FUNDAMENTALS OF ELECTRIC POWER SYSTEMS ANALYSIS

(a detailed outline follows the schedule and registration information)

Jerry Shaw Conference Room, Goddard Hall
New Mexico State University
Las Cruces, NM

August 7-9, 2006 (three days)

Daily Schedule

8:15 a.m. Coffee and snacks
8:30 – 11:45 a.m. Morning Session (with break)
11:45 a.m. LUNCH (provided)
1:15 p.m. - 5:00 p.m. Afternoon Session (with break and refreshments)

! The course is designed to meet the Continuing Education competency requirement for many professional registrations

! The required textbook, as well as a detailed set of notes, will be given to each person attending

! There will be approximately 6 contact hours per day

! A credit of 18 PDH (Professional Development Hours) will be provided to each attendee desiring it, upon completion of the entire course. This will appear on any NMSU transcript requested afterward (There is no additional charge for this, and the attendee does not have to be enrolled at NMSU as a regular student)

! Lunch will be provided each day

! Refreshments will be served each morning and afternoon
FUNDAMENTALS OF
ELECTRIC POWER SYSTEMS ANALYSIS
Detailed Outline

Developed and offered by
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Textbook (provided with course):
The short course will address many of the topics covered in this text. The text will provide a useful permanent reference for each attendee.

Supplemental notes will be handed out as appropriate.

This short course provides a comprehensive review of most of the fundamental topics covered in a modern undergraduate course sequence in electric power system analysis. It is directed primarily toward the needs of those engineers who have not been exposed to a recent treatment of power-system modeling and analysis techniques, or whose background is in related areas. Emphasis will be placed upon intensive teaching of relevant theory, presentation of practical examples, and problem solving using both hand calculations and the personal computer.

Attendees should be familiar with basic Electrical Engineering concepts (in particular, alternating-current fundamentals) but need not have an extensive background in electrical power systems. Appropriate examples will be presented and example problems will be solved. Demonstrations of relevant analysis software will be made, and the attendees will have the opportunity to see and use small interactive programs for line-constants and voltage-regulation calculation, parameter conversion, power-flow, fault analysis, transient stability, and other system studies. Prior computer experience is not necessary.
• **Who should attend:**

Persons involved in the design, analysis, and construction of electric power systems, facilities, and equipment. **Non-power engineers and design technicians** will profit from this intensive exposure to the principles of electric power systems. **More experienced power engineers** should find the course an effective review and an introduction to modern analysis and solution methods. **Power-system operators and major customers** will learn how power system problems are formulated and solved, and how some of the most frequently-encountered large-scale studies (power-flow, short-circuit, transient-stability) are made.

**Day 1:**

- Review of steady-state sinusoidally-excited ac circuits and devices
- Vector representation, phasors, and RMS values
- Resistance, inductance, capacitance, and sources
- Fundamentals of ac circuit theory
- Balanced and unbalanced three-phase circuits
- Energy and power in single-phase and three-phase circuits
- real, reactive, complex, and apparent power
- power factor and power-factor correction
- measurement of power quantities in three-phase circuits
- Numerical examples

**Per-unit calculations**
- Meaning of per-unit and base quantities; change of base
- Use of per-unit methods in power-system calculations
- Numerical examples

**Components of the power system and their models**
- Transmission and distribution lines
- circuit models
- evaluation of series and shunt parameters; use of ABCD parameters
- voltage regulation, voltage ratio, efficiency, hand calculations
- Shunt and series compensation
- Computer demonstration of line-constants and voltage-regulation calculations
Day 2:

Components of the power system (continued)

- Transformers
  - single-phase and three-phase
  - design and internal construction
  - ratings, circuit models
  - per-unit impedances
  - autotransformers
  - three-winding transformers
  - transformer losses, testing and measurements
  - introduction to harmonics in three-phase connections
    sample calculations

- Synchronous generators and motors
  - basic concepts and construction
  - the revolving field
  - circuit models, internal voltages, and impedances
  - power transfer and power-angle characteristics
    the effect of excitation

- Induction motors
  - basic concepts and construction
  - the induction motor as a load
  - starting characteristics and power-factor
  - generation and plugging modes of operation

- Power-flow analysis
  - reasons for performing
  - data requirements and data preparation
  - formulation and use of the bus admittance matrix
  - primary power-flow solution algorithms
  - calculation of line flows
  - control of P and Q flow
  - effects of transformer tap settings
  - computer demonstrations of power-flow and line-loss calculations
Day 3:

**Symmetrical components**
- Importance and philosophy
- Graphical explanation
- Relevant equations
- Sequence voltages, currents, and impedances
- Sequence networks and models
- Phase shift in delta-wye transformer banks
- Zero-sequence and neutral considerations
- Numerical examples

**Short-circuit analysis**
- Symmetric faults
- Transients in R-L circuits
- Transient and subtransient models of machines
- Fault analysis on loaded and unloaded machines and systems
- Short-circuit MVA
- Evaluation and use of bus impedance matrix
- Calculation of balanced fault currents
- Computer demonstration of balanced fault calculations

**Asymmetric faults**
- Line-to-ground
- Line-to-line
- Double-line-to-ground
- Use of symmetrical-component models
- Calculation of unbalanced fault currents
- Computer demonstration of unbalanced fault calculations

**Power-system stability**
- The stability problem: steady-state, transient and dynamic
- Steady-state stability and stability limits
- Fundamentals of transient stability
- Rotational dynamics of machines
- Stability models; data preparation, network reduction
- Representation of machines and loads
- The swing curves: calculation and interpretation

Question/answer session and conclusion of course
Registration Form

(Please print one per attendee and send, fax, or email to the address below. For multiple enrollments from one organization, you may list the persons, with the information required, in a file. Please note that a Social Security number is needed for each person desiring to receive CEU’s)

Fundamentals of Electric Power System Analysis

Jerry Shaw Conference Room, Goddard Hall
New Mexico State University
Las Cruces, NM        August 7-9, 2006

Name:____________________________________________

Organization:______________________________________

Address, zip: ______________________________________

Phone, email: ______________________________________

SS# (needed if you wish to be awarded Continuing Education (CEU) credit)_______ - _______ - _______

Fee (select appropriate one):

Basic enrollment:
   1 to 4 persons from your organization, each $1095 $______
   5 or more persons from your organization, each $995 $______

Employee of EUMP-sponsoring organization:
   1 to 4 persons from your organization, each $995 $______
   5 or more persons from your organization, each $950 $______

Early enrollment discount:
   Deduct an additional $20 per person if payment is made by June 30 - ($______)
Total amount enclosed $_____

Please attach a check (made payable to New Mexico State University), or a company Purchase Order.

Please Note:

1. Requests for refund of fees cannot be honored after 30 business days prior to the beginning of the course. Substitutions will be allowed, however, at no additional charge.

2. NMSU reserves the right to cancel this course no later than 25 days prior to the scheduled beginning date. In such an event participants will be notified as quickly as possible and a full refund of all registration fees will be made promptly.

I agree to the conditions stated herein.

Signature:______________________________

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If you need a map, directions to the campus, a list of accommodations, or assistance in planning your stay, please feel free to contact us.