SYLLABUS

DATE OF LAST REVIEW: 02/2013
CIP CODE: 46.0302
SEMESTER: Departmental Syllabus
COURSE TITLE: Generators and Transformers
COURSE NUMBER: ELET0265
CREDIT HOURS: 2
INSTRUCTOR: Departmental Syllabus
OFFICE LOCATION: Departmental Syllabus
OFFICE HOURS: Departmental Syllabus
TELEPHONE: Departmental Syllabus
EMAIL: KCKCC issued email accounts are the official means for electronically communicating with our students.

PREREQUISITE (S): ELET0101 Electromechanical Systems

REQUIRED TEXT AND MATERIALS: Please check with the KCKCC TEC bookstore, http://www.kckccbookstore.com, for the required texts for your particular class.

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.
METHOD OF INSTRUCTION:

A variety of instructional methods may be used depending on content area. These may include but are not limited to lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, and 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
      1. Explain the basic operation of a generator.
      2. Explain the use of brushes and commentators' in generators.
      3. Differentiate between single-phase output power and three-phase output power.
      4. Differentiate between a generator and a motor.
      5. Explain the difference between a wye connected system and a delta connected system.
      6. Explain how to properly locate a generator for installation using the requirements of the NEC.
      7. Calculate the size of the over-current protection device for a generator.
      8. Calculate the conductor size for a generator.
   B. Emergency System Generators and the National Electrical Code
      1. Explain the purpose of the emergency system generator.
      2. Explain how to size an emergency system generator.
      3. Explain the use of a transfer switch.
   C. Legally Required and Optional Stand-by Systems
      1. Explain the purpose of a legally required generator system.
      2. List the requirements of the NEC pertaining to transfer switches and its related equipment.
      3. 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
      1. Explain the requirements for emergency systems.
      2. Differentiate a life safety branch circuit and a critical branch circuit.
      3. Explain an isolated power system.
      4. List the NEC requirements for generator grounding for 480 volt to 1,000 volt systems, NEC Article 517.
5. Explain the methods of high-impedance grounding.

II. Transformers
   A. Transformer Theory
      1. List the primary components of a transformer.
      2. Explain turns-ratio in transformer windings.
      3. Explain the characteristics of a wye-connected three-phase transformer.
      4. Explain the characteristics of a delta-connected three-phase transformer.
      5. Describe an open-delta connected transformer.
      6. Explain the purpose of balancing loads on single-phase and three-phase transformer windings.
      7. Explain the purpose of de-rating a transformer in a high-altitude.

   B. Installing Transformers, NEC Article 450
      1. Describe the markings on a transformer nameplate.
      2. Explain the NEC requirements for transformer guarding and ventilation.
      3. Explain the NEC requirements for clearances of dry-type transformers installed indoors.
      4. Explain the different NEC requirements for transformer vaults.
      5. Explain the different types of liquid materials used as transformer insulation and the NEC requirements for each.
      6. Explain the NEC requirements for construction of transformer vaults.
      7. Explain the NEC requirements for doorways in a transformer vault.
      8. List the NEC requirements for ventilation openings, drainage, and storage in a transformer vault.

   C. Sizing Transformers and Connections
      1. Size the kVA rating of a transformer using wye-connected secondaries.
      2. Size the kVA rating of a transformer using closed delta-connected secondaries.
      3. Size the kVA rating of a transformer using open delta-connected secondaries.
      4. Explain the use of the ten-foot tap rule and the twenty-five foot tap rule for transformer secondaries.

   D. Protecting Transformers
      1. Calculate the current rating in the primary and secondary winding of a transformer.
      2. Calculate the available fault current in a transformer.
      3. Explain the NEC requirements for over-current protection in transformers rated over 600 volts.
      4. Explain the NEC requirements for over-current protection in transformers rated less than 600 volts.
5. Explain the NEC requirements for grounding transformers.

E. Secondary Ties
   1. Define a secondary tie circuit.
   2. Explain the NEC requirements for tie circuit protection.
   3. Define a radial supply system.
   4. Explain a loop supply system.
   5. Define a bus-tie loop.

F. Windings and Components
   1. Explain how to test a transformer winding for continuity.
   2. Define an additive type and subtractive type winding.
   3. Explain how to test a transformer winding for polarity.
   4. Differentiate phase-to-phase voltage and phase-to-ground voltage.
   5. Identify the high voltage and low voltage connections.
   6. Demonstrate how to connect a three-phase, closed delta system and a three-phase, open delta system
   7. Demonstrate how to connect a three-phase, four wire, wye system.
   8. Show how to connect a three-phase, corner grounded delta system.

EXPECTED LEARNER OUTCOMES:

1. The student will be able to 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.
2. The student will be able to design a three-phase transfer switch installation and its required branch circuits for a legally required generator system.
3. The student will be able to explain the operating principle of a three-phase transformer.
4. The student will be able to 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.
5. The student will be able to demonstrate how to connect a three-phase, four wire, wye connected transformer and the NEC requirements for bonding, grounding electrode conductors and grounding electrodes.

CORE COMPETENCIES:

Upon successful completion of this course:

The student will be able to 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. The student will be able to define wye connection generator.
2. The student will be able to define delta connection generator.
3. The student will be able to determine load requirement for wye generator.
4. The student will be able to determine load requirement for delta generator.
5. The student will be able to ground generator according to NEC.

   The student will be able to design a three-phase transfer switch installation and its
   required branch circuits for a legally required generator system.

6. The student will be able to explain a three-phase transfer switch.
7. The student will be able to wire a three-phase transfer switch.
8. The student will be able to test a three-phase transfer switch.

   The student will be able to explain the operating principle of a three-phase transformer.
9. The student will be able to explain a three-phase transformer.
10. The student will be able to connect a three-phase transformer.
11. The student will be able to test input voltage.
12. The student will be able to test output voltage.

   The student will be able to 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. The student will be able to explain three-phase transformer rating system.
14. The student will be able to determine maximum voltage output.
15. The student will be able to ground transformer as required by NEC
16. The student will be able to determine conductor size.
17. The student will be able to determine over-current protection.

   The student will be able to 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. The student will be able to explain connections for three-phase four wire wye transformer.
19. The student will be able to explain grounding and bonding according to NEC.

ASSESSMENT OF LEARNER OUTCOMES:

Student progress is evaluated by means that include, but are not limited to, exams, written
assignments, and class participation.

SPECIAL NOTES:

This syllabus is subject to change at the discretion of the instructor. Material included is intended
to provide an outline of the course and rules that the instructor will adhere to in evaluating the
student's progress. However, this syllabus is not intended to be a legal contract. Questions
regarding the syllabus are welcome anytime.
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