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

# Course Outline Cover Page

**Digital Electronics II** — Course Title
**VEE 235** — Department and Number

**Course Description:** Further explores digital circuits and concepts including registry circuits, counters, adders, decoders, shift registers and digital to analog converters.

**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 | _____XX_____ |
| Certificate | _____ |
| Remedial | _____ |
| Other (Workshop) | _____ |

**Prerequisite Course(s):** VEE 135 Digital Electronics I

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

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

## General Objective:

This course serves as a continuation study of digital electronics. It includes the study of digital function circuits such as shift & storage register circuits, memory circuits, counter circuits, adder/subtractor circuits, A/D & D/A converters, and data selector & distribution circuits.

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

1. Describe the basic operating principles of registers and memory circuits.
2. Identify the purpose and probe the input and output of a 4-bit storage register.
3. Identify the purpose and probe the input and output of a 4-bit shift register.
4. Identify the purpose and probe the input and output of an 8-bit shift register.
5. Describe the normal operation and the characteristics of a 64-bit memory circuit.
6. Describe how counting circuits perform arithmetic functions.
7. Recognize the normal operation of a ripple counter circuits.
8. Describe the purpose of an up counter circuits and probe its outputs.
9. Describe the purpose of a down counter circuits and probe its outputs.
10. Describe the function and the operating characteristics of a 4-bit adder circuit.
11. Describe the normal operation of a 4-bit subtractor circuit.
12. Explain the basic operating principles of conversion and data circuits.
13. Identify the purpose of a D/A conversion circuit and its operating characteristics.
14. Identify the purpose and describe the basic operation of a data selector circuit and measure its output signals.
15. Describe the function of a data distribution circuit and its operating characteristics and measure its output signals.

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

1. **Introduction to Registers and Memory**
    a. Data, bit, and byte
    b. Serial & Parallel Data Transfer
    c. Identification and purpose of a Shift Register & Storage Register.

2. **4-Bit Storage Register**
    a. Purpose of a 4-bit Storage Register
    b. Output predictions
    c. Input and output measurements
    d. Normal operation

3. **4-Bit Shift Register**
    a. Purpose of a 4-bit Shift Register

b. Left & Right Shifts
c. Input & Output predictions and actual measurements
d. Normal operation

**4. 8-Bit Shift Register**

a. Purpose of a 8-bit Shift Register
b. Synchronous & asynchronous data transfer
c. Input & Output predictions and measurements
d. Normal operation

**5. 64-Bit Memory Circuit**

a. Purpose of a 64-bit Memory circuit
b. Word, address, read, write, RAM, ROM volatile and nonvolatile
c. Input & Output predications and measurements
d. Normal operation

**6. Introduction to Arithmetic Counting Circuits**

a. Purpose of a counter
b. Modulus
c. Basic synchronous and asynchronous counter circuits
d. Counter circuits used as timing circuits
e. Purpose of an adder circuit
f. Adder circuits used in addition, multiplication, subtraction, and division
g. Basic half and full adder circuits

**7. Ripple Counter**

a. Purpose of a ripple counter
b. Various modulus ripple counter circuits
c. Output predictions and measurements
d. Normal operation

**8. Up Counters**

b. Purpose of an Up Counter Circuit
c. Free run and single step circuits of an up counter
d. Output predictions and measurements
e. Normal operation

9. **Down Counters**

a. Purpose of a Down Counter Circuit
b. Free run and single step circuits of a down counter circuit
c. Outputs predictions and measurements
d. Normal operation

10. **4-Bit Adder**
    a. Purpose of a 4-Bit Adder Circuit
    b. Serial & Parallel full adder circuits
    c. Outputs predictions and measurements
    d. Normal operation

11. **4-Bit Subtractors**
    a. Purpose of a 4-Bit Subtractor Circuit
    b. Two's complement
    c. Output predictions and measurements
    d. Normal operation

12. **Introduction to Conversion and Data Circuits**
    a. Purpose of conversion circuits
    b. Basic A/D & D/A circuits
    c. Basic data selector & data distributor
    d. Purpose of data circuits
    e. Normal operation of a R/2R ladder D/A converter

13. **D/A Conversion**
    a. Purpose of D/A Conversion Circuits
    b. Binary weighted D/A converter circuits
    c. R/2R ladder D/A converter circuits and resolution
    d. Outputs predictions and measurements of a R/2R ladder converter

14. **Data Selector Circuit**
    a. Purpose of a Data Selector Circuit
    b. Outputs predictions and measurements
    c. Normal operation

15. **Data Distribution Circuit**
    a. Purpose of Data Distributor Circuits
    b. Output predictions & measurements
    c. Normal operation

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

**Learning Outcome 1** **Describe the basic operating principles of registers and memory circuits.**

Assessment Criteria
a. Describe the terms data, bit, and byte.
b. Describe serial data transfer.

c. Describe parallel data transfer.
d. Identify the purpose of a register
e. Describe storage and shift registers

Assessment Method

Multiple choice questions
Short answer questions
Quiz

**Learning Outcome 2**

**Identify the purpose and probe the input and output of a 4-bit storage register.**

Assessment Criteria

a. Identify the purpose of a 4-bit storage register.
b. Recognize 4-bit storage register circuits
c. Predict outputs of a 4-bit storage register.
d. Probe the inputs and outputs of a 4-bit storage register.
e. Recognize normal operation of a 4-bit storage register.

Assessment Method

Multiple choice questions
Short answer questions
Practical Exercises
Quiz

**Learning Outcome 3**

**Identify and describe the function and probe the input and output of a 4-bit shift register.**

Assessment Criteria

a. Identify the purpose of a 4-bit shift register.
b. Describe right & left shifts.
c. Recognize 4-bit shift register circuits.
d. Predict outputs of a 4-bit shift register.
e. Probe the inputs and outputs of a 4-bit shift register.
f. Recognize normal operation of a 4-bit shift register.

Assessment Method

Multiple choice questions
Short answer questions
Practical exercises
Quiz

**Learning Outcome 4**

**Identify and describe the function and probe the input and output of an 8-bit shift register.**

Assessment Criteria

a. Identify the purpose of an 8-bit shift register.
b. Describe synchronous and asynchronous data transfer.
c. Recognize 8-bit shift register circuits.
d. Predict the outputs of an 8-bit shift register.

e. Probe the inputs & outputs of an 8-bit shift register.
f. Recognize normal synchronous & asynchronous operation of an 8-bit shift register.

Assessment Method

Multiple choice questions
Short answer questions
Practical exercises
Quiz

**Learning Outcome 5** **Describe the normal operation and the characteristics of a 64-bit memory circuit.**

Assessment Criteria

a. Identify the purpose of a 64-bit memory circuit.
b. Describe word, address, read, write, RAM, ROM volatile, and nonvolatile.
c. Recognize 64-bit memory circuits.
d. Predict outputs of a 64-bit memory circuit.
e. Probe the outputs of a 64-bit memory circuit.
f. Recognize normal operation of a 64-bit memory circuit.

Assessment Method

Multiple choice questions
Short answer questions
Practical exercises/tests

**Learning Outcome 6** **Describe how counting circuits perform arithmetic functions.**

Assessment Criteria

a. Identify the purpose of a counter.
b. Describe Modulus.
c. Recognize basic synchronous and asynchronous counter circuits.
d. Describe how a counter divides and is used as a timing circuit.
e. Identify the purpose of an adder.
f. Describe how adders are used in addition, multiplication, subtraction, and division.
g. Recognize basic half & full adder circuits.

Assessment Method

Multiple choice questions
Short answer questions
Quiz

**Learning Outcome 7** **Recognize the normal operation of a ripple counter circuits.**

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|---|---|
| Assessment Criteria | a. Identify the purpose of a ripple counter.<br>d. Describe a basic ripple counter circuit.<br>e. Recognize various modulus ripple counter circuits.<br>f. Predict & probe outputs of a ripple counter.<br>g. Recognize normal operation of a ripple counter. |
| Assessment Method | Multiple choice questions<br>Short answer questions<br>Practical Exercises<br>Quiz |
| **Learning Outcome 8** | **Describe the purpose of an up counter circuits and probe its outputs.** |
| Assessment Criteria | a. Identify the purpose of an up counter.<br>b. Describe a basic up counter circuit.<br>c. Recognize free run & single step circuits of an up counter.<br>a. Predict and measure outputs of an up counter.<br>b. Recognize normal operation of an up counter. |
| Assessment Method | Multiple Choice Questions<br>Short Answer Questions<br>Practical exercises<br>Quiz |
| **Learning Outcome 9:** | **Describe the purpose of a down counter circuits and probe its outputs.** |
| Assessment Criteria: | a. Identify the purpose of a down counter.<br>b. Describe a basic down counter circuit.<br>c. Recognize free run & single step circuits of a down counter<br>a. Predict and probe the outputs of a down counter.<br>b. Recognize normal operation of a down counter. |
| Assessment Method: | Multiple Choice Questions<br>Short Answer Questions<br>Practical exercises<br>Quiz |

**Learning Outcome 10:** **Describe the function and the operating characteristics of a 4-bit adder circuit.**

Assessment Criteria:

a. Identify the purpose of a 4-bit adder.
b. Describe adder circuits.
c. Recognize serial & parallel full adder circuits.
a. Predict and probe the outputs of a 4-bit adder.
b. Recognize normal operation of a 4-bit adder.

Assessment Method:

Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

**Learning Outcome 11:** **Describe the normal operation of a 4-bit subtractor circuit.**

Assessment Criteria:

a. Identify the purpose of a 4-bit subtractor.
b. Describe Two's complement
c. Recognize serial & parallel full subtractor circuits.
d. Predict and probe outputs of a 4-bit subtractor.
e. Recognize normal operation of a 4-bit subtractor.

Assessment Method:

Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

**Learning Outcome 12:** **Explain the basic operating principles of conversion and data circuits.**

Assessment Criteria:

a. Identify the purpose of conversion circuits.
b. Recognize basic A/D & D/A circuits.
c. Identify the purpose of data circuits.
e. Recognize basic data selector and data distributor.
f. Recognize normal operation of a R/2R ladder D/A converter

Assessment Method:

Multiple Choice Questions
Short Answer Questions
Quiz

**Learning Outcome 13:** **Identify the purpose of a D/A conversion circuit and its operating characteristics.**

Assessment Criteria:

a. Identify the purpose of D/A conversion circuits.
b. Recognize binary weighted D/A converter circuits.
c. Recognize R/2R ladder D/A converter circuits and describe resolution.
d. Predict and measure the outputs of a R/2R ladder D/A converter.

Assessment Method:

Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

**Learning Outcome 14:** **Identify the purpose and describe the basic operation of a data selector circuit and measure its output signals.**

Assessment Criteria:

a. Identify the purpose of data selector circuits.
b. Recognize data selector circuits.
c. Predict and measure the outputs of a data selector circuit.
d. Recognize normal operation of a data selector circuit.

Assessment Method:

Multiple Choice Questions
Short Answer Questions
Practical exercises
Quiz

**Learning Outcome 15:** **Describe the function of a data distribution circuit and its operating characteristics and measure its output signals.**

Assessment Criteria:

a. Identify the purpose of data distributor circuits.
b. Recognize distributor circuits.
c. Predict and measure outputs of a data distributor circuit.
d. Recognize normal operation of a data distributor circuit.

Assessment Method:

Multiple Choice Questions
Short Answer Questions
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