection for
senior and
graduate
students in the
field of
electric power
engineering and
a reference
book for
practising
relay
engineers.***

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System Relaying

Provides the student with an understanding of power system protection principles and an insight into the phenomena involved.

Discusses in detail the emerging technologies of

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***adaptive
relaying,
hidden
failures, wide
area
measurement,
global
positioning
satellites and
the specific
application of
digital
devices.***

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System Relaying

Includes relay designs such as electromechanical, solid-state and digital relays to illustrate the advantages and disadvantages of each. Re-examines traditional equipment

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protection practices to include new concepts such as transmission line differential protection, load encroachment on distance relay characteristics , distributed

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***generation
systems, and
techniques to
improve
protection
system response
to power system
events.***

***Analyzes system
performance
through
oscillographs
and alarms***

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schemes.

Features

**problems to be
worked through
at the end of
each chapter.
Designed to
increase
understanding
on a practical
and theoretical
basis, this
invaluable**

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***resource
provides
engineers,
plant
operators,
electricians
and technicians
with a thorough
grounding in
the principles
and
practicalities
behind power***

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system

protection.

Coverage of the

fundamental

knowledge

needed to

specify, use

and maintain

power

protection

systems is

included,

helping readers

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***to increase
plant
efficiency,
performance and
safety.***

***Consideration
is also given
to the
practical
techniques and
engineering
challenges
encountered on***

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*a day-to-day
basis, making
this an
essential
resource for
all.*

**DIGITAL POWER
SYSTEM**

PROTECTION

**Computer Aided
Design and
Analysis
Protective**

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***Relaying
Protective
Relay
Principles
Protective
Relaying for
Power
Generation
Systems***

This book focuses on protective relaying, which is an indispensable part of

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electrical power systems. The recent advancements in protective relaying are being dictated by MMPRs (microprocessor-based multifunction relays). The text covers smart grids, integration of wind and solar generation, microgrids, and

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MMPRs as the driving aspects of innovations in protective relaying. Topics such as cybersecurity and instrument transformers are also explored. Many case studies and practical examples are included to emphasize real-world applications. This handbook on

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power systems

consists of a set of 4 volumes. These books are carefully planned and designed to provide the state of art material on major aspects of electrical power systems, short-circuit currents, load flow, harmonics and protective relaying.

Many aspects of

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power systems are transparent between different types of studies and analyses; knowledge of short-circuit currents and symmetrical component is required for protective relaying, and fundamental frequency load flow is required for harmonic

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analysis. Currently, power systems, large or small, are analyzed on digital computers with appropriate software. However, it is necessary to understand the theory and basis of these calculations to debug and decipher the results. The material is organized with sound

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theoretical base,
practical applications,
and case studies based
on the authors 45+
years of experience
with real world
problems.

This book is a
practical guide to
digital protective
relays in power
systems. It explains
the theory of how the

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protective relays work in power systems, provides the engineering knowledge and tools to successfully design them and offers expert advice on how they behave in practical circumstances. This book helps readers gain technical mastery of how the relays

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function, how they are designed and how they perform. This text not only features in-depth coverage of the theory and principles behind protective relays, but also includes a manual supplemented with software that offers numerous hands-on examples in

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MATLAB. A great resource for protective relaying labs and self-learners, its manual provides lab experiments unavailable elsewhere. The book is suitable for advanced courses in Digital Relays and Power Systems Fault Analysis and Protection, and will

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prove to be a valuable resource for practitioners in the utility industry, including relay designers.

Digital power system protection, as a subject, offers the use of computers in power line relaying which is the act of automatically

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controlling the power system via instrumentation and control devices. This book is an attempt to make a gentle introduction to the nitty-gritty of digital relays. Written in a simple, clear and student-friendly style, this text covers basics of digital processing

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of analog signals for the purpose of relaying. All important basic algorithms that are used in various types of digital relays have been explained. FIR and IIR filters have been presented in such a manner that students will be able to develop intuitive

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understanding. The book also covers DFT and FFT and synchrophasor technology in details. MATLAB programs and Excel simulations have been given to reinforce the comprehension of the algorithms. This book has been thoroughly class-room tested and

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based on course notes
which is primarily
intended for
undergraduate and
postgraduate students
of electrical
engineering. Key
Features • In-depth
coverage of DSP
fundamentals •
Pedagogical tools like
figures, flowcharts,
block diagrams and

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tables have been

extensively used •

Review questions are
given at the end of
each chapter •

Extensive references
to literature on power
system protection

Power System

Protection in Smart
Grid Environment

Fundamentals of

Power System

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Protection

Protection & Control
for Power System
Power System
Relaying, Third
Edition

Symmetrical
Components for
Power Systems
Engineering

**Modern
Solutions for**

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**Protection,
Control, and
Monitoring of
Electric Power
Systems,
Edited by
Héctor J.
Altuve Ferrer
and Edmund
O. Schweitzer,
III & publishing
on June 1,**

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2010 :

addresses the concerns and challenges of protection, control, communications and power system engineers. It also presents solutions relevant to de

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**cision-making
personnel at
electric
utilities and
industries, and
is appropriate
for university
students and f
aculty. Approac
hes,
technology
solutions and**

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**examples
explained in
this book
provide
engineers with
tools to help
meet today's
power system
requirements,
including:-
Reduced
security**

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**margins
resulting from
limitations on
new
transmission
lines and
generating
stations.-
Variable and
less
predictable
power flows**

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**stemming
from new
generation
sources and
free energy
markets.-
Modern
protection,
control, and
monitoring
solutions to
prevent and**

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**mitigate
blackouts.-
Increased com
munications
and
automation
(sometimes
referred to as
the 'smart
grid')Modern
Solutions
brings**

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**together the
combined
expertise of
engineers
working on
power system
operation,
planning,
asset
management,
maintenance,
protection,**

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**control,
monitoring,
and communic
ations.**

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Armando
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Daqing Hou,**

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Gabriel
Benmouyal,
Gregary C.
Zweigle,
Héctor J.**

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**Altuve Ferrer,
Joseph B.
Mooney,
Michael J.
Thompson,
Ronald A.
Schwartz, and
Veselin
Skendzic.
The protection
which is
installed on an**

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**industrial
power system
is likely to be
subjected to
more difficult
conditions
than the
protection on
any other kind
of power
system.**

Starting with

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**the many
simple devices
which are
employed and
covering the
whole area of
industrial
power system
protection,
this book aims
to help
achieve a**

**thorough
understanding
of the
protection
necessary.
Vital aspects
such as the
modern
cartridge fuse,
types of
relays, and the
role of the**

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**current
transformer
are covered
and the widely
used inverse d
efinite-
minimum time
overcurrent
relay, the
theory of the
Merz-Price
protection**

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**system and
the
development
of the high-
impedance
relay system
are critically
examined.
This new
edition has
come about in
response to**

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**the dramatic
change from
the use of elec
tro-magnetic
relays to
electronic and
micro-
processor
relays which
figure in
practically all
new**

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installations.

**Therefore,
although the
theory and
usage are the
same, the
application
can be much
improved
owing to the
increased
range and**

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**accuracy and
the added
facilities
provided with
the modern
relays. This
book reflects
the change
and explains
the technical
advantages.
The new**

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**edition of
POWER
SYSTEM
ANALYSIS AND
DESIGN
provides
students with
an
introduction to
the basic
concepts of
power systems**

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**along with
tools to aid
them in
applying these
skills to real
world
situations.
Physical
concepts are
highlighted
while also
giving**

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**necessary
attention to
mathematical
techniques.
Both theory
and modeling
are developed
from simple
beginnings so
that they can
be readily
extended to**

new and complex situations. The authors incorporate new tools and material to aid students with design issues and reflect recent trends in the field.

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**A newly
updated guide
to the
protection of
power systems
in the 21st
century Power
System
Protection,
2nd Edition
combines
brand new**

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**information
about the
technological
and business
developments
in the field of
power system
protection
that have
occurred since
the last
edition was**

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**published in
1998. The new
edition
includes
updates on
the effects of
short circuits
on: Power
quality
Multiple
setting groups
Quadrilateral**

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distance relay characteristics Loadability It also includes comprehensive information about the impacts of business changes, including deregulation,

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disaggregation of power systems, dependability, and security issues. Power System Protection provides the analytical basis for design,

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**application,
and setting of
power system
protection
equipment for
today's
engineer.
Updates from
protection
engineers with
distinct
specializations**

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**contribute to a
comprehensiv
e work
covering all
aspects of the
field. New
regulations
and new
components
included in
modern power
protection**

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systems are discussed at length. Computer-based protection is covered in-depth, as is the impact of renewable energy systems connected to

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**distribution
and
transmission
systems.
Disturbance
Analysis for
Power
Systems
Power Supply
Devices and
Systems of
Relay**

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**Protection
Their Theory
and Practice
Volume One
Short-Circuits
in AC and DC
Systems
Electrical
Power
Systems**

Most textbooks
that deal with

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the power
analysis of
electrical
engineering
power systems
focus on
generation or
distribution
systems.

Filling a gap
in the
literature,

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Modern Power
System
Analysis,
Second Edition
introduces
readers to
electric power
systems, with
an emphasis on
key topics in
modern power
transmission

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engineering.

Throughout,
the boo
For many
years,
Protective
Relaying:
Principles and
Applications
has been the
go-to text for
gaining

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proficiency in
the
technological
fundamentals
of power
system
protection.
Continuing in
the
bestselling
tradition of
the previous

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editions by
the late J.
Lewis
Blackburn, the
Fourth Edition
retains the
core concepts
at the heart
of power
system
analysis.
Featuring

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refinements
and additions
to accommodate
recent
technological
progress, the
text: Explores
developments
in the
creation of
smarter, more
flexible

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protective
systems based
on advances in
the
computational
power of
digital
devices and
the
capabilities
of
communication

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systems that
can be applied
within the
power grid
Examines the
regulations
related to
power system
protection and
how they
impact the way
protective

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relaying
systems are
designed,
applied, set,
and monitored
Considers the
evaluation of
protective
systems during
system
disturbances
and describes

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the tools
available for
analysis
Addresses the
benefits and
problems
associated
with applying
microprocessor-
based devices
in protection
schemes

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Contains an expanded discussion of intertie protection requirements at dispersed generation facilities
Providing information on a mixture of

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old and new
equipment,
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Principles and
Applications,
Fourth Edition
reflects the
present state
of power
systems
currently in

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operation,
making it a
handy
reference for
practicing
protection
engineers. And
yet its
challenging
end-of-chapter
problems,
coverage of

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the basic
mathematical
requirements
for fault
analysis, and
real-world
examples
ensure
engineering
students
receive a
practical,

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effective
education on
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systems. Plus,
with the
inclusion of a
solutions
manual and
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with
qualifying
course

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adoption, the
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is ready-made
for classroom
implementation

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Power System
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Protection
focuses on the
control and
protection of

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power systems
to ensure a
secure and
reliable
supply as the
society
depends
greatly on
electric
energy. This
book examines
the problems

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surrounding
the
generation,
transmission,
distribution,
and
utilization of
electricity.
Comprised of
10 chapters,
this book
starts with an

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overview of
the functional
and
environmental
requirements
for the
intelligent
remote
terminal in
which much of
the logic
linked with

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each function has been programmed and is executed in a digital processor. This text then examines the objectives, functions, and elements of the control

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center design.
Other chapters
consider the
operating char
acteristics
and
configuration
of the system
components of
an audio-
frequency
power line

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carrier load management system. This book discusses as well the concept of transmission line relaying by digital computer. The final chapter deals with the

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large-scale utilization of wind energy. Power systems engineers will find this book useful.

This book is a long awaited comprehensive introduction to the

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protection of electrical power systems using computer-based methods (i.e. digital relays). The treatment is logically structured, taking the reader through

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the

mathematics
and principles
underlying the
development
and
implementation
of the major
algorithms
underlying
different
protection

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techniques.

They can be applied to protection of generator transformers, lines, switchgear and cable circuits: the main components of

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transmission
and
distribution
systems. The
book deals
with the
research and
development
activity in
the field of
digital
protection

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during the last 15 years. The reader will become familiarised with the fast developing field of power system protection using computers and

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microcomputers

. "This book provides a full introduction for senior undergraduates and graduates, and acts as a sound reference for engineers

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already

practising in
this area."

Protection of
Industrial
Power Systems
Power Systems
Handbook -
ANSI, IEEE,
and IEC
Standards
Digital

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Protection for
Power Systems
Modern Power
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Analysis
Computer
Relaying for
Power Systems
With
distributed
generation int
erconnection

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power flow
becoming
bidirectional,
culminating in
network
problems,
smart grids
aid in
electricity
generation,
transmission,
substations,

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distribution
and
consumption to
achieve a
system that is
clean, safe
(protected),
secure,
reliable,
efficient, and
sustainable.
This book

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illustrates
fault
analysis,
fuses, circuit
breakers,
instrument
transformers,
relay
technology,
transmission
lines
protection

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setting using
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Intended
audience is
senior
undergraduate
and graduate
students, and
researchers in
power systems,
transmission

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and

distribution,
protection
system broadly
under
electrical
engineering.
Since
publication of
the first
edition of
Computer

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Relaying for
Power Systems
in 1988,
computer
relays have
been widely
accepted by
power
engineers
throughout the
world and in
many countries

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they are now
the protective
devices of
choice. The
authors have
updated this
new edition
with the
latest
developments
in technology
and

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applications
such as
adaptive
relaying, wide
area
measurements,
signal
processing,
new GPS-based
measurement
techniques and
the

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application of artificial intelligence to digital relays. New material also includes sigma-delta and oversampling A/D converters, self-polarizing

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and cross-
polarizing in
transmission
lines
protection and
optical
current and
voltage
transformers.
Phadke and
Thorp have
been working

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together in
power systems
engineering
for more than
30 years.

Their
impressive
work in the
field has been
recognized by
numerous
awards,

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including the
prestigious
2008 Benjamin
Franklin Medal
in Electrical
Engineering
for their
pioneering
contributions
to the
development
and

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application of
microprocessor
controllers in
electric power
systems.

Provides the
student with
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understanding
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relaying

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Contents
include
relaying
practices,
mathematical
basis for
protective
relaying

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algorithms,
transmission
line relaying,
protection of
transformers,
machines and
buses,
hardware
organization
in integrated
systems,
system

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relaying and
control, and
developments
in new
relaying
principles
Features
numerous
solved
examples to
explain
several of the

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more complex topics, as well as a problem at the end of each chapter. Includes an updated list of references and a greatly expanded subject index.

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Practical

Power System
and Protective
Relays

Commissioning
is a unique
collection of
the most
important
developments
in the field
of power

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simple
explanations
and cost
affordable
models for
operating
engineers. The
book explains
the theory of
power system

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components in
a simple,
clear method
that also
shows how to
apply
different
commissioning
tests for
different
protective
relays. The

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book discusses
scheduling for
substation
commissioning
and how to
manage
available
resources to
efficiently
complete
projects on
budget and

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with optimal
use of
resources.

Explains the
theory of
power system
components and
how to set the
different
types of
relays

Discusses the

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time schedule
for substation
commissioning
and how to
manage
available
resources and
cost
implications
Details worked
examples and
illustrates

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Protection
provides
practising
engineers with
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date and
comprehensive
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available.

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on fundamental
methods and
technology and
with extensive
examples drawn
from current
practice inter

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this book will
be a major
reference tool
for engineers
involved with
and affected
by power
system
protection.

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Stability and

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Applications,

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Theory and

Applications

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Relays

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Systems
More than ninety
case studies shed
new light on
power system
phenomena and
power system
disturbances
Based on the

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author's four decades of experience, this book enables readers to implement systems in order to monitor and perform comprehensive analyses of power system disturbances.

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any power system. Logically organized, Disturbance Analysis for Power Systems begins with an introduction to the power system disturbance analysis function and its implementation.

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The book then guides readers through the causes and modes of clearing of phase and ground faults occurring within power systems as well as power system phenomena and their impact on

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relay system

performance. The

next series of

chapters presents

more than ninety

actual case

studies that

demonstrate how

protection

systems have

performed in

detecting and

isolating power

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system

disturbances in:
Generators
Transformers
Overhead
transmission
lines Cable
transmission line
feeders Circuit
breaker failures
Throughout these
case studies,
actual digital

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fault recording (DFR) records, oscillograms, and numerical relay fault records are presented and analyzed to demonstrate why power system disturbances happen and how the sequence of events are

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deduced. The final chapter of the book is dedicated to practice problems, encouraging readers to apply what they've learned to perform their own system disturbance

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analyses. This book makes it possible for engineers, technicians, and power system operators to perform expert power system disturbance analyses using the latest tested and proven

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methods.

Moreover, the book's many cases studies and practice problems make it ideal for students studying power systems.

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electricity supply
industry and
manufacturing
companies to
provide a
comprehensive
treatment of
power system
protection.

More than 75
case studies are
presented,
shedding light on

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design and relay
setting
calculations for
the protection
and control of
power system
elements.

Logically
organized,
Protection and
Control for Power
Systems begins
with an

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introduction to
power system
relaying
functions and
their
implementation.
Moving on, it
deals with system
faults, relay
transducers,
relay DC tripping
circuits, and
system

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grounding.

Subsequent chapters discuss protection and control systems for transformers, generators, lines and cables, buses, breakers, distribution systems, phase angle regulating transformers,

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shunt capacitors
and shunt
reactors.

Drawing on the
author's half
century of
experience, the
text enables
engineers and
other readers to
utilize techniques
and calculations
in the application

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of protection and control for power system. It documents material published for the first time covering the philosophy of setting ground time over-current protection for transmission

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lines, supported by actual power system case studies.

Additionally, protection of phase angle regulating transformers is covered in detail using real world numerical relaying

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relay input
devices, relay
design and relay
setting
calculations are
fully addressed.
It further outlines
the basics of
protection and
control for power
system elements
utilizing actual
system case

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studies involving the protection system methods. This use of case studies and problems provides insights into protection and control engineering not usually presented in a single text. The emphasis on

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design
application and
relay settings
calculations are a
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these reasons,
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necessary
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knowledge to
help them work
more effectively
with the
equipment. The
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the book then
cover built-in
digital protection
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chargers,
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batteries,
uninterruptible
power supply,
and
characteristic
features of
auxiliary DC
systems at
substations and
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final chapters

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discuss questions and problems that engineers and technicians may face. These include insulation problems, issues in auxiliary DC power supply such as voltage dips, and electromagnetic disturbances

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such as

blackouts, spikes,
and surges. The
author also
explains how to
address them.

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presents the foundations of symmetrical components with a review of per unit (percent), phasors, and polarity--keeping the mathematics as simple as possible throughout.

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*Application to a
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*2. Relay Design
and*

Construction.

Characteristics.

Choice of

Measuring Units.

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*Construction of
Measuring Units.
Construction of
Timing Units.
Details of
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The Main
Characteristics
of Protective
Relays. Phase*

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and Amplitude

Comparators.

Relay

Characteristics.

General Equation

for

Characteristics.

Inversion Chart.

Resonance.

Appendix.- 4.

Overcurrent

Protection. Time-

Current

Characteristics.

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units (PMU),
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links the
chapter to the
previous ones,
and then

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