

COURSE OUTLINE

Mathematics for Electrical and Electronics

Course Title

ET 103

Dept & Course No.

COURSE DESCRIPTION

This course is designed to fulfill mathematical needs of students taking electrical technology and general electronics technology. It covers unit conversion, Ohm's Law, Kirchoff's Law, Power Law, power and energy calculations, wire resistance and voltage drops, AC circuit calculations, AC power and power factor calculations.

SEMESTER CREDIT: 3

I. CONTACT HOURS PER WEEK:

<u>2</u>	<u>3</u>	<u>5</u>
Lecture	Lab	Total

II. PREREQUISITE: None

III. STUDENT LEARNING OUTCOME:

Upon completion of the course, the students will be able to, with 65% accuracy to;

1. Demonstrate ability to convert unit from one form to another.
2. Demonstrate ability to calculate problems involving Ohm's Law.
3. Demonstrate ability to solve problems involving Power Law.
4. Demonstrate ability to apply principles of Kirchoff's law in the circuit.

IV. COURSE CONTENT

- A. Conversion of units
 - 1) Length
 - 2) Volume
 - 3) Weight
 - 4) Temperature
 - 5) Powers of ten
 - 6) Units of measurements in electrical/electronics
- B. Ohm's law
 - 1) Fraction
 - 2) Decimal fraction
 - 3) Series circuit
 - 4) Parallel circuit
 - 5) Combination circuit
 - 6) Solving Ohm's law problems
 - 7) Extending range of an ammeter
 - 8) Reading ammeters of extended range
 - 9) Extending the range of voltmeter
 - 10) Voltage dividers
 - 11) Resistance measurements by the voltage comparison method
- C. Power law
 - 1) Square root
 - 2) Exponents
 - 3) Solving power law problems
- D. Algebra for complex electrical circuits
 - 1) Combining like terms
 - 2) Combining unlike terms
 - 3) Solving simple equation using algebraic expressions
 - 4) Solving equation by transposition method

- and cross multiplication
 - 5) Integers - positive and negative numbers
 - 6) Combining unlike terms involving signed numbers
 - 7) Multiplying and dividing sign quantities
 - 8) Removing parenthesis
 - 9) Solving equations which have unknowns and numbers on both side of the equality sign
 - 10) Solving equations with possible negative answers
 - 11) Solving equations containing parenthesis
 - 12) Solving equations containing fractions
 - 13) Solving simultaneous equations by addition
 - 14) Solving simultaneous equations by substitution
 - E. Kirchhoff's law
 - 1) Kirchhoff's first law
 - 2) Kirchhoff's second law
 - 3) Kirchhoff's law in series circuit
 - 4) Kirchhoff's law in parallel circuit
 - 5) Kirchhoff's law in complex circuit
 - F. Electrical Energy
 - 1) Finding mechanical and electrical energy
 - 2) Cost of electrical energy
 - G. Wire calculations
 - 1) Ratio and proportion
 - 2) American wire gage table
 - 3) Resistance of wire of different materials
 - 4) Resistance of wire of different length
 - 5) Resistance of wire of different areas
 - 6) Resistance of wire of, any diameter, any length or any material
 - 7) Finding the length of wire needed to make a certain resistance
 - 8) Finding the diameter of wire needed to make a certain resistance
 - H. Size of wiring
 - 1) Maximum current carrying capacity of wire
 - 2) Finding the minimum size of wire to supply a given load
 - 3) Finding the size of wire to needed to prevent excessive voltage drops
 - I. Trigonometry for Alternating current circuits
 - 1) Trigonometric function of right angles
 - 2) Using the table of trigonometric functions
 - 3) Finding the acute angles of the right triangles
 - 4) Finding the sides of a right triangle
 - J. Introduction to AC electricity
 - 1) Graphs
 - 2) The generation of an AC voltage
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- 5. Estimate electrical energy consumed through the given loads and power rating
 - 6. Demonstrate ability to calculate wire resistance and voltage drops.
 - 7. Demonstrate ability to perform AC circuits calculations.

8. Demonstrate ability to perform inductance and transformer calculations

9. Demonstrate ability to perform capacitance calculation.

10. Demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits.

11. Demonstrate ability to calculate alternating current power and power factor

- 3) Instantaneous values
 - 4) Maximum values
 - 5) Phase angle of an AC wave
 - 6) Effective value of an AC wave
- K. Inductance and transformer calculations
- 1) Inductance of a coil
 - 2) Reactance of a coil
 - 3) The square and square root of powers of ten
 - 4) Impedance of a coil
 - 5) Measuring the inductance of a coil
 - 6) Introduction to transformer
 - 7) Current in a transformer
 - 8) Efficiency of a transformer
- L. Capacitance calculation
- 1) Introduction to capacitance
 - 2) Capacitors in parallel
 - 3) Capacitors in series
 - 4) Reactance of a capacitor
 - 5) Impedance of a capacitor
 - 6) Measurement of capacity
- M. Series AC circuits
- 1) Simple series AC circuit
 - 2) The Pythagorean Theorem
 - 3) Resistance and inductance in series
 - 4) Resistance and capacitance in series
 - 5) Resistance, inductance and capacitance in series
 - 6) Series resonance
 - 7) Finding inductance or capacitance needed to make a series resonant circuit
- N. Parallel AC circuits
- 1) Simple parallel AC circuit
 - 2) Resistance and inductance in parallel
 - 3) Resistance and capacitance in parallel
 - 4) Resistance, inductance and capacitance in parallel – the equivalent series circuit
 - 5) Resolution of phasors
 - 6) Parallel-series AC circuits
 - 7) Series-parallel AC circuits
 - 8) Parallel resonance
- O. Alternating current power
- 1) Power and power factor
 - 2) Resistive loads
 - 3) Inductive loads
 - 4) Capacitive loads
 - 5) Combination of resistive, inductive and capacitive loads
 - 6) Power factor correction

V. MATERIALS AND EQUIPMENT

- A. Classroom materials and equipment
- B. calculator

VI. TEXT AND REFERENCES

- A. *Required Text*
Singer, Bertrand B. **BASIC MATHEMATICS FOR ELECTRICAL AND ELECTRONICS 8th Edition**, McGraw-Hill Book Company: 1999.

VII. METHOD OF INSTRUCTION

- A. Lecture-discussion
- B. Demonstration
- C. Peer teaching

VIII. METHOD OF EVALUATION

- A. Knowledge will be evaluated using the following methods:
 - 1. Written test
 - 2. Graded recitation/Oral presentation
- B. Midterm and final grade are computed and weighted using the following criteria:

Class participation.....	10%
Quizzes/Assignments.....	30%
Chapter Test.....	30%
Midterm/Final Exams.....	30%
TOTAL	100%
- C. Transmutation of total percent to letter grade:

90-100%.....	A
80-89%.....	B
70-79%.....	C
65-69%.....	D
00-64%.....	F

TASK LISTING

ET 103

Course No. Title

Credit:

2

Lec

1

Lab

48

Total Lab Hrs

STUDENT LEARNING OUTCOMES	Allotted Hours
<p>1. Demonstrate ability to convert unit from one form to another</p> <ul style="list-style-type: none"> a. Convert small unit to large unit and vice versa. b. Convert metric to English units and vice versa c. Multiply and divide by positive and negative powers of 10 d. Multiply and divide by powers of 10 	3
<p>2. Demonstrate ability to calculate problems involving Ohm's Law</p> <ul style="list-style-type: none"> a. Demonstrate how electrical energy is produced through different sources. b. Simplify a fraction. c. Change mixed number to an improper fraction. d. Change an improper fraction to a mixed number. e. Multiply fractions and mixed numbers. f. Convert fractions and mixed fractions to decimal. g. Add, subtract, multiply and divide decimals. h. Apply Ohm's Law to find the voltage in the circuit. i. Convert fraction to decimal and vice versa. j. Solve problems involving Ohm's Law 	10
<p>3. Demonstrate ability to solve problems involving Power Law</p> <ul style="list-style-type: none"> a. Add/Subtract signed numbers b. Multiply/Divide signed numbers c. Solve mathematical expression using correct order of operation. d. Work with formulas containing exponent e. Calculate electric power using using exponential power formulas. f. Determine the square root of a number g. Determine the square root of a power of 10 	3
<p>4. Demonstrate ability to apply principles Kirchhoff's Law in the circuit.</p> <ul style="list-style-type: none"> a. Combine like and unlike terms b. Solve simple algebraic expressions for the value of unknown variable c. Use method of cross multiplication and transposition to solve an equation for the value of unknown variable d. Solve equations containing fractions e. Solve simultaneous equations using addition and substitution method. f. Apply Kirchhoff's Voltage Law to find the unknown voltage and current in series circuit g. Apply Kirchhoff's Voltage Law to find the unknown voltage, current and resistance in parallel circuit. h. Apply Kirchhoff's Law to solve for the unknown values of voltage and current in complex electric circuit. 	5
<p>5. Estimate electrical energy consumed through the given loads and power rating.</p> <ul style="list-style-type: none"> a. Write percent to decimal and decimal to percent. b. Write fraction as percent c. Find percent, base and rate using the formula $P=B \times R$ d. Use conversion factors to change from one unit of electric/mechanical power to another. e. Use formula to determine the efficiency of machine f. Find the output and input power of an electric machine g. Determine the maximum transfer of power from a source to a load 	3

<p>6. Demonstrate ability to calculate wire resistance and voltage drops.</p> <ul style="list-style-type: none"> a. Solve problems involving ratio and proportions. b. Use wire table to find the appropriate wire size c. Determine the resistance of wires of different materials. d. Determine the resistance of wires of different length. e. Determine the resistance of wires of different areas. f. Determine the resistance of wires of different diameters, lengths and materials. g. Find the length of a wire of that produces a given resistance. h. Find the diameter of a wire of that produces a given resistance. i. Use the temperature coefficient of resistance to find resistance at a different temperature. j. Find wire size to prevent excessive voltage drop. k. Find the minimum wire size to supply a given load. l. Determine ampacity of wires. 	5
<p>7. Demonstrate ability to perform AC circuits calculations</p> <ul style="list-style-type: none"> a. Use trigonometric functions to solve problem. b. Solve problems involving Pythagorean Theorem c. Determine the effective value of an AC wave d. Find instantaneous values, maximum values and phase angles of an AC wave. 	2
<p>8. Demonstrate ability to perform inductance and transformer calculations</p> <ul style="list-style-type: none"> a. Find the current values in a transformer b. Calculate inductance/inductive reactance in a circuit c. Determine the efficiency of a transformer. d. Perform calculations involving transformation ratio. 	5
<p>9. Demonstrate ability to perform capacitance calculation.</p> <ul style="list-style-type: none"> a. Find the total capacitance of parallel capacitors. b. Find the total capacitance of series capacitors. c. Determine the reactance of a capacitor. 	5
<p>10. Demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits.</p> <ul style="list-style-type: none"> a. Calculate series R-L, R-C and R-L-C circuits. b. Calculate phase angle c. Calculate resonant circuits. 	5
<p>11. Demonstrate ability to calculate alternating current power and power factor</p> <ul style="list-style-type: none"> a. Determine power and power factor in an AC circuit b. Determine the total power drawn by reactive load. c. Determine power drawn by resistive, inductive and capacitive load. d. Find the capacitance needed for power factor correction 	5

Palau Community College
MA 102 Mathematics for Electrical and Electronics
Course Learning Outcomes

During the course experience, the **course learning outcomes** (CLO) will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical rating of 4, 3, 2 and 1 are not intended to represent the traditional school grading system of A, B, C, D and F. The descriptions associated with each of the numbers focus on the level of student performance for each of the course learning outcome listed below.

Rating Scale:	5.	Excellent
	4.	Above average
	3.	Average
	2.	Below Average
	1.	Unacceptable

CLO 1: Demonstrate ability to convert unit from one form to another

5	The student is able to demonstrate ability to convert unit from one form to another without any supervision or instruction.
4	The student is able to demonstrate ability to convert unit from one form to another with limited supervision but no instruction.
3	The student is able to demonstrate ability to convert unit from one form to another with limited supervision and limited instruction.
2	The student has difficulty to demonstrate ability to convert unit from one form to another and requires considerable supervision and instruction.
1	The student is unable to demonstrate ability to convert unit from one form to another even with instruction and supervision.

CLO 2: Demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law.

5	The student is able to demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law without any supervision or instruction.
4	The student is able to demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law with limited supervision but no instruction.
3	The student is able to demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law with limited supervision and limited instruction.
2	The student has difficulty to demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law and requires considerable supervision and instruction.
1	The student is unable to demonstrate ability to calculate problems involving Ohm's Law, Kirchoff's Law, and power law even with instruction and supervision.

CLO3: Estimate electrical energy consumed through the given loads and power rating.

5	The student is able to estimate electrical energy consumed through the given loads and power rating without any supervision or instruction.
4	The student is able to estimate electrical energy consumed through the given loads and power rating with limited supervision but no instruction.
3	The student is able to estimate electrical energy consumed through the given loads and power rating with limited supervision and limited instruction.
2	The student has difficulty to estimate electrical energy consumed through the given loads and power rating and requires considerable supervision and instruction.
1	The student is unable to estimate electrical energy consumed through the given loads and power rating even with instruction and supervision.

CLO 4: Demonstrate ability to calculate wire resistance and voltage drops.

5	The student is able to demonstrate ability to calculate wire resistance and voltage drops without any supervision or instruction.
4	The student is able to demonstrate ability to calculate wire resistance and voltage drops with limited supervision but no instruction.
3	The student is able to demonstrate ability to calculate wire resistance and voltage drops with limited supervision and limited instruction.
2	The student has difficulty to demonstrate ability to calculate wire resistance and voltage drops and requires considerable supervision and instruction.
1	The student is unable to demonstrate ability to calculate wire resistance and voltage drops even with instruction and supervision.

CLO 5: Demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits.

5	The student is able to demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits without any supervision or instruction.
4	The student is able to demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits with limited supervision but no instruction.
3	The student is able to demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits with limited supervision and limited instruction.
2	The student has difficulty to demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits and requires considerable supervision and instruction
1	The student is unable to demonstrate ability to calculate problems involving resistance, inductance and capacitance in AC circuits even with instruction and supervision.

CLO 6: Demonstrate ability to calculate alternating current power and power factor

5	The student is able to demonstrate ability to calculate alternating current power and power factor without any supervision or instruction.
4	The student is able to demonstrate ability to calculate alternating current power and power factor with limited supervision but no instruction.
3	The student is able to demonstrate ability to calculate alternating current power and power factor with limited supervision and limited instruction.
2	The student has difficulty to demonstrate ability to calculate alternating current power and power factor and requires considerable supervision and instruction.
1	The student is unable to demonstrate ability to calculate alternating current power and power factor even with instruction and supervision.