

**College of Micronesia – FSM10/06/2008**  
**Course Modification Request**

VEM 104 Basic Electricity 2  
 Course Number and Title

Technology and Trade  
 Department

Same as above  
 Recommended Course Number and Title

Same as above  
 Department

New Course Objectives:  
No change

New Course Description  
No change

Revision/s Requested:

**Request 1** is to make the correction on page 1 of the course VEM 104 Basic Electricity 2. It was incorrectly typed as VEE 104 and approved. Electronic Fundamentals II is the correct VEE 104

Justification for Revising the Course:  
 The revision is to have the correct name/number for VEM 104 Basic Electricity 2.

**Request 2** is for book change for VEM 104 to Electrical Level Two NCCER, Trainee Guide 2003 Revision, Prentice Hall, Inc Upper Saddle River New Jersey

Justification for Changing the Textbook:  
 Since Electrical Level Two covers the topics in VEM 104 and is used for other electricity courses VEM 111 and VEE 266 we recommend to use the same for VEM 104.

Signed by Bernando Dimaliwat  
 Division Chairperson

02-03-05  
 Date

\_\_\_\_\_  
 Chairperson, Curriculum Committee

\_\_\_\_\_  
 Date

\_\_\_\_\_  
 President, COM – FSM

\_\_\_\_\_  
 Date

<b>Official Use Only</b>
<b>New Course Number and Title:</b>

**College of Micronesia – FSM  
P.O.Box 159  
Kolonia, Pohnpei**

**Course Outline Cover Page**

Basic Electricity 2  
Course Title

**VEM 104**  
Department and Number

**Course Description:** This course covers the introduction and examination of the principles, applications and measurement of alternating current. Students will compare different types of alternating current circuits. The course emphasizes filtering basics, reactance, resonance, RC, RL, RLC, relays, transformers, phase angles & relationship and power factors. Students will apply formula to analyze AC circuits. It also includes the theoretical and practical aspects of series, parallel, and series-parallel circuit construction using the breadboarding method.

**Prepared by:** Grilly Jack

**State:** Pohnpei Campus

	Hours per Week	No. of Weeks	Total Hours	Sem. Credits
Lecture	5/10	16/8	80	5
Laboratory				
<b>Total Semester Credits:</b>				<b>5</b>

**Purpose of Course**

Degree Requirement \_\_\_\_\_  
 Degree Elective \_\_\_\_\_  
 Advanced Certificate \_\_\_\_\_  
 Certificate \_\_\_\_\_XXX\_\_\_\_\_   
 Remedial \_\_\_\_\_  
 Other( workshop ) \_\_\_\_\_

**Prerequisite Course(s):** VEE 103

\_\_\_\_\_  
**Signature, Chairman, Curriculum Committee**

\_\_\_\_\_  
**Date Approved by Committee**

\_\_\_\_\_  
**Signature, President, COM – FSM**

\_\_\_\_\_  
**Date Approved by the President**

## **General Objective:**

This course will serve as a comprehensive study in alternating current ( AC circuits ). Student will be introduced to the principles, applications, and measurements of alternating current. Generally, students will begin their learning with AC measurements, then the use of AC measuring tools, and progressing into analyzing & troubleshooting various components commonly used in filter circuits, time constant operations, and resonant circuits. The course of study also includes transformer and relay operations and troubleshooting.

**Learning Outcomes:** Upon successful completion of this course the student will be able to:

1. Describe the basic principles of alternating current and analyze various ac waveforms ( such as sine-wave, square-wave, saw tooth-wave, etc... ) by determining their frequency/cycle in Hertz, period ( Time ), and other parameters, such as voltage & current values ( as in peak, peak-to-peak, average, and RMS ), phase relationships, magnitude and degree (angle).
2. Explain the operation of an AC generator and its characteristics.
3. Use Ohm's Law to calculate voltage, resistance and current in an AC circuit and to discuss the relationship between the three quantities.
4. Describe the function of an oscilloscope and its controls. Also students demonstrate how to accurately and safely set up an oscilloscope to measure voltage and frequency.
5. Describe the function of a frequency counter and its controls. Safely and accurately use a function generator to adjust and module various output signals.
6. Describe the function of a frequency counter and its controls. Students demonstrate how a frequency counter is set up for normal operations to calibration, other measurements, and how to compare frequency and period measurements using a frequency counter and an oscilloscope.
7. Describe the purpose of an inductor, its current opposing characteristics and applications and identify various types of inductors, unit of measurement and its schematic symbol.
8. Analyzes the following circuits by calculating total inductance, total reactance, and total impedance: by measuring phase relationship between voltage & current and phase differences between inductive & resistive branches in an RL circuit; and by performing troubleshooting practices to identify faults in an RL circuit.
  - a. RL Series Circuits
  - b. RL Parallel Circuits

9. Describe an RL Filter circuits and its circuit Characteristics, and by experimentation, compare the calculated and measured values in an RL Filter circuit.
10. Describe the construction, normal operation, measurement and the characteristics of charge & discharge of a capacitor and identify the various types of capacitors, schematics symbols, and capacitance & voltage values.
11. Analyze the following circuits by calculating total capacitance, total reactance, and impedance. Measure voltage & current phase relationship of an RC Series & Parallel circuits. Troubleshoot RC circuits for faults.
12. Describe an RC Filter Circuit and its characteristics. By experimentation, measure and calculate RC filter circuits.
13. Describe and measure circuit values on RC Time Constant operations. Analyze and troubleshoot RC Circuit Transient.
14. Identify and describe RCL/LCR circuits. Analyze and troubleshoot an LCR series & parallel circuits by experimentation.
15. Describe the operation and the effects of a Series/Parallel Resonant Circuits. Troubleshoot series/parallel resonant circuits by experimentation.
16. Describe the purpose, operation and characteristics of a transformer. Calculate and measure primary and secondary parameters of a transformer. Troubleshoot a transformer to determine faults.
17. Describe the purpose & operation, basic construction and troubleshooting procedures of the various types of relays switches commonly used in the field. Troubleshoot relays and switches by experimentation.
18. Discuss the operation of an electrical circuit, trace & measure AC and DC values in an electrical circuit.
19. Use Bread boarding techniques to construct and analyze AC series & parallel circuits.

***STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT ALL TIMES.***

**Outline of Content:**

This course contains:

1. Alternating Current & Generating Electricity
  - ◆ Alternating Current and AC sine wave.
  - ◆ Frequency, cycles (Hertz), wavelength and period of a sine wave.

- ◆ Characteristics of induction
  - ◆ Magnitude and polarity of voltage produced in a magnetic field.
  - ◆ Operation of an AC generator
  - ◆ Calculating peak, peak-to-peak, average and RMS values.
  - ◆ Using vectors to identify phase, magnitude and degree of AC wave form.
2. Non-Sinusoidal Wave
    - ◆ Harmonic Frequencies
    - ◆ Square and tooth waves and their wave cycles.
  3. Resistance in AC Circuits
    - ◆ Ohm's Law is used to calculate & analyze the relationship between V, I, and R in an AC circuit.
  4. Oscilloscope and Use
    - ◆ Purpose and controls of an oscilloscope
    - ◆ Oscilloscope types: Single Trace and Double Trace
    - ◆ Procedures for setting up and operating an oscilloscope.
    - ◆ Voltage & frequency measurements using an oscilloscope.
  5. Function Generator and Use
    - ◆ Purpose and controls of a function generator
    - ◆ Types of output signals generated by a function generator
    - ◆ Procedures in setting up and operating a function generator
    - ◆ Adjust and modulate a function generator for various output signals.
  6. Frequency Counter and Use
    - ◆ Purpose, controls, and reading measurements of a frequency counter
    - ◆ Procedures in setting up and operating a frequency counter
    - ◆ Calibration and the utilization of a frequency counter with an oscilloscope to compare frequency and period measurements
  7. Introduction to Inductors and identification
    - ◆ Purpose and types of inductors and their schematic symbols

- ◆ Characteristics of an inductor and inductance
  - ◆ Unit of measurements for inductance
  - ◆ Determine inductance using inductor color codes
8. RL Circuits: Series/Parallel and Troubleshooting
- ◆ Total inductance, reactance, impedance and other circuit values in an RL series/RL parallel circuits
  - ◆ Normal operation and phase relationship between voltage and current in an RL circuit
  - ◆ Fault identification in an RL circuit
  - ◆ Troubleshooting an RL circuit to locate fault(s) in an RL circuit
9. RL Filters
- ◆ Filter circuits and their characteristics
  - ◆ Calculating and measuring filter circuit values
10. Capacitors and identification
- ◆ Purpose and types of capacitor and its symbol
  - ◆ Capacitance and characteristics of capacitor
  - ◆ Unit measurement of capacitance
  - ◆ Capacitor coding & Voltage values
11. RC Circuits: Series/Parallel and Troubleshooting
- ◆ Total capacitance, total capacitive reactance and total impedance
  - ◆ Phase relationship between voltage & current
  - ◆ Normal operation in an RC circuits
12. RC Filter Circuits
- ◆ RC Filter Circuits and circuit characteristics & circuit values
  - ◆ RC Low-Pass Filter Circuit
  - ◆ RC High-Pass Filter Circuit
  - ◆ Circuit measurements: RC Low/High Pass Filter Circuit
13. RC Time Constant Circuits
- ◆ RC Time Constant and operation
  - ◆ RC Circuit Transient Analysis
  - ◆ Experimentation: RC Circuit Transient Analysis
  - ◆ Troubleshooting RC Circuit Transient

- 14, RCL/LRC Circuits and Troubleshooting
  - ◆ Effects of Inductors & Capacitors in an RCL Circuit
  - ◆ Circuit Calculations: RCL Series/Parallel Circuits
  - ◆ Circuit Analysis: LCR Series/Parallel Circuits
  - ◆ LCR Circuits Troubleshooting
  
- 14. Resonant Circuits & Troubleshooting
  - ◆ Series/Parallel Resonant Circuits and resonant frequency
  - ◆ Circuit calculations & measurements: Series & Parallel Resonant Circuits
  - ◆ Troubleshooting Resonant Circuits
  
- 15. Transformers
  - ◆ Purpose, Schematic symbols, operations, and characteristics
  - ◆ Transformer ratios: primary values to secondary values
  - ◆ Transformer testing
  - ◆ Troubleshooting Transformers
  
- 16. Relays & Switches
  - ◆ Types of Relays & Switches and their purposes
  - ◆ Constructions & operations
  - ◆ Troubleshooting Relays & Switches
  
- 18. Electrical Circuits
  - ◆ Interpret schematic drawing of an electrical circuit
  - ◆ Perform signal tracing on an electrical circuit
  - ◆ Electrical Circuits Troubleshooting

**Learning Outcome 1**

**Describe the basic principles of alternating current and analyze various ac waveforms (such as sine-wave, square-wave, saw tooth-wave, etc...) by determining their frequency/cycle in Hertz, period (Time), and other parameters, such as voltage & current values (as in peak, peak-to-peak, average and RMS), phase relationships, magnitude and degree (angle).**

Assessment Criteria

1. Define alternating current
2. Define and determine frequency, wavelength, and period of a sine wave.

3. Define the characteristics of induction.
4. Calculate peak, peak-to-peak, average and RMS.

Assessment Methods

Multiple Choice Questions  
Short Answer Questions

**Learning Outcome 2:**

**Explain the operation of an AC generator and its characteristics.**

Assessment Criteria

1. Determine the magnitude and polarity of voltage produced in a magnetic field.
2. Describe the operation of an AC generator.
3. Identify in & out of phase and magnitude & degree of an AC wave using vectors.

Assessment Methods:

Multiple Choice Questions  
Short Answer Questions  
Quiz

**Learning Outcome 3:**

**Use Ohm's Law to calculate voltage, resistance, and current in an AC circuit and to discuss the relationship between the three quantities**

Assessment Criteria:

1. Use Ohm's Law to determine resistance in an AC circuit.
2. Identify the relationship between voltage, current and resistance in a AC series/parallel circuit.
3. Calculate resistance, voltage and current in an AC series/parallel circuit.
4. Summarize the relationship between voltage, current and resistance in an AC series/parallel circuit.

Assessment Methods:

Multiple Choice Questions  
Short Answer Questions

**Learning Outcome 4:**

**Describe the function of an oscilloscope and its controls. Also, students demonstrate how to accurately and safely set up an oscilloscope to measure voltage and frequency.**

Assessment Criteria:

1. Summarize the purpose of an oscilloscope and its controls.
2. Describe single trace and dual trace oscilloscope.
3. Set up an oscilloscope for normal operation.
4. Measure voltage and frequency using an oscilloscope.



Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercise/Test

**Learning Outcome 5:** **Describe the function of a function generator and its controls. Safely and accurately use a function generator to adjust and modulate various output signals.**

Assessment Criteria: 1. Describe the purpose of a functions generator and its controls & switches.  
2. Identify the types of output signals generated by a function generator.  
3. Set up a function generator for normal operation and adjust & modulate output signals.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 6:** **Describe the function of a frequency counter and its controls. Students demonstrate how a frequency counter is set up for normal operation to perform calibration, other measurements, and how to compare frequency and period measurements using a frequency counter and an oscilloscope.**

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 7:** **Describe the purpose of an inductor, its current opposing characteristics, and applications and identify various types of inductors, unit of measurement and its schematic symbol.**

Assessment Criteria 1. Describe inductance and its characteristics.  
2. Identify types of inductors and schematic symbols  
3. Identify the unit of measurement for inductance.  
4. Use inductor color codes to determine inductance.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions

**Learning Outcome 8:** **Analyze the following circuits by calculating total inductance, total reactance and total impedance; by measuring phase relationship between voltage &**

**current and phase difference between inductive and resistive branches in an RL circuit; and by performing troubleshooting practices to identify faults in an RL circuit.**

- 1. RL Series Circuits**
- 2. RL Parallel Circuits**

Assessment Criteria

1. Calculate total inductance, total reactance, and total impedance.
2. Measure phase relationships between voltage & current and verify normal operation of an RL Series and RL parallel circuits.
3. Troubleshoot an RL circuit to locate open, shorted and other faults.

Assessment Methods:

Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 9: Describe an RL Filter circuits and its circuit characteristics, and by experimentation, compare the calculated and measured values in an RL Filter circuit.**

Assessment Criteria:

1. Identify RL Filter circuits.
2. Describe RL Filter circuit characteristics.
3. Calculate RL Filter circuit values.
4. Measure RL Filter circuit values.
5. Compare measured RL filter circuit values with calculated circuit values.

Assessment Methods:

Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 10: Describe the construction, normal operation, measurement, and the characteristics of charge & discharge of a capacitor and identify the various types of capacitors, schematics symbols, and capacitance & voltage values.**

Assessment Criteria

1. Identify types of capacitors and schematic symbols.
2. Describe charge and discharge characteristics of capacitors.
3. Read capacitance and voltage values.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions

**Learning Outcome 11:** Analyze the following circuits by calculating total capacitance, total reactance and impedance Measure voltage & current phase relationship of an RC Series & RC Parallel circuits. Troubleshoot RC circuits for faults.

Assessment Criteria:

1. Calculate total capacitance, total reactance and impedance in a RC Series & RC Parallel circuits.
2. Measure phase relationship between voltage and current.
3. Verify normal operation of a RC parallel circuit.
4. Troubleshoot to locate open, short and other faults in a RC circuit.

Assessment Methods: Multiple choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 12:** Describe an RC Filter Circuit and its characteristics. By experimentation, measure and calculate RC filter circuits.

Assessment Criteria:

1. Identify RC filter circuits.
2. Describe RC filter circuit characteristics.
3. Calculate RV filter circuit values.
4. Measure RC low pass filter circuit values.
5. Compare RC high pass filter circuit values with calculated circuit values.
6. Measure RC high pass filter circuit values.
7. Compare measured RC high pass filter circuit values with calculated circuit values.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 13:** Describe and measure circuit values on RC Time Constant operations. Analyze and troubleshoot RC Circuit Transient.

Assessment Criteria:

1. Discuss RC Time constants.
2. Calculate RC time constants.
3. Measure the charging and discharging of a capacitor

- using a mutimeter and an oscilloscope.
4. Describe the effects of a capacitor on non sinusoidal wave shape and how RC time constant relates to capacitive reactance.
  5. Predict and measure voltage & current wave form.
  6. Recognize and describe faulty RC transient circuits.
  7. Determine faulty components in an RC transient circuit.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Tests

**Learning Outcome 14: Identify and describe LRC circuits. Analyze and troubleshoot an LRC series & parallel circuits by experimentation.**

- Assessment Criteria:
1. Describe the effects of inductors and capacitors when used in the same circuit.
  2. Calculate the circuit values in a RC series and a RC parallel circuit.
  3. Calculate and measure the voltage drops in a LRC series circuit.
  4. Verify normal operation of a LRC series circuit.
  5. Measure phase relationship between  $E_a$ ,  $E_r$ ,  $E_c$  and  $E_I$  in a LRC series circuit.
  6. Calculate and measure the branch currents in a LRC parallel circuit.
  7. Verify normal operation of a LRC parallel circuit.
  8. Measure the phase relationship between  $I_t$ ,  $I_r$ ,  $I_c$  and  $I_l$  in a LRC parallel circuit.
  9. Identify an open & shorted component in a LRC series and parallel circuit.
  10. Identify a changed value component in a LRC series and parallel circuit.
  11. Observe the effects of an open and a shorted component in a LRC circuit.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 15: Describe the operation and the effects of a Series/Parallel Resonant circuits. Troubleshoot series/parallel resonant circuits by experimentation.**

- Assessment Criteria:
1. Describe series resonance and LRC series circuit values

- at resonance.
- 2. Calculate and measure resonant frequency of a LRC series circuit.
- 3. Observe the effects of voltage magnification and the values of  $E_r$ ,  $I_t$ , and  $Z_t$  below at and above resonance in a series LRC circuit.
- 4. Describe parallel resonance.
- 5. Calculate and measure the resonant frequency in a LRC parallel circuit.
- 6. Identify and observe open & shorted component in a series and parallel resonant circuit.
- 7. Determine the faulty component in a series and parallel resonant circuit.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 16: Describe the purpose, operation and characteristics of a transformer. Calculate and measure primary & secondary parameters of a transformer. Troubleshoot a transformer to determine faults.**

- Assessment Criteria:
- 1. Describe the purpose of transformers.
  - 2. Identify transformer schematic symbols and the
  - 3. Describe transformer-operating characteristics.
  - 4. Calculate turns ratio, secondary & primary voltage, current and power.
  - 5. Measure primary & secondary voltage of a transformer.
  - 6. Determine step up or step down transformer action.
  - 7. Describe faults in transformer circuits and transformer troubleshooting procedures.
  - 8. Determine when a transformer is faulted.
  - 9. Observe the effects of an open and shorted secondary in a transformer circuit.

Assessment Methods: Multiple Choice Questions  
Short Answer Questions  
Practical Exercises/Test

**Learning Outcome 17: Describe the purpose & operation, basic construction and troubleshooting procedures of the various types of relays switches commonly used in the field Troubleshoot relays switches by experimentation.**

- Assessment Criteria:
- 1. Describe the types of relays and their purpose.

2. Describe basic relay construction and operation
3. Identify the schematic