

Course Outline of Record

1. Course Code: ESYS-002
2.
 - a. Long Course Title: Electricity & Electrical Theory
 - b. Short Course Title: ELEC THEORY
3.
 - a. Catalog Course Description:

This course provides a solid foundation of the theory behind electricity, electrical circuits, circuit components, electrical test equipment and safe practices when working with electricity. A lab uniform is required for this course.
 - b. Class Schedule Course Description:

This course will take the mystery out of electricity. Electrical theory, characteristics of electricity and safe practices will be examined. A lab uniform is required for this course.
 - c. Semester Cycle (*if applicable*): Every Semester
 - d. Name of Approved Program(s):
 - AIR CONDITIONING AND REFRIGERATION AS Degree for Employment Preparation
 - ENERGY SYSTEMS TECHNOLOGY Certificate of Achievement
 - AIR CONDITIONING AND REFRIGERATION Certificate of Achievement
4. Total Units: 3.00 Total Semester Hrs: 90.00
 Lecture Units: 2 Semester Lecture Hrs: 36.00
 Lab Units: 1 Semester Lab Hrs: 54.00
 Class Size Maximum: 30 Allow Audit: Yes
 Repeatability No Repeats Allowed
 Justification 0
5. Prerequisite or Corequisite Courses or Advisories:

Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)

 Advisory: RDG 061
 Advisory: MATH 060
6. Textbooks, Required Reading or Software: (*List in APA or MLA format.*)
 - a. Herman, S., L. (2009). *The Complete Lab Manual for Electricity* (4th/e). Baytown cengage Learning . ISBN: 9781133673828
 College Level: Yes
 Flesch-Kincaid reading level: 11
 - b. Herman, S., L. (2016). *Delmar's Standard Textbook of Electricity* (6th/e). Boston cengage Learning . ISBN: 9781305616431
 College Level: Yes
 Flesch-Kincaid reading level: 11.2
7. Entrance Skills: *Before entering the course students must be able:*
 - a.

Demonstrate proficiency in basic number facts (addition, subtraction, multiplication, division).

 - MATH 060 - Compute using the four basic operations of addition, subtraction, multiplication, and division on the rational numbers in both fraction and decimal form.
 - MATH 060 - Apply the basic operations to solve application problems that involve whole numbers, integers, and rational numbers.
 - MATH 060 - Apply the order of operations to simplify expressions involving several operations using rational numbers.

- MATH 060 - Use rounding and estimation to solve problems involving rational numbers.
- MATH 060 - Apply methods of conversion between percents, decimals, and fractions.
- MATH 060 - Use concepts and formulas from geometry.
- MATH 060 - Understand the concept of a variable and how a variable can be used to represent an unknown quantity.

b.

Use various reading strategies to prepare, read and comprehend expository text

- RDG 061 - Use SQ3R &/or SOAR along with outlining, note-taking, mapping summarizing and other strategies to prepare, read, & comprehend expository text.

c.

Read a variety of texts fluently

- RDG 061 - Read a variety of texts fluently.

d.

Write organized summaries & reactions that capture main idea and supporting details

- RDG 061 - Write organized summaries & reactions that capture main idea and supporting details.

e.

Understand multiple word meanings, uses & synonyms

- RDG 061 - Understand multiple word meanings, uses & synonyms

8. Course Content and Scope:

Lecture:

1. Electrical Safety Introduction
 1. Electrical Shock Reducing Your Risk
 2. Personal Protective Equipment (PPE) OSHA
 3. Safety Standards
 4. Safety Philosophy
 5. Electrical Regulations
 6. Ladders
 7. Basic Tool Safety Confined Space Entry
 8. Fall Protection
 9. First Aid
2. Electrical Theory Introduction
 1. Atomic Theory
 2. Electrical Power Generation and Distribution
 3. Electric Charge and Current
 4. Ohm's Law
 5. Kirchhoff's Law's
 6. Electrical Circuits
3. Electrical Measuring Instruments
 1. Measuring Current
 2. Measuring Voltage
 3. Measuring Resistance
 4. Voltage Testers
 5. Loop Equations
4. Conductors and Insulation
 1. Wire Size
 2. Ampacity
 3. Conductor Material
 4. Conductor Insulation
 5. Cables
5. Introduction to Construction Drawings
 1. Site Plan
 2. Floor Plan

3. Electrical Drawings
4. Drawing Layout
5. Electrical Symbols
6. Scale Drawings
6. Power Plans
 1. Electrical Details and Diagrams
 2. Written Specifications
7. Sine Wave Generation
 1. Sine Wave Terminology
 2. AC Phase Relationships
 3. Non-Sinusoidal Waveforms
8. Resistance, Inductance & Capacitance
 1. Inductance in AC Circuits
 2. Factors Affecting Inductance
 3. Inductive Reactance
 4. Capacitance
 5. Series Circuits
 6. Parallel Circuits
9. Power in AC Circuits
 1. True Power
 2. Apparent Power
 3. Reactive Power
 4. Power Factor
 5. Power Triangle
10. Transformers
 1. Construction
 2. Operating Characteristics
 3. Turns Voltage Ratios
 4. Types of Transformers
 5. Transformer Basics
 6. Wound
 7. Mitered
 8. Transformer Characteristics
 9. Transformer Tap
 10. Basic Transformer Connections
 11. Single Phase
 12. Three Phase
 13. Parallel Operation of Transformers
 14. Transformer Grounding
 15. Switchgear
 16. Switchgear Construction
 17. Testing and Maintenance
11. Purpose of Grounding and Bonding
 1. Short Circuit
 2. Ground Fault
 3. Types of Grounding Systems
 4. Grounding Requirement
 5. Grounding Methods
 6. Grounding Electrodes
 7. Equipment Grounding
 8. Equipment Grounding Conductor
 9. Grounding Enclosures
 10. Bonding Service Equipment
 11. Effective Grounding Paths
 12. Grounded Conductor
 13. Testing of Effective Grounds
 14. Measuring Earth Resistance
 15. How the Ground Tester Works
12. Circuit Breaker Ratings
 1. Current Rating

2. Interrupting Capacity Rating
3. Ground Fault Current Circuit Protection
4. Fuses
5. Over Currents
6. Guide for Sizing Fuses

Lab: *(if the "Lab Hours" is greater than zero this is required)*

1. Fundamentals of Electricity
 1. Use an AC tester to check a wall outlet for electricity
2. Electrical Circuit Components
 1. Connect and operate a power supply
3. Manual Input Devices
 1. Connect and operate a circuit using three types of manual switches
4. Output Devices
 1. Connect and operate an electrical circuit with a;
 1. Resistor
 2. Buzzer
 3. Solenoid
 4. Motor
5. Voltage Measurement
 1. Use an analog voltmeter to measure the voltage at a point referenced to ground
 2. Use a DMM to measure voltage drops in series and parallel circuits
6. Current Measurement
 1. Use a DMM to measure the electrical current
 2. Use a DMM to measure current in series and parallel circuits
7. Resistance Measurement
 1. Use a DMM to measure the resistance of a component
 2. Measure the resistance in series and parallel circuits
 3. Test the continuity of wires using a DMM
8. Power In Series Circuits
 1. Calculate series resistance given each load's resistance
 2. Use Ohm's Law to calculate voltage, current and resistance in a series circuit
 3. Calculate the total power used by a series circuit
9. Power In Parallel Circuits
 1. Calculate the main line current in a parallel circuit
 2. Calculate the total parallel resistance
 3. Calculate the total power used in a parallel circuit
10. Circuit Protection Devices
 1. Operate a circuit using a fuse
 2. Test and replace a fuse
 3. Operate a circuit using a circuit breaker
 4. Test and reset a circuit breaker
11. Electromagnetism
 1. Connect and operate a relay in a circuit
12. Inductance
 1. Calculate the total load on an AC circuit with inductors
13. Capacitance
 1. Discharge a capacitor
 2. Test a capacitor with a DMM
14. Characteristics of Capacitance
 1. Measure the voltage across a charged capacitor

2. Calculate the total load on an AC circuit with capacitors
15. Inductor and Capacitor Applications
 1. Calculate the time to charge and discharge a capacitor
16. Combination Circuit Characteristics
 1. Trace the current path in a combination circuit
 2. Solve a combination circuit
17. Lighting Circuits
 1. Connect and operate a basic lighting circuit
 2. Connect and operate a ceiling fan circuit
 3. Connect and operate a rheostat as a light dimmer
18. Voltage Dividers
 1. Design a voltage divider network
 2. Connect and operate a voltage divider network
19. Troubleshooting
 1. Locate a short circuit
 2. Locate an open circuit
20. Introduction to Transformers
 1. Connect and operate a transformer
 2. Calculate the secondary coil voltage of a transformer
 3. Troubleshoot a transformer by measuring continuity
21. Sizing a Transformer
 1. Size a transformer
 2. Calculate the current load on a transformer
22. Transformer Types
 1. Design a control transformer circuit to provide a given output voltage

9. Course Student Learning Outcomes:

1.

Upon successful completion of this course the student should be able to;

- List the 4 most life threatening hazards on a construction site.
- Describe and apply Ohm's Law.
- Differentiate between Alternating Current and Direct Current.
- Identify 4 types of AC Waveforms.
- Identify 4 types of transformers and explain the theory of operation for each.
- Describe 4 examples of circuit protection devices.

10. Course Objectives: *Upon completion of this course, students will be able to:*

- a. Explain the purpose of OSHA and how it promotes safety on the job.
- b. Develop a plan and a hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task.
- c. Define voltage and identify the ways in which it can be produced.
- d. Explain the difference between conductors and insulators.
- e. Define the units of measurement that are used to measure the properties of electricity.
- f. Identify the meters used to measure voltage, current, and resistance.
- g. Explain the basic characteristics of series and parallel circuits.
- h. Using Kirchhoff's voltage/current law, calculate total current and voltage drop in parallel and series-parallel circuits.
- i. Using Ohm's law, find the unknown parameters in series, parallel and series-parallel circuits.
- j. Determine the allowable ampacity of a conductor for a given application.
- k. Explain the basic layout of a set of construction drawings.

- l. Calculate peak and effective voltage or current values for an AC waveform.
- m. Define capacitive reactance and state how it is affected by frequency.
- n. Distinguish between a short circuit and a ground fault.
- o. Explain the purposes of the grounded conductor (neutral) in the operation of overcurrent devices.
- p. Explain the necessity of overcurrent protection devices in electrical circuits.
- q. Describe the operation of single-element and time delay fuses.
- r. Compute transformer sizes for various applications.
- s. Describe the four general classifications of circuit breakers and list the major circuit breaker ratings.
- t. Describe switch gear construction, metering layouts, wiring requirements, and maintenance.
- u. select electrical conductors for specific applications.
- v. Size conductors for the load.

11. Methods of Instruction: (*Integration: Elements should validate parallel course outline elements*)

- a. Activity
- b. Collaborative/Team
- c. Demonstration, Repetition/Practice
- d. Discussion
- e. Individualized Study
- f. Laboratory
- g. Lecture
- h. Observation
- i. Participation
- j. Technology-based instruction

12. Assignments: (*List samples of specific activities/assignments students are expected to complete both in and outside of class.*)

In Class Hours: 90.00

Outside Class Hours: 72.00

a. In-class Assignments

Students will take lecture notes
Students will complete end of chapter quizzes in required text
Students will form learning teams (4 students per team), select a team spokesperson and begin to develop a learning team written assignment based upon a selected topic related to the power generation industry
Students will handle an use various electrical components outlined in the required reading of the text

b. Out-of-class Assignments

Read assigned Text
Develop industry related journal
Students will complete various wrksheets prepared by instructor. Worksheets will consist of word search and cross word puzzles based upon vocabulary taken directly from the required text readings.
As a team, students will develop a written assignment detailing a person who has been instrumental in our understanding of electrical theories and principles, i.e. Nicola Tesla, Alessandro Volta, Michael Faraday, Georg Ohm, etc.

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*

- Written homework
Written hovework will be measured upon the student's ability to produce a final product that meets the criteria of the assignment, is complete, neat and on time.
- Guided/unguided journals
Students will be graded upon the quality of the industry journals they will create. The journal grading will be based upon the quality, content and neatness of the entries.
- Term or research papers

Research papers will be evaluated upon quality and content.

- Laboratory projects
Student will be graded on practical exams that will derive from the designated labs.
- True/false/multiple choice examinations
Students will be given weekly quizzes on material that was covered in the previous lecture class.
- Student participation/contribution
Students will receive credit for being an active member in lectures, discussions and laboratory exercises.

14. Methods of Evaluating: Additional Assessment Information:

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*

PO - Career and Technical Education

- Fulfill the requirements for an entry- level position in their field.
- Apply critical thinking skills to execute daily duties in their area of employment.
- Apply critical thinking skills to research, evaluate, analyze, and synthesize information.
- Display the skills and aptitude necessary to pass certification exams in their field.
- Exhibit effective written, oral communication and interpersonal skills.

IO - Global Citizenship - Scientific & Technological Literacy

- Utilize quantitative expression in a variety of contexts. These would include units of measurement, visual representations, and scales and distributions.
- Synthesize, interpret, and infer, utilizing information, data, and experience to solve problems, innovate, and explore solutions.
- Produce oral and written information in various modes and media, using technology such as computers, the Internet, and library databases.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
CSU	CSU Chico	EECE 110	Basic Electricity and Instruments	2012

17. Special Materials and/or Equipment Required of Students:

NA

18. Materials Fees: Required Material?

Material or Item	Cost Per Unit	Total Cost
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19. Provide Reasons for the Substantial Modifications or New Course:

Change requisite and entrance skills to Reading 061

20. a. Cross-Listed Course (*Enter Course Code*): *N/A*
- b. Replacement Course (*Enter original Course Code*): *N/A*

21. Grading Method (*choose one*): Letter Grade Only

22. MIS Course Data Elements

- a. Course Control Number [CB00]: CCC000546104
- b. T.O.P. Code [CB03]: 94610.00 - Energy Systems Technology
- c. Credit Status [CB04]: D - Credit - Degree Applicable
- d. Course Transfer Status [CB05]: B = Transfer CSU
- e. Basic Skills Status [CB08]: 2N = Not basic skills course
- f. Vocational Status [CB09]: Clearly Occupational

ESYS 002-Electricity & Electrical Theory

- g. Course Classification [CB11]: Y - Credit Course
- h. Special Class Status [CB13]: N - Not Special
- i. Course CAN Code [CB14]: N/A
- j. Course Prior to College Level [CB21]: Y = Not Applicable
- k. Course Noncredit Category [CB22]: Y - Not Applicable
 - 1. Funding Agency Category [CB23]: A = Fully Economic Development funds
- m. Program Status [CB24]: 1 = Program Applicable

Name of Approved Program (if program-applicable): AIR CONDITIONING AND REFRIGERATION, AIR CONDITIONING AND REFRIGERATION, ENERGY SYSTEMS TECHNOLOGY

Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)

23. Enrollment - Estimate Enrollment

First Year: 48

Third Year: 75

24. Resources - Faculty - Discipline and Other Qualifications:

- a. Sufficient Faculty Resources: Yes
- b. If No, list number of FTE needed to offer this course: N/A

25. Additional Equipment and/or Supplies Needed and Source of Funding.

Seven (7) Portable AC/DC Electrical Learning Systems

Three (3) Table-top AC/DC Electrical Learning Systems

Twenty (20) Multimedia Courseware packages to support AC/DC Electrical Learning Systems.

Various wire and cable sections

Various fuses and breakers

Various low voltage transformers

Funding Source - Workforce Innovation Partnership Grant

26. Additional Construction or Modification of Existing Classroom Space Needed. (Explain:)

NA

27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES

Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes

28. Originator Gary Bergstrom Origination Date 11/10/17