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

Digital Electronics I — Course Title

VEE 135 — Department and Number

Course Description: This course provides the students with the basic concepts of logic gates and digital circuits. Topics include digital switches, combinational and sequential logic gates, number systems, Boolean algebra, Karnaugh Maps, 555 Timers, flip-flops and logic design techniques.

Prepared by: Gardner Edgar

State: Pohnpei Campus

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	3/6	16/8	48	3
Laboratory				
		Total Semester Credits:		3

Purpose of Course

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

Prerequisite Course(s): VEE 110 or concurrently

_____ _____
Signature, Chairman, Curriculum Committee **Date Approved by Committee**

_____ _____
Signature, President, COM-FSM **Date Approved by the President**

General Objective:

This course covers the introduction to digital electronics, digital circuits, number systems, logic circuits, flip-flops, and their applications.

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

1. Identify and describe the history and development of digital electronics.
2. Describe digital electronics hardware.
3. Describe the basic operating principles of buffers and inverters.
4. Describe various digital test equipment and their operating characteristics.
5. Explain the purpose and the operation for the 555 Timer.
6. Describe the purpose, construction, and operation of various integrated circuits.
7. Identify and describe the AND gate operation. Measure input to output waveforms.
8. Identify and describe the OR gate operation. Measure input to output waveforms.
9. Identify and describe the NOT gate operation. Measure input to output waveforms.
10. Identify and describe the NAND gate operation. Measure input to output waveforms.
11. Identify and describe the NOR gate operation. Measure input to output waveforms.
12. Identify and describe the XOR gate operation. Measure input to output waveforms.
13. Describe the purpose and operation of various combinational circuits.
14. Describe the different types of logic families and their operating characteristics.
15. Describe the number systems used in digital electronics. Perform mathematical calculations and conversions using digital mathematics.
16. Describe how a decimal encoder performs base 10 to binary conversion.
17. Describe how a binary decoder performs binary to 7 segment conversions.
18. Identify and describe the operation of a 4-bit comparator.
19. Explain the basic operating principles of a flip-flop circuit.
20. Identify and describe the purpose and the operation of an RS flip-flop circuit.
21. Identify and describe the purpose and the operation of a Clocked RS flip-flop circuit.
22. Identify and describe the purpose and the operation of a D-type flip-flop circuit.
23. Identify and describe the purpose and the operation of a JK flip-flop circuit.
24. Identify and describe the purpose and the operation of a Master Slave flip-flop circuit.

Outline of Content: **This course contains:**

1. **Introduction to digital electronics**
    a. Developments of digital electronics
    b. Growth of computing equipment
    c. Uses of digital electronics
    d. Input and output conditions for digital circuits
    e. AND, OR, NOT functions
    f. Truth table and Boolean algebra

2. **Digital Electronics Hardware**
    a. Integrated Circuits (IC)
    b. IC Packaging
    c. Markings associated with ICs
    d. IC Functions
    e. Purpose and use of Data Book

3. **Buffers and Inverters**
    a. Purposes of Buffers & Inverters
    b. Input/output threshold voltages
    c. Noise Margins
    d. Measuring threshold voltages

4. **Digital Test Equipment**
    a. Purpose & operation of a clock generator circuit
    b. Purpose & operation of a logic probe
    c. Uses of a clock generator and a logic probe

5. **555 Timer**
    a. 555 Timer Description
    b. Purpose & internal operation of the 555 timer
    c. 555 Timer configurations
    d. 555 Timer used as a monostable and as a astable mulitvibrator
    e. 555 Timer

6. **Introduction to Integrated Circuits**
    a. IC Construction and Classifications
    b. IC Packaging Arrays and Materials
    c. IC Pin Identifications and Numbers
    d. IC Data Book

7. **Logic Gates**
    b. AND Gates
    c. OR Gates
    d. NOT Gates
    e. NAND Gates
    f. NOR Gates
    g. XOR Gates

9. **Introduction to Combinational Circuits**
    a. Combinational Logic and Circuit
    b. Universal property of the NAND & NOR Gates
    c. Output Measurements in a Combinational Circuit
    d. NAND gates performing AND, OR, and NOR functions

10. **Logic Families**
    a. TTL Logic
    b. Identification of supply voltages
    c. Fan-in and Fan-out
    d. Propagation
    e. CMOS Logic
    f. ECL Logic
    g. IIL Logic

11. **Number System**
    a. Decimal Number
    b. Binary Number System
    c. Octal Number System
    d. Decimal to Binary Conversion and vise versa
    e. Octal to Binary Conversion and vise versa
    f. Hexadecimal to Binary Conversion
    g. Add, subtract, multiply, and divide Binary numbers

12. **Base 10 to Binary Conversions**
    a. Decimal encoder
    b. Decimal to Binary encoder circuit
    c. Decimal to Binary encoder circuit operation

13. Binary to 7-segment Conversions
    a. Binary Decoder
    b. Seven-segment Display
    c. Binary to Decimal seven-segment decoder circuit
    d. Operation of a Binary decoder

14. 4-Bit Comparator
    a. Purpose of a Comparator
    b. Comparator circuit and circuit operations

15. Introduction to Flip-Flops
    a. Purpose of feedback
    b. Conditions of Q, NOT Q, SET, and RESET
    c. Basic flip-flop operation
    d. Single and double gate flip-flop

16. RS Flip-Flop

a. Purpose of an RS flip-flop circuit and operation
b. Input and Output measurements
c. Normal operation of an RS flip-flop

17. Clocked RS Flip-Flop

a. Purpose of a clocked RS flip-flop circuit and operation
b. Input and Output measurements
c. Normal operation of a clocked RS flip-flop

18. D-Type Flip-Flop

a. Purpose of a D-type flip-flop circuit and operation
b. Input and Output measurements
c. Normal operation of a D-type flip-flop

19. J-K Flip Flop

a. Purpose of a J-K flip-flop circuit and operation
b. Input and Output measurements
c. Normal operation of a J-K flip-flop

20. Master Slave Flip-Flop

h. Flip-flop level, edge, and pulse triggering
i. Purpose of a Master Slave flip-flop and circuit operations
j. Input and Output Measurements
k. Normal operation of a Master Slave flip-flop

Learning Outcomes: On completion of this course the learner will be able to:

Learning Outcome 1 **Identify and describe the history of digital electronics.**

Assessment Criteria

a. Identify developments of digital electronics.
b. Describe the growth of computing equipment.
c. Identify the uses of digital electronics.
d. Describe input and output conditions for digital circuits.
e. Identify the AND, OR, and NOT functions.
f. Recognize the truth table.
g. Recognize the AND, OR, and NOT Boolean Algebra.

Assessment Method

Multiple choice questions
Short answer questions
Quiz

Learning Outcome 2 **Describe digital electronics hardware.**

Assessment Criteria	a. Define an Integrated Circuit. b. Identify three forms of Packaging an Integrated Circuit. c. Identify markings associated with Integrated Circuit. d. Identify Integrated Circuit functions. e. Describe the purpose of a Data Book.
Assessment Method	Multiple choice questions Short answer questions Quiz

Learning Outcome 3	**Describe the basic operating principles of buffers and inverters.**
Assessment Criteria	a. Describe the purpose of a buffer. b. Describe the purpose of an inverter. c. Describe input & output threshold voltages. d. Describe noise margins. e. Measure threshold voltages.
Assessment Method	Multiple choice questions Short answer questions Practical exercises Quiz

Learning Outcome 4	**Describe various digital test equipment and their operating characteristics.**
Assessment Criteria	a. Describe the purpose of a clock generator circuit. b. Identify the signals produced by the clock generator. c. Identify the basic components of a clock generator. d. Describe the purpose of a logic probe. e. Describe the basic operation of a logic probe. f. Operate a simple clock generator circuit. g. Operate a logic probe.
Assessment Method	Multiple choice questions Short answer questions Practical exercises Quiz

Learning Outcome 5	**Explain the purpose and the operation for the 555 Timer.**
Assessment Criteria	a. Describe the purpose of the 555 Timer. b. Describe the internal operation of the 555 Timer.

c. Describe the 555 Timer Configurations.
d. Describe the operation of a 555 Timer used as an Astable and Monostable Multivibrator.
e. Observe the operation of a 555 Timer circuit.
f. Operate a 555 Timer in Astable and Monostable Multivibrator configurations.

Assessment Method

Multiple choice questions
Short answer questions
Practical exercises/tests

Learning Outcome 6 **Describe the purpose, construction, and operation of various integrated circuits.**

Assessment Criteria

a. Identify the different IC Construction classifications.
b. Identify Integrated Classifications
c. Explain the construction of a basic IC.
d. Identify basic IC packaging materials.
e. Describe the pin naming conversion with ICs.
f. Interpret basic IC numbers.
g. Locate information on an IC using an IC Data Book.

Assessment Method

Multiple choice questions
Short answer questions
Quiz

Learning Outcome 8 **Identify and describe the AND gate operation. Measure input to output waveforms.**

Assessment Criteria

a. Identify AND operation, logic symbols and logic schematic representation.
b. Construct an AND gate truth table.
c. Identify input to output waveforms.
d. Measure input to output waveforms.

Assessment Method

Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

Learning Outcome 9: **Identify and describe the OR gate operation. Measure input to output waveforms.**

Assessment Criteria:	a. Identify OR operation. b. Identify OR gate truth table. c. Construct an OR gate truth table. d. Identify and measure input to output waveforms.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 10:	**Identify and describe the NOT gate operation. Measure input to output waveforms.**
Assessment Criteria:	a. Identify NOT operation. b. Identify NOT logic symbols and schematic representation. c. Construct a NOT gate truth table. d. Identify and measure input to output waveforms.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 11:	**Identify NAND gate operation. Measure input to output waveforms**.
Assessment Criteria:	a. Identify NAND operation. b. Identify NAND logic symbols and schematic representation. c. Construct a NAND gate truth table. d. Identify and measure input to output waveforms.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 12:	**Identify and describe the NOR gate operation. Measure input to output waveforms.**
Assessment Criteria:	a. Identify NOR operation. b. Identify NOR logic symbols and schematic representation. c. Construct an NOR gate truth table. d. Identify and measure input to output waveforms.

Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 13:	**Identify and describe the XOR gate operation. Measure input to output waveforms.**
Assessment Criteria:	a. Identify XOR operation. b. Identify XOR logic symbols and schematic representation. c. Construct an XOR gate truth table. d. Identify and measure input to output waveforms.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 14:	**Describe the purpose and operation of various combinational circuits.**
Assessment Criteria:	a. Define combinational logic. b. Describe the uses of combinational logic. c. Trace inputs through a combinational logic circuit. d. Describe the universal property of the NAND gate. e. Describe the universal property of the NOR gate. f. Measure outputs in a combinational logic circuit. g. Verify NAND gates performing AND, OR, and NOR functions.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 15:	**Describe the different types of logic families and their operating characteristics.**
Assessment Criteria:	a. Describe TTL logic. b. Identify supply voltages. c. Define fan-in and fan-out. d. Define propagation. e. Describe CMOS logic. f. Describe ECL logic. g. Describe IIL logic.

Assessment Method: Multiple Choice Questions
Short Answer Questions
Quiz

Learning Outcome 16: **Describe the number systems used in digital electronics. Perform mathematical calculations and conversions using digital mathematics.**

Assessment Criteria:
a. Recognize the Decimal, Binary, Octal, and Hexadecimal number systems.
b. Convert decimal numbers to binary numbers and vise-versa.
c. Convert octal numbers to binary numbers.
d. Convert hexadecimal numbers to binary numbers.
e. Using binary numbers, perform the following operations:
- Addition, subtraction, multiplication, and division.

Assessment Method: Multiple Choice Questions
Short Answer Questions
Quiz

Learning Outcome 17: **Describe how a decimal encoder performs base 10 to binary conversion.**

Assessment Criteria:
a. Identify the purpose of a decimal encoder.
b. Identify a decimal to binary encoder circuit.
c. Predict the outputs of a decimal encoder.
d. Probe the outputs of a decimal encoder.
e. Recognize normal operation of a decimal encoder.

Assessment Method: Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

Learning Outcome 18: **Describe how a binary decoder performs binary to 7 segment conversions.**

Assessment Criteria:
a. Identify the purpose of a binary decoder.
b. Describe a seven-segment display.
c. Describe a binary to decimal seven-segment decoder circuit.
d. Predict and probe the outputs of a binary decoder.
e. Recognize normal operation of a binary decoder.

Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 19:	**Identify and describe the operation of a 4-bit comparator.**
Assessment Criteria:	a. Identify the purpose of a comparator. b. Describe a comparator circuit. c. Apply binary input codes to a 4-bit comparator. d. Measure outputs from a 4-bit comparator.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 20:	**Explain the basic operating principles of a flip-flop circuit.**
Assessment Criteria:	a. Identify the purpose of feedback. b. Recognize a Q and NOT Q condition. c. Recognize a SET and RESET condition. d. Identify basic flip-flop operation. e. Recognize a single and double gate flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Quiz
Learning Outcome 21:	**Identify and describe the purpose and the operation of an RS flip-flop circuit.**
Assessment Criteria:	a. Identify the purpose and describe an RS flip-flop circuit. b. Predict the outputs of an RS flip-flop. c. Probe the inputs and outputs of an RS flip-flop. d. Recognize normal operation of an RS flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 22:	**Identify and describe the purpose and the operation of a Clocked RS flip-flop circuit.**
Assessment Criteria:	a. Identify the purpose of a Clocked RS flip-flop. b. Describe a Clocked RS flip-flop. c. Predict and probe the inputs and outputs of a Clocked RS flip-flop. d. Recognize normal operations of a Clocked RS flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 23:	**Identify and describe the purpose and the operation of a D-type flip-flop circuit.**
Assessment Criteria:	a. Identify the purpose of a Type D flip-flop. b. Describe a Type D flip-flop circuit. c. Predict the inputs and outputs of a Type D flip-flop. d. Probe normal operation of Type D flip-flop. e. Recognize outputs of a Type D flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz
Learning Outcome 24:	**Identify and describe the purpose and the operation of a JK flip-flop circuit.**
Assessment Criteria:	a. Identify the purpose of a JK flip-flop. b. Recognize a JK flip-flop circuit. c. Predict the outputs of a JK flip-flop. d. Probe the inputs and outputs of a JK flip-flop. e. Recognize normal operation of a JK flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

Learning Outcome 25:	**Identify and describe the purpose and the operation of a Master Slave flip-flop circuit.**
Assessment Criteria:	a. Describe flip-flop level triggering. b. Describe flip-flop edge triggering. c. Describe flip-flop pulse triggering. d. Identify the purpose of a Master Slave flip-flop. e. Recognize Master Slave flip-flop circuits. f. Predict the outputs of a Master Slave flip-flop. g. Probe the inputs and outputs of a Master Slave flip-flop. h. Recognize normal operation of a Master Slave flip-flop.
Assessment Method:	Multiple Choice Questions Short Answer Questions Practical exercises Quiz

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:

Principles of Digital Electronics, Seventh Edition
Thomas L. Floyd

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