SOUTHWESTERN ILLINOIS COLLEGE

**COURSE SYLLABUS**

**EET 243: Electrical Code Calculations**

## GENERAL INFORMATION

**Instructor**:

**Class time**:

**Semester hours:** 3 **Lecture Hours:** 3  **Lab Hours:** 0

**Class Location:**

**Phone:**

**Toll Free in Illinois:** 1-800-222-5432

**Office Hours**:

**Office:**

**E-mail:**

**Website:** www.swic.edu

### COURSE DESCRIPTION

Course is designed to provide the student with the basic knowledge and skills necessary to calculate residential, commercial, industrial and/or specialized electrical equipment, material and component sizes and quantities to achieve safe and effective electrical systems that comply with the National Electrical Code.

### PREREQUISITES

GT 104 and EET 131 or consent of the coordinator

**COURSE OBJECTIVES:**

Upon successful completion of this course, the student will be able to meet the following objectives:

* Perform and evaluate Electrical Calculations for:
	+ Multiwire Circuits
	+ Alternating Current Power
	+ Motors and Transformers
	+ Raceways and Boxes
	+ Conductor Sizing and Protection
	+ Motors and Air Conditioners
	+ Voltage Drop
	+ Dwelling Units
	+ Multifamily Dwelling Units
	+ Commercial Buildings
	+ Three Phase Transformers

**COURSE COMPETENCIES:**

**Cognitive Domain:**

Upon successful completion of this course, the student will be able to:

* Know the rules and regulations governing the calculations of electrical residential and commercial systems and equipment.
* Explain the correct procedures for calculating electrical circuits and equipment sizes.
* Know how to read and interpret electrical equipment specifications.

**Psychomotor Domain:**

Upon successful completion of this course, the student will be able to:

* Calculate the sizes of electrical residential and commercial systems and equipment.
* Select proper electrical residential and commercial systems equipment and components.
* Demonstrate the ability to evaluate residential and commercial electrical systems and circuits for proper sizing and compliance with the National Electrical Code.

**TEXTBOOK(S) AND OTHER REQUIRED MATERIALS**

1.Holt, Mike (2011). Electrical Exam Preparation, FL: Mike Holt Enterprises, Inc.

2. National Fire Protection Association, 2011 National Electric Code.

**GRADING PROCEDURE**

A= 100-90

B= 89-80

C= 79-70

D= 69-60

F= 60 and below

### ATTENDANCE POLICY

College Policy: You are expected to be present for all assigned classes, lectures or laboratory sessions. If you are absent, you must show your instructor that your absence has been for a good cause. If you are absent more times during the semester that the number of times the class meets per week, you may be dropped from the course at the discretion of the instructor. When a student is dropped by an instructor with an effective date before the midterm date of the class a “W” will be recorded. When a student is dropped for non-attendance by an instructor with an effective date after the midterm date, the instructor will have the prerogative to assign a grade of “WF” or “W”.

### ADDITIONAL INFORMATION

**Disability & Access Center** - Students with disabilities who believe that they may need accommodations are encouraged to contact the Disability & Access Center at 618-222-5368 or 618-234-3347 (TDD) to ensure that such accommodations are implemented in a timely fashion.

**Student Learning Outcomes** - The assessment of student learning is an integral part of the educational experience at Southwestern Illinois College. To this end, the faculty continually assess student learning to improve student success. Occasionally you will be requested to participate in college-wide and discipline specific assessment activities. Please take these assessments seriously. The data that is collected will provide valuable information to faculty and will be used to improve student learning at SWIC.

**Academic Dishonesty-College Policy -** Academic misconduct includes, but is not limited to cheating, plagiarism and forgery, failure or refusal to follow clinical practice standards, and soliciting, aiding, abetting, concealing, or attempting such acts. Plagiarism is defined as the act of representing the work of another as one’s own. Plagiarism may consist of copying, paraphrasing, or otherwise using written or oral work of another without proper acknowledgment of the source or presenting oral or written material prepared by another as one’s own.

**Phones in Classroom** – All cell phones and electronic devices should be turned off or silenced prior to entering the classroom.

**Academic Rigor Statement -** You are enrolled in an academically rigorous college course. Your success in this course will require a significant investment of time outside of the class. According to the Administrative Rules of the Illinois Community College Board (section 1501.309), it is assumed that the student will invest two hours of outside study time for each hour of classroom lecture time and one hour of outside study time for each two hour laboratory session.

# **Policy for Inclement Weather Conditions – D**uring times of inclement weather, Southwestern Illinois College has three options for dealing with the situation: cancel classes and cease all business, exercise the delayed-start option, or keep the college open. If the college chooses to use the delayed-start option rather than close, **the college will open at 10 a.m.** The decision to cancel classes or exercise the delayed-start option will be posted on the home page of Southwestern’s Web site at [www.swic.edu](http://www.swic.edu/) as well as broadcast on FOX 2 (KTVI), KMOV-TV Channel 4, KSDK-TV Channel 5, and radio stations KMOX-AM 1120 and WIL-FM 92.3.

**SWIC Know online orientation** - All new students are encouraged to participate in the SWIC Know online orientation, where students learn about the many programs and services available to help them succeed in college.  SWIC know orientation can be found at eSTORM.SWIC.edu.

**TOPICAL OUTLINE/SCHEDULE**

1. **MULTIWIRE BRANCH CIRCUITS**
	1. Neutral Conductor
	2. Grounded Conductor
	3. Current Flow on the Neutral Conductor
	4. Balanced Systems
	5. Unbalanced Current
	6. Multiwire Branch Circuits
	7. Dangers of Multiwire Branch Circuits
	8. NEC Requirements
2. ALTERNATING CURRENT
	1. Apparent Power (Volt-Amperes)
	2. True Power (Watts)
	3. Power Factor
	4. Unity Power Factor
	5. Power Factor Formulas
	6. Cost of True Power
	7. Effects of Power Factor
	8. Efficiency Formulas
3. MOTORS AND TRANSFORMERS
	1. Motor Principles
	2. Dual-Voltage Alternating-Current Motors
	3. Motor Horsepower Ratings
	4. Motor Current Ratings
	5. Calculating Motor FLA
	6. Motor-Starting Current
	7. Motor-Running Current
	8. Motor Locked-Rotor Current (LRC)
	9. Motor Overload Protection
	10. Direct-Current Motor Principles
	11. Direct-Current Motor Types
	12. Reversing the Rotation of a Direct-Current Motor
	13. Alternating-Current Induction Motor
	14. Alternating-Current Motor Types
	15. Reversing the Rotation of an Alternating-Current Motor
	16. Transformer Basics
	17. Transformer Secondary Induced Voltage
	18. Transformer Efficiency
	19. Transformer Turns Ratio
	20. Autotransformers
	21. Transformer Power Losses
	22. Transformer kVA Rating
	23. Transformer Current Flow
	24. Transformer Current Rating
4. RACEWAY AND BOX CALCULATIONS
	1. NEC Chapter 9 Tables
	2. Raceway Calculations
	3. Wireways
	4. Sizing Box—Conductors All the Same Size [NEC Table 314.16(A)]
	5. Conductor Equivalents
	6. Outlet Box Sizing [NEC Art 314.16(B9)]
	7. Pull/Junction Box Sizing Requirements
5. CONDUCTOR SIZING AND PROTECTION CALCULATIONS
	1. Conductor Insulation [NEC Table 310.104(A)]
	2. Conductor Sizing [NEC Art. 110.6]
	3. Smallest Conductor Size [NEC Art. 310.106(A)]
	4. Conductor Size—Terminal Temperature Rating [NEC Art. 110.14)]
	5. Conductors in Parallel
	6. NEC Requirements for Conductors in Parallel [NEC Art. 310.10(H)]
	7. Overcurrent Protection [NEC Art. 240]
	8. Overcurrent Protection of Conductors—General Requirements [NEC Art. 240.4]
	9. Overcurrent Protection of Conductors—Specific Requirements
	10. Conductor Ampacity
	11. Ambient Temperature Correction Factors [NEC Table 310.15(B)(2)(a)]
	12. Conductor Bundling Ampacity Adjustment Factors [NEC Table 310.15(B)(3)(a)]
	13. Ambient and Conductor Bundling Adjustment
	14. Current-Carrying Conductors
	15. Wireway Conductor Ampacity [NEC Art. 376.22(B)]
	16. Conductor Sizing Summary
	17. NEC Article 690 Solar PV systems Maximum Voltage [NEC Art. 690.7]
	18. NEC Article 690 Solar PV systems Circuit Sizing and Protection [NEC Art. 690.8]
	19. NEC Article 690Solar PV systems Overcurrent Protection [NEC Art. 690.9]
6. MOTOR AND AIR-CONDITIONING CALCULATIONS
	1. Article 430 FLC versus Motor Nameplate
	2. Highest Rated Motor [NEC Art. 430.17]
	3. Branch-Circuit Conductor Size
	4. Feeder Conductor Size [NEC Art. 430.24]
	5. Overload Protection [NEC Art. 430.6(A)(2) and 430.32(A)]
	6. Branch-Circuit Short-Circuit and Ground-Fault Protection [NEC Art. 430.51]
	7. Branch-Circuit Summary
	8. Feeder Protection [NEC Art. 430.62]
	9. Motor VA Calculations
	10. NEC Article 440
	11. Other Articles related to Air-conditioning
	12. Short-Circuit and Ground-Fault Protection
	13. Conductor Sizing for a Single Motor-Compressor
7. VOLTAGE-DROP CALCULATIONS
	1. Conductor Resistance
	2. Conductor Resistance—Direct-Current Circuits [NEC Chapter 9, Table 8]
	3. Conductor Resistance—Alternating-Current Circuits
	4. Alternating-Current Resistance
	5. Alternating-Current Resistance as Compared to Direct-Current Resistance
	6. NEC Voltage-Drop Recommendations
	7. Determining Circuit Conductors’ Voltage Drop—Ohm’s Law Method
	8. Determining Circuit Conductors’ Voltage Drop— Formula Method
	9. Sizing Conductors to Prevent Excessive Voltage Drop
	10. Limiting Conductor Length to Minimize Voltage Drop
	11. Limiting Current to Limit Voltage Drop
8. DWELLING UNIT CALCULATIONS
	1. General Requirements
	2. Voltages [NEC Art. 220.5(A)]
	3. Fraction of an Ampere [NEC Art. 220.5(B)]
	4. Lighting and Receptacles
	5. Cooking Equipment—Branch Circuit [NEC Table 220.55, Note 4]
	6. Dwelling Unit Feeder/Service Load Calculations (Article 220, Part III)
	7. Dwelling Unit Example
	8. Dwelling Unit Optional Calculations [NEC Art. 220.82]
	9. Optional Calculation Example
	10. Neutral Calculations [NEC Art. 220.61]
	11. Grounding and Bonding of Service Equipment
9. MULTIFAMILY DWELLING CALCULATIONS
	1. Multifamily Dwelling Calculations—General
	2. Multifamily Dwelling Calculations—Standard Method Example
	3. Multifamily Dwelling Unit Calculations [NEC Art. 220.84]— Optional Method
	4. Two-Family Dwelling Units [NEC Art. 220.85]
10. COMMERCIAL CALCULATIONS
	1. General Requirements
	2. Conductor Ampacity [NEC Article 100]
	3. Conductor Overcurrent Protection [NEC Art. 240.4]
	4. Voltages [NEC Art. 220.5(A)]
	5. Fractions of an Ampere [NEC Art. 220.5(B)]
	6. Lighting—Demand Factors [NEC Tables 220.12 and 220.42]
	7. Lighting Without Demand Factors [NEC Art. 215.2(A) (1), 230.42(A)(1), and Table 220.12]
	8. Sign Circuit [NEC Art. 220.14(F) and 600.5]
	9. Lighting—Miscellaneous
	10. Multioutlet Receptacle Assembly [NEC Art. 220.14(H)]
	11. Receptacle VA Load
	12. Banks and Offices—General Lighting and Receptacles [NEC Art. 220.14(K)]
	13. Bank/Office Building Example
	14. Mobile/Manufactured Home Park [NEC Art. 550.31]
	15. Recreational Vehicle Park [NEC Art. 551.73]
	16. Marina [NEC Art. 555.12]
	17. New Restaurant—Optional Method [NEC Art. 220.88]
	18. Arc Welders
	19. Resistance Welders
	20. Light Industrial Calculation
11. THREE PHASE TRANSFORMER CALCULATIONS
	1. Transformer Basics
	2. Secondary Induced Voltage
	3. Autotransformers
	4. Power Losses
	5. Efficiency
	6. Delta/Delta Connected Transformers
	7. Delta/Wye Connected Transformers
	8. Transformer Turns Ratio
	9. Transformer kVA Rating
	10. Current Flow
	11. Line Currents
	12. Transformer Overcurrent Protection
	13. Primary Conductor Sizing
	14. Secondary Conductor Sizing
	15. Grounding and Bonding

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