SOUTHEAST COMMUNITY COLLEGE
CONSTRUCTION, MANUFACTURING AND TECHNOLOGY DIVISION
Energy Generation Operations Technology Program
Revision Date: August 21, 2023

I. CATALOG DESCRIPTION

Course Number:	ENER1210
Course Title:	Electrical Power Theory
Prerequisite(s):	MATH1050 or higher MATH
Catalog Description:	This course introduces the student to electricity and electrical power concepts. Topics include the study of basic electrical characteristics, series and parallel circuits, resistance and impedance, single-phase and three-phase circuits, power generation and transmission, power factor and correction, DC transmission, rectification, inverter systems, and grid transfer. The student will also learn about generator control, protection and fault management. Industrial backup power systems and their application will be covered as well. Lab must be taken concurrently.
Credit Hours:	4
Class Hours:	53
Lab Hours:	23
Total Contact Hours:	76

II. COURSE OBJECTIVES: *Course will:*

A. Introduce students to the fundamental principles of electricity.
B. Explain the relationships between Voltage, Current, Power, and Resistance/Impedance.
C. Explain the difference between DC and AC circuits.
D. Introduce students to power generation in AC systems.
E. Explain the relationship between resistance, reactance and impedance.
F. Introduce students to the basic relationship between real power, apparent power and reactive power.
G. Introduce students to the basic operation of single phase and three phase transformers.
H. Introduce students to the basic relationship between real power, apparent power, and reactive power.
I. Introduce students to power factor correction and its application to electrical operations.
J. Define backup power and its role in maintaining system operations.
K. Explain the primary sources of backup power used in industrial systems.

III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

A. Student Learning Outcomes: *Student will be able to:*
1. Explain the basic principles of electricity
2. Understand the relationships between Voltage, Current and Resistance
3. Understand basic series and parallel circuits
4. Explain the difference between AC and DC power
5. Explain the relationship between resistance, reactance and impedance
6. Understand the principles of 3-phase power generation
7. Understand 3-phase transformers and power distribution
8. Understand the design and operation of AC and DC generators and motors
9. Explain the fundamentals of power operations and prime movers
10. Explain power factor, reactive power, and their application to operations
11. Understand and interpret one-line diagrams

12. Describe generator and system protection techniques
13. Understand grid synchronization, isolation operations, black start operations
14. Understand fault control and analysis
15. Define backup power
16. Identify primary sources of industrial backup power

B. General Education Learning Outcomes (GELOs)

1. GELO #5: Analytical, Quantitative, and Scientific Reasoning
Outcome 1: Apply mathematical and scientific methods to solve problems from an array of contexts and everyday situations.

IV. CONTENT/TOPICAL OUTLINE

A. Basic electrical concepts
1. Atomic structure
2. Electric charge
3. Voltage, current, resistance

B. Ohm's Law
1. DC electricity
2. Voltage, current, resistance relationship
3. Power and efficiency

C. Series and Parallel circuits
1. Basic series circuits
2. Basic parallel circuits
3. Series-parallel circuits

D. Magnetism
1. Magnetic characteristics
2. Electromagnetism

E. Inductors and capacitors
1. Inductance
2. Capacitance
3. Impedance

F. AC Fundamentals
1. Basic AC operations
2. AC magnitude related values (peak, peak-to-peak, instantaneous, RMS)
3. Reactive circuits
4. Power Factor (PF)

G. Transformers
1. Purpose and construction
2. Basic types of transformers (step-up, step-down, 1-to-1)
3. Turns Ratio
4. Calculate primary and secondary voltage and current relationships
5. Calculate primary and secondary power relationship

H. 3-Phase power
1. 3-Phase AC waveforms
2. Phase sequence
3. Wye (Y-) and Delta (Δ-) circuits
4. Calculate line and phase voltages and currents
5. Y-Δ and Δ-Y circuits
6. Understand reactive power
7. Explain power factor and power factor correction

I. 3-Phase Transformers
1. Explain Y-Y, Δ-Δ, Y-Δ, Δ-Y connected transformer wiring

2. List advantages of configuring single phase transformer banks as three phase transformers
3. Calculate primary & secondary voltage, current, and power relationships
4. Understand and calculate true, apparent, and reactive power in balanced loads

J. AC Generators and Motors
1. Identify the major components of AC generators and motors
2. Understand the operation of AC generators and motors
3. Compare 1-phase and 3-phase alternators
4. Understand control circuits, output, and frequency

K. AC Transmission and Distribution
1. Describe power T&D systems
2. Explain the advantages of AC vs. DC T&D
3. Identify key elements of T&D systems
4. Describe the major types of power generation plants
5. Review prime movers and primary energy sources
6. Identify key components of a large scale generator

L. Backup Power
1. Application of backup power to industrial systems
2. Types of backup power

V. INSTRUCTIONAL MATERIALS

A. Required Text(s):
1. Cengage Learning, *Delmar's Standard Textbook of Electricity*, by Stephan L. Herman; (Refer to CID and/or instructor for current edition)
2. Clough, Robert, *Electric Power System Fundamentals* (Refer to CID and/or instructor for current edition)

B. Other Resources: Instructor provided.

C. Supplies: Computer with internet access, Canvas account and Calculator

VI. METHODS OF PRESENTATION/INSTRUCTION

A. Methods of presentation typically include a combination of the following:
1. Face to face course

VII. METHODS OF EVALUATION

A. Methods of evaluation, although determined by the individual instructor, traditionally includes a combination of the following:
1. Class participation
2. Regular assignments
3. Written exams and/or quizzes
4. Performance and observational assessments

VIII. SPECIFIC COURSE REQUIREMENTS

A. A minimum grade of "C" or 70% is required to receive credit for this course.

B. A minimum grade of "B" or 80% is required to achieve the NUCP certificate, in accordance with ACAD 08-006, Revision 1, dated October 2016

C. Cheating within the Manufacturing Division: Any violation of academic integrity on assignments, quizzes, or tests will result in a grade of 0 on that assignment, quiz, or test. A second violation in any course after the initial infraction will result in a grade of F for that course. Any additional violations while in the program will result in a suspension from the program.

D. Credit by Examination: Credit for the course CANNOT be earned through Credit by Examination.