



## COURSE TOPICS

- **System Analysis**
  - Fault Current and Load Flow Calculations Using Computer Software
  - Remote Effects Of Faults
  - Hand calculation method overview
- **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
  - Transformer Effects on Coordination
- **Equipment and Device Characteristics**
  - Fuses - Low Voltage and Medium Voltage
  - Molded case and Insulated Case Breakers
  - Solid-State Trip Low Voltage Breakers
  - Equipment Damage Characteristics
  - Proper Protective Device Selection
  - High Voltage Breakers
  - 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 calculations
- **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 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 Tips for a Coordinated System
- **Government Criteria** (Optional, for government classes)
  - 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

### ABOUT THE INSTRUCTOR

#### **Charles Pratt, P.E.**

Mr. Pratt has been a practicing professional engineer for over 30 years in this subject. He has been an instructor for the U.S. Army Corps of Engineers for 17 years in the subject areas and an engineer for the U.S. Air Force and U.S. Army Corps of Engineers. He is president and principal engineer of Quadrelec Engineering Corporation in Tulsa, OK. His experience in the coordination of power systems and the associated studies span industrial, manufacturing, utility, 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 and previously trained through industry courses, he brings a wealth of knowledge and practical experience to the course.

#### **ESA**

ESA Inc. may be conducting their regional training courses in the same city on use of EasyPower software or other related topics. Learn from the experts, tips and techniques to facilitate your use of EasyPower. See the ESA website for such course offerings at <http://www.easypower.com/support>.

***The 4-day basic course does not focus on EasyPower use but merely utilizes the unsurpassed characteristics of EasyPower® as a training tool with student involvement.***

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### COURSE REGISTRATION AND DATES

Check the following websites for course registration, locations 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.

### 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.

### REGISTRATION AND CANCELLATION POLICY

See registration form on the website.

### STUDENT SUPPLIED ITEMS

The course has been structured so that **no computers are needed during classroom lectures.** The course is designed to teach coordination principles and methods rather than computer software usage. Students should bring a hand calculator. All other necessary training materials will be supplied.

Students are encouraged to submit a one-line diagram with the necessary system and protective device data for use during the Thursday sessions. These systems may be selected as a “study system” for the students analysis. During this all day session the students will perform portions of an actual coordination study of the system. **Thus a side benefit of the course is that you will receive tips on coordination problems within an actual system in your plant or real world examples.**