



## COURSE TOPICS

- **System Analysis**
  - Fault Current and Load Flow Calculations Using Computer Software
  - Remote Effects Of Faults
  - Hand calculation method discussion
- **Protective Device Coordination Principles**
  - Graphical Tools and Time/Current Curve Interpretation
  - Load Flow and Unbalanced Fault Effects
  - Cold Load Pickup
  - Grounding System Constraints
  - Coordination Economics
  - Asymmetrical Current Impacts
  - Coordination Time Intervals of Relays
  - Transformer Effects on Coordination
- **Equipment and Device Characteristics**
  - Fuses – including current limiting fuses
  - Molded case and Insulated Case Breakers
  - Solid-State Trip Low Voltage Breakers
  - Equipment Damage Characteristics
  - Proper Protective Device Selection
  - Circuit Breaker Ratings and Selection
  - Low Voltage Cable Protection
  - Shielded Cable Protection
  - Overhead Conductor Protection
  - Motor Protection
  - Generator Protection
  - Transformer Protection
  - Panelboard and Switchgear Protection
  - Inverse Time/Overcurrent Protective Relays and Instantaneous Trip Devices
  - Series Rated Breakers
  - Differential and Voltage Constrained Relays
  - Reclosing relays, reclosers, and sectionalizers
  - Current transformer characteristics and selection
- **Ground Fault Protection**
  - Arcing Ground Fault Magnitudes
  - Ground Fault Protection Schemes
  - Interaction Of Ground Fault Relays And Phase Overcurrent Devices
- **Emergency Power System Design**
  - Weak Source Systems
  - Generator Fault Characteristics
  - Uninterruptible Power Supply Fault Characteristics
  - Transfer and Static Switch Limitations
  - Improving Emergency Circuit Design
- **Common Coordination Problems, Errors, And Misconceptions**
- **Preliminary System One-line Development for a Coordinated System**

- Lessons Learned and “Rules of Thumb” to spot uncoordinated systems and *methods to develop a coordinated system design*
- **Criteria Impacting Coordination**
  - NESC, IEEE Std C2,
  - NFPA 70-National Electrical Code
  - **Arc Flash Protection of Employees**
- **Switchgear And Relay Commissioning Including Optional Hands-On Student Calibration Of A Relay**
- **Putting It All Together**
  - 8 classroom hours will be used to work example design problems with student involvement in the following system types:
    - Low voltage system with critical systems fed from normal and emergency power sources
    - Medium voltage system from a 15 kV class substation primary to the low voltage secondary.
  - Specification Writing for a Coordinated System
- **Government Criteria**
  - D.o.D. Unified Facility and FAA Criteria
  - Some classes extend to the fifth day which can be spent covering the government criteria related to protective device coordination or by participation in a hands-on training session in using EasyPower directed by ESA instructors. See [www.easypower.com](http://www.easypower.com) for details.

*The course does spend any classroom time on software training but will utilize the unsurpassed characteristics of EasyPower® software during the Thursday session.*

### ABOUT THE INSTRUCTOR

**Charles Pratt, P.E.**

Mr. Pratt has been a practicing professional engineer for over 30 years in this subject. He is president and principal engineer of Quadrelec Engineering Corporation in Tulsa, OK and has been an instructor for the U.S. Army Corps of Engineers for 17 years in the subject area. His 20 years of experience as an engineer for the U.S. Air Force and U.S. Army Corps of Engineers provides a broad background in federal and public sector issues related to electrical systems design and contracting. His experience in the coordination of power systems and the associated studies span industrial, manufacturing, utility and T&D entities, power generation, hospital, and critical military facilities and related load flow and arc flash hazard analyses. Prior to his professional career he was trained by the Oklahoma Gas & Electric Company in the areas of overhead and underground system design and in substation and protective relaying testing and commissioning. As a member of the IEEE Power Engineering and Industrial Applications societies since 1976, active engagement in on going studies, and from previous training through other industry courses, he brings a wealth of knowledge and practical experience to the course.

### COURSE REGISTRATION AND DATES

Check the following website training links for course registration and dates. [www.quadrelec.com](http://www.quadrelec.com)

### COURSE SUPPLIED MATERIALS

Each student will receive a CDROM containing a copy of government criteria and sample problem files. In addition a copy of the book “A Practical Guide to Short-Circuit Calculations” by Conrad St. Pierre and a complete ring bound set of lecture notes related to over 200 lecture slides will be provided. See website for sample.

### REGISTRATION FEE

The registration fee is payable by check, credit card (Master Card and Visa only), government form DD1556, SF82, or company purchase orders. The fee includes course materials, break refreshments, completion certificate, and transcript of CEU or PDH credits.

The cost of the course will be \$1,800 per student. (Note: **A 10% discount is available for IEEE members.** See registration forms at the above website link.)

### DAILY SCHEDULE

8:00 AM – 11:30 AM - Morning Session  
12:30 PM – 5:00 PM – Afternoon Session  
8:00 AM – 5:00 PM Thursday – Specific Example Problem Exercises (Student Participation in actual coordination problems)

### CONTINUING EDUCATION CREDIT

One CEU will be granted for every 10 hours of actual class attendance. A maximum of 3.0 CEUs are available and will be provided by the I.E.E.E. Education Program.

### CANCELLATION POLICY

See registration form.

### STUDENT SUPPLIED ITEMS

The course has been structured so that **no computers are required during classroom lectures.** If the student desires, a laptop computer may be used with the course lecture portions related to example problem solutions and EasyPower specific areas of the lecture. The EasyPower sample files will be provided at the beginning of the course to each student so that the student can work through the examples after hours. If the student desires for a computer to be provided, the student should advise the registrar during the registration. Additional fees will be required to supply the computer.

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