EE 330 *Energy Systems*
EE 330L *Energy Systems Lab*

Catalog Data:

EE 330 Energy Systems Credits: 3. Production, transmission, and utilization of energy in systems with major electrical subsystems, with particular emphasis on electromagnetic and electromechanical systems and devices.

Prerequisites: EE 221 with a grade of "C" or higher.

Corequisites: EE 330L

EE 330L Energy Systems Lab Credits: 1. Laboratory to accompany EE 330.

Corequisites: EE 330

Textbook:

S. J. Chapman, *Electric Machinery and Power System Fundamentals*, McGraw-Hill Higher Education, 2002, ISBN-13 978-0-07-229135-3, ISBN-10 0-07-229135-4.

Coordinator:

Dr. Thomas P. Montoya, Associate Professor

Goals:

Lecture: The goal of this course is to introduce students to the power engineering field before taking EE 431/531 Power Systems and/or EE432/532 Power Electronics. By the end of this course, students are expected to understand the fundamentals of AC power, transformers, and AC machinery and introduce them to power systems. Also, this course aims to help EE students prepare for future careers in the following areas: 1. Power industry, 2. Power-related component manufacturers, 3. EV companies, 4. EV Charging infrastructure manufacturers, and/or 5. Renewable energy sectors.

Lab: A goal of this course is to introduce students to the power engineering field before taking EE 431/531 Power Systems and/or EE 432/532 Power Electronics. Further, students are expected to be able to follow electrical safety standards and proper operating procedures when working with high-power systems, relate experimental results to theoretical concepts of energy systems, and understand the fundamental operation of the power systems and their components by the end of this course.

Class Schedule:

Lecture: 3 hours per week.

Lab: scheduled weekly labs; lab projects will be scheduled as required.

Topics:

1. Mechanical and Electromagnetic Fundamentals
    a. Electric Machines & Power Systems
    b. Rotational motion, velocity, acceleration, torque, work & power
    c. Magnetic Field

   d. Faraday's Law
   e. Induced force on wire
   f. Induced voltage on conductor
   g. Real, Reactive, & Apparent Power (single-phase/1ϕ)
   h. Power Factor (PF) correction
2. Three-Phase Circuits
   a. Generation of Three-Phase (3ϕ) Voltages and Currents
   b. Voltages and Currents in 3ϕ Circuit (wye/Y & delta/Δ connections)
   c. Power Relationships in 3ϕ Circuits
   d. Analysis of Balanced 3ϕ Systems
   e. One-Line Diagrams
   f. Using Power Triangle
3. Transformers
   a. Types & Construction of Transformers
   b. Ideal Transformer
   c. Theory of Operation of Real 1ϕ Transformers
   d. Equivalent Circuit of a Transformer
   e. Per-Unit System
   f. Transformer Voltage Regulation & Efficiency
   g. Transformer Voltage Taps & Voltage Regulation
   h. Autotransformer
   i. 3ϕ Transformers
   j. Transformer Ratings & Related Problems
   k. Instrument Transformers
4. AC Machinery Fundamentals
   a. Rotating Magnetic Field
   b. MMF & Flux Induced Voltage
   c. Induced Torque
   d. Winding Insulation
   e. AC Machine Power Flows & Losses
   f. Voltage & Speed Regulation
5. Synchronous Machines
   a. Synchronous Machine Construction
   b. Speed of Rotation
   c. Internal Generated Voltage
   d. Equivalent Circuit; Phasor Diagram
   e. Power and Torque
   f. Measuring Model Parameters
   g. Operating Alone
   h. Synchronous Motors
   i. Steady-State Synchronous Motor Operation
6. Induction Motors
   a. Construction

    b. Basic Concepts
    c. Equivalent Circuit
    d. Power and Torque
    e. Speed Characteristics
    f. Variations Torque-Speed Characteristics
    g. Starting
    h. Speed Control
7. Transmission Lines
    a. Resistance
    b. Inductance and Inductive Reactance
    c. Capacitance and Capacitive Reactance
    d. Transmission Line (TL) Models
    e. Short TL
    f. TL Characteristics
    g. Two-Port Networks and ABCD Model
    h. Medium-Length TL
    i. Long TL
8. Power System Representation and Equations
    a. One-Line Diagrams
    b. Equivalent Circuits
    c. Node Equations for Equivalent Circuits
    d. Solving Power System Node Equations w/ MATLAB

TECHNOLOGY EQUIPMENT AND SKILLS NEEDED FOR THE COURSE:

Lecture- The course requires use of a laptop computer and a scientific calculator (capable of complex number operations). Ability to navigate D2L and internet, upload/download files (e.g., pdf files), use MS-Office programs, communicating via email, and possibly connecting computer audio/video and using tools such as Zoom. MATLAB and/or MathCad may be used/useful for some assignments.

Lab- The course requires use of a laptop computer and a scientific calculator (capable of complex number operations) as well as LabVolt system. Ability to LVDAC-EMS software, use navigate D2L and internet, upload/download files (e.g., pdf files), use MS-Office programs, communicating via email, and possibly connecting computer audio/video and using tools such as Zoom. MATLAB and/or MathCad may be used/useful for some assignments.

COURSE LEARNING OBJECTIVES (CLO) FOR LECTURE:

Upon completion of this course, students should demonstrate the ability to:

A. Analyze single-phase and three-phase circuits to determine currents, voltages, and power.

B. Understand the basic operation of single-phase and three-phase transformers as well as their use in energy systems.

C. Understand the basic operation, parameters, and properties of AC machinery such as synchronous machines and induction motors.

D. Understand the basic parameters and properties of transmission lines.

E. Analyze and describe the components and structure of electrical power systems, including generation, transmission, and distribution.

COURSE LEARNING OBJECTIVES (CLO) FOR LABORATORY:

Upon completion of this course, students should demonstrate the ability to:

A. Use meters, data acquisition tools, and LabVolt systems to collect, process, and interpret experimental data.
B. Measure, model, and interpret single-phase and three-phase circuit behavior and parameters under different loading and connection conditions including power factor correction.
C. Measure, model, and interpret single-phase and three-phase transformer behavior and parameters under different loading and connection conditions.
D. Analyze and measure current, voltage, and power characteristics of transmission lines under different loading conditions including power factor correction.
E. Operate, analyze, and take measurements on electrical machines (e.g., induction motors) to determine their characteristics and performance.
F. Design, investigate, and analyze three-phase power system.
G. Properly document and report results of experimental/laboratory work.

RELATION OF COURSE LEARNING OBJECTIVES TO STUDENT OUTCOMES (SO):

These course learning objectives fulfill the following student outcomes for the B.S. EE program:

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public, health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3) An ability to communicate effectively with a range of audiences.
4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environment, and societal contexts.
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The following tables indicates the relative strengths of each course objective in addressing the program's student outcomes listed above (on a scale of 0 to 4 where 4 indicates a strong emphasis)

Lecture

SO / CLO	1	2	3	4	5	6	7
A	4	2					
B	4	2					
C	4	2					
D	4	2					
E	4	2					

Laboratory

SO / CLO	1	2	3	4	5	6	7
A						4	
B	4					4	
C	4					4	
D	4					4	
E	4					4	
F	4	3				4	
G			4		2	3	

PREPARED BY:

Thomas P. Montoya, Date: August 18, 2026