College of Micronesia – FSM
P.O. Box 159
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Course Outline Cover Page

Electronic Fundamentals II — Course Title
VEE 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 & relationships 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: Gardner Edgar **State:** Pohnpei Campus

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	4/8	16/8	64	4
Laboratory				
		Total Semester Credits:		4

Purpose of Course

Degree Requirement	_____
Degree Elective	_____
Advanced Certificate	_____
Certificate	_____XX_____
Remedial	_____
Other (Workshop)	_____

Prerequisite Course(s): VEE 103 Electronic Fundamentals I

_____ _____
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 function generator and its controls. Safely and accurately use a function generator to adjust and modulate 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 operation to perform 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. 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 & 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 & 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, and troubleshoot an electrical circuit to identify faults in an electrical circuit.

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 an AC wave form

2. Non-Sinusoidal Wave
    - Harmonic Frequencies
    - Square and saw 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 measurement 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 relationships 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 circuit
    - Troubleshooting RC circuits

12. RC Filter Circuits
    - RC Filter Circuits and circuit characteristics & circuit values
    - RC Low-Pass Filter Circuits
    - RC High-Pass Filter Circuits
    - Circuit measurements: RC Low/High Pass Filter Circuits

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 RLC Circuit
    - Circuit Calculations: RCL Series/Parallel Circuits
    - Circuit Analysis: LCR Series/Parallel Circuits
    - LCR Circuits Troubleshooting

15. Resonant Circuits & Troubleshooting
    - Series/Parallel Resonant Circuits and resonant frequency
    - Circuit calculations & measurements: Series & Parallel Resonant Circuits

- Troubleshooting Resonant Circuits

16. Transformers
    - Purpose, schematic symbol, operations, and characteristics
    - Transformer ratios: primary values to secondary values
    - Transformer testing
    - Troubleshooting Transformers

17. 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.
5. 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 Criteria:	1. Describe the purpose of a frequency counter and its controls. 2. Set up for normal operation 3. Perform calibration period, frequency, and totalize measurements. 4. 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 & 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.
4. Calculate RL Filter circuit values.
5. Measure RL Filter circuit values.
6. 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 & 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 Series and 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 Outcome12:

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 RC filter circuit values.
4. Measure RC low pass filter circuit values.
5. Compare RC high pass filter circuit values with calculated circuit values.
7. Measure RC high pass filter circuit values.
8. 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 multimeter 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 waveforms.
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/Test

Learning Outcome 14: **Identify and describe LCR circuits. Analyze and troubleshoot an LCR 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 LCR series circuit.
4. Verify normal operation of a LCR series circuit.
5. Measure phase relationship between Ea, Er, Ec, and EI in a LCR series circuit.
6. Calculate and measure the branch currents in a LCR parallel circuit.
7. Verify normal operation of a LCR parallel circuit.
9. Measure the phase relationship between It, Ir, Ic, and Il in a LCR parallel circuit.
10. Identify an open & shorted component in a LCR series and parallel circuit.
11. Identify a changed value component in a LCR series and parallel circuit.
12. Observe the effects of an open and a shorted component in a LCR 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 LCR series circuit values at resonance.
2. Calculate and measure resonant frequency of a LCR series circuit.
3. Observe the effects of voltage magnification and the values of Er, It, and Zt below, at, and above resonance in a series LCR circuit.
4. Describe parallel resonance.
5. Calculate and measure the resonant frequency in a LCR 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 reference designation.
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 and 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 symbol and reference designator for relays.
4. Describe the latched relay and the time delay relay.
5. Measure voltage and trace signal flow through a relay circuit.
6. Describe faults in relays and describe relay-troubleshooting procedures.
7. Recognize that a relay circuit is faulted and identify the fault in a faulted relay circuit.

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

Learning Outcome 18: **Discuss the operation of an electrical circuit, trace & measure AC and DC values in an electrical circuit, and troubleshoot an electrical circuit to identify faults in an electrical circuit.**

Assessment Criteria:

1. Identify component symbols from a schematic drawing.
2. Describe the operation of an electrical circuit using a schematic drawing.
3. Trace signal flow through an electrical circuit and measure AC and DC voltages in an electrical circuit.
4. Describe faults in electrical circuits and describe electrical circuit troubleshooting procedures.
5. Recognize and identify faults in an electrical circuit.

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

Required Course Materials:

1. Instructor:

a. CAI Classroom with whiteboard or chalkboard
b. Laboratory equipment with tools of the trade
c. Text, Teacher's Resource Guide, workbook
d. Overhead projector, transparencies

2. Student:

a. Text(s), handouts provided by instructor
b. Ring binder
c. College ruled note sheet, pencil or pen
d. Scientific calculator

Reference Materials:

Electronics Fundamentals: Circuits, Devices, and Applications
Thomas L. Floyd, Fifth Edition

Method of Instruction:

1. Computer Aided Instruction
2. Practical/Experimentation
3. Lecture/Demonstration

Evaluation:

Final Grade for this course will be based on meeting the course requirements at the following percentage rates:

90% - 100%	A – Superior
80% - 89%	B – Above Average
70% - 79%	C – Average
60% - 69%	D – Below Average
0 % - 59%	F – Failure

Attendance:

The COM-FSM attendance policy will apply