COURSE SYLLABUS

LAST REVIEW	Fall 2022
COURSE TITLE	Generators and Transformers
COURSE NUMBER	ELET 0265
DIVISION	Career and Technical Education
DEPARTMENT	ELET
CIP CODE	46.0302
CREDIT HOURS	2
CONTACT HOURS/WEEK	Class: 2 Lab: 0
PREREQUISITES	ELET 0101 Electromechanical Systems

COURSE DESCRIPTION

This is an advanced course on the use of generators, transformers, and motors. Upon successful completion of this course, the student should be able to interpret and apply the rules of the current National Electrical Code to wiring systems composed of these electrical components. Also, the student will gain a working knowledge of the theory of these single-phase and 3-phase electrical components and their practical applications in everyday use in the electrical industry.

PROGRAM ALIGNMENT

This course is part of a program aligned through the Kansas Board of Regents and Technical Education Authority. For more information, please visit: https://kansasregents.org/workforce_development/program-alignment

PROGRAM LEARNING OUTCOMES

1. The Student will be able to identify workplace safety issues in accordance with OSHA standards.
2. Upon successful completion of this course, the student should be able to identify the job skills necessary to have a successful career in the Electrical Profession.
3. Inspect electrical circuit connections in accordance with the N.E.C. standards of compliance.

TEXTBOOKS

http://kckccbookstore.com/

METHOD OF INSTRUCTION

A variety of instructional methods may be used depending on content area. These include but are not limited to lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

COURSE OUTLINE

I. Generators
  A. Generator Principles
    i. Explain the basic operation of a generator.
    ii. Explain the use of brushes and commentators in generators.
    iii. Differentiate between single-phase output power and three-phase output power.
    iv. Differentiate between a generator and a motor.
    v. Explain the difference between a wye connected system and a delta connected system.
    vi. Explain how to properly locate a generator for installation using the requirements of the NEC.
    vii. Calculate the size of the over-current protection device for a generator.
    viii. Calculate the conductor size for a generator.
  B. Emergency System Generators and the National Electrical Code
    i. Explain the purpose of the emergency system generator.
    ii. Explain how to size an emergency system generator.
    iii. Explain the use of a transfer switch.
  C. Legally Required and Optional Stand-by Systems
    i. Explain the purpose of a legally required generator system.
    ii. List the requirements of the NEC pertaining to transfer switches and its related equipment.
    iii. List the requirements of the NEC for over-current protection devices and grounding that pertain to transfer switches, NEC Article 701.
  D. Generators Supplying Essential Loads for Hospitals
    i. Explain the requirements for emergency systems.
    ii. Differentiate a life safety branch circuit and a critical branch circuit.
    iii. Explain an isolated power system.
    iv. List the NEC requirements for generator grounding for 480-volt to 1,000-volt systems, NEC Article 517.
    v. Explain the methods of high-impedance grounding.
II. Transformers
  A. Transformer Theory
    i. List the primary components of a transformer.

ii. Explain turns-ratio in transformer windings.
iii. Explain the characteristics of a wye-connected three-phase transformer.
iv. Explain the characteristics of a delta-connected three-phase transformer.
v. Describe an open-delta connected transformer.
vi. Explain the purpose of balancing loads on single-phase and three-phase transformer windings.
vii. Explain the purpose of de-rating a transformer in a high-altitude.

B. Installing Transformers, NEC Article 450
i. Describe the markings on a transformer nameplate.
ii. Explain the NEC requirements for transformer guarding and ventilation.
iii. Explain the NEC requirements for clearances of dry-type
iv. transformers installed indoors.
v. Explain the different NEC requirements for transformer vaults.
vi. Explain the different types of liquid materials used as transformer insulation and the NEC requirements for each.
vii. Explain the NEC requirements for construction of transformer vaults.
viii. Explain the NEC requirements for doorways in a transformer vault.
ix. List the NEC requirements for ventilation openings, drainage, and storage in a transformer vault.

C. Sizing Transformers and Connections
i. Size the kVA rating of a transformer using wye-connected secondaries.
ii. Size the kVA rating of a transformer using closed delta-connected secondaries.
iii. Size the kVA rating of a transformer using open delta-connected secondaries.
iv. Explain the use of the ten-foot tap rule and the twenty-five-foot tap rule for transformer secondaries.

D. Protecting Transformers
i. Calculate the current rating in the primary and secondary winding of a transformer.
ii. Calculate the available fault current in a transformer.
iii. Explain the NEC requirements for over-current protection in transformers rated over 600 volts.
iv. Explain the NEC requirements for over-current protection in transformers rated less than 600 volts.
v. Explain the NEC requirements for grounding transformers.

E. Secondary Ties
i. Define a secondary tie circuit.
ii. Explain the NEC requirements for tie circuit protection.

iii. Define a radial supply system.
iv. Explain a loop supply system.
v. Define a bus-tie loop.

F. Windings and Components
i. Explain how to test a transformer winding for continuity.
ii. Define an additive type and subtractive type winding.
iii. Explain how to test a transformer winding for polarity.
iv. Differentiate phase-to-phase voltage and phase-to-ground voltage.
v. Identify the high voltage and low voltage connections.
vi. Demonstrate how to connect a three-phase, closed delta system and a three-phase, open delta system
vii. Demonstrate how to connect a three-phase, four wire, wye system.
viii. Show how to connect a three-phase, corner grounded delta system.

COURSE LEARNING OUTCOMES AND COMPETENCIES
Upon successful completion of this course, the student will:

A. Design a three-phase generator installation using a wye connected system and a delta connected system to include calculating the size of the over-current protection device, the conductor size and the NEC requirements for grounding.
1. Define wye connection generator.
2. Define delta connection generator.
3. Determine load requirement for wye generator.
4. Determine load requirement for delta generator.
5. Ground generator according to NEC.

B. Design a three-phase transfer switch installation and its required branch circuits for a legally required generator system.
6. Explain a three-phase transfer switch.
7. Wire a three-phase transfer switch.
8. Test a three-phase transfer switch.

C. Explain the operating principle of a three-phase transformer.
9. Explain a three-phase transformer.
10. Connect a three-phase transformer.
11. Test input voltage.
12. Test output voltage.

D. Design a three-phase transformer installation to include the proper KVA rating of the transformer, over-current protection, conductor size and proper grounding using the requirements of the NEC.
13. Explain three-phase transformer rating system.
14. Determine maximum voltage output.

15. Ground transformer as required by NEC
16. Determine conductor size.
17. Determine over-current protection.

E. Demonstrate how to connect a three-phase, four wire, wye connected transformer and the NEC requirements for bonding, grounding electrode conductors and grounding electrodes.
18. Explain connections for three-phase four wire wye transformer.
19. Explain grounding and bonding according to NEC.

ASSESSMENT OF COURSE LEARNING OUTCOMES AND COMPETENCIES

Student progress is evaluated through both formative and summative assessment methods. Specific details may be found in the instructor's course information document.

COLLEGE POLICIES AND PROCEDURES

Student Handbook
https://www.kckcc.edu/files/docs/student-resources/student-handbook-and-code-of-conduct.pdf

College Catalog
https://www.kckcc.edu/academics/catalog/index.html

College Policies and Statements
https://www.kckcc.edu/about/policies-statements/index.html

Accessibility and Accommodations
https://www.kckcc.edu/academics/resources/student-accessibility-support-services/index.html.