ITT Technical Institute

ET1220T

Digital Fundamentals

Onsite and Online Course

SYLLABUS

Credit hours: 4.5

Contact/Instructional hours: 67 (41 Theory Hours, 26 Lab Hours)

Prerequisite(s) and/or Corequisite(s):

Prerequisite: ET1210T DC-AC Electronics or equivalent; Prerequisite or Corequisite: MA1210T College Mathematics I or equivalent

Course Description:

In this course, students examine the differences between analog and digital signals. Topics include transmission methods, binary data, logic operations, logic circuits, logic symbols, registers and counters.

COURSE SUMMARY

COURSE DESCRIPTION

In this course, students examine the differences between analog and digital signals. Topics include transmission methods, binary data, logic operations, logic circuits, logic symbols, registers and counters.

MAJOR INSTRUCTIONAL AREAS

1. Analog and digital data, devices, and signal conversion
2. Number systems, operations, and codes
3. Logic gates
4. Boolean algebra and logic simplification
5. Combinational and sequential logic circuits
6. Arithmetic operations and circuits
7. Analog and digital signal converters
8. Shift registers
9. Memory and storage
10. State machines and the organization of computer processors and their applications

COURSE LEARNING OBJECTIVES

By the end of this course, you should be able to:

1. Explain the differences, advantages, disadvantages, and means of conversion between analog and digital systems.
2. Use multiple numbering systems, base conversions, operators, and codes to solve digital problems.
3. Explain Boolean logic concepts and construct their equations, truth tables, and equivalent circuits.
4. Demonstrate the use of basic logic blocks, including AND, OR, NAND, NOR, XOR, and inverters.
5. Explain the operation and use of higher level logic such as decoders, flip-flops, shift registers, and memories.

6. Perform logical simplifications and transformations between Boolean equations and circuits.
7. Explain the operation of and differences between combinational and sequential logic circuits, such as decoders and counters.
8. Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.
9. Explain the important electrical characteristics of digital gates and signals.
10. Describe the applications of logic and state machines, including memory circuits and computers.

COURSE OUTLINE

MODULE 1: INTRODUCTION TO DIGITAL TECHNOLOGY

COURSE LEARNING OBJECTIVES COVERED

- Explain the differences, advantages, disadvantages, and means of conversion between analog and digital systems.
- Use multiple numbering systems, base conversions, operators, and codes to solve digital problems.
- Explain Boolean logic concepts and construct their equations, truth tables, and equivalent circuits.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.

TOPICS COVERED

- Analog Versus Digital Systems
- Number Systems, Operations, and Codes
- Logic Circuits: AND, OR, Exclusive OR, and Exclusive NOR Gates

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 1, Chapter 2 (pp. 45–87, pp. 94–99), and Chapter 3 (pp. 119–130, pp. 138–141).	No	6.5 hours
Lesson: Study the lesson for this module.	No	1.5 hours
Exercise: Submit the exercise titled "Digital Technology and Combinational Logic."	Yes	1 hour
Lab: Complete the lab titled "Digital Components to Decode and Add Binary Numbers."	Yes	N/A
Quiz: Prepare for Quiz 1.	No	2 hours

Total Out-Of-Class Activities: 11 Hours

MODULE 2: LOGIC EXPRESSIONS AND BOOLEAN ALGEBRA

COURSE LEARNING OBJECTIVES COVERED

- Explain Boolean logic concepts and construct their equations, truth tables, and equivalent circuits.
- Demonstrate the use of basic logic blocks, including AND, OR, NAND, NOR, XOR, and inverters.
- Perform logical simplifications and transformations between Boolean equations and circuits.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.
- Explain the important electrical characteristics of digital gates and signals.

TOPICS COVERED

- NAND Gates, NOR Gates, and Universal Property
- Boolean Algebra and Boolean Expressions
- Pulse Waveform Operation, Demorgan's Theorems, and Truth Tables

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 3 (pp. 109–119, pp. 130–138, pp. 142–157) and Chapter 4.	No	6.5 hours
Lesson: Study the lesson for this module.	No	2 hours
Quiz: Prepare for Quiz 2.	No	2 hours
Discussion: Participate in the discussion titled "The Rising Use of Programmable Logic Devices."	Yes	3 hours
Exercise: Submit the exercise titled "Logic Families and Boolean Algebra."	Yes	2.5 hours
Lab: Complete the lab titled "Use of Combinational Logic to Implement a Digital Solution."	Yes	N/A
Quiz: Take Quiz 1.	Yes	N/A

Total Out-Of-Class Activities: 16 Hours

MODULE 3: LOGIC CIRCUITS

COURSE LEARNING OBJECTIVES COVERED

- Demonstrate the use of basic logic blocks, including AND, OR, NAND, NOR, XOR, and inverters.
- Explain the operation and use of higher level logic such as decoders, flip-flops, shift registers, and memories.
- Perform logical simplifications and transformations between Boolean equations and circuits.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.

TOPICS COVERED

- Half and Full Adders
- Encoders and Decoders
- Multiplexers and Demultiplexers
- Parity Generation and Bus Interfacing

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 5 and Chapter 14 (pp. 693–703).	No	5.5 hours
Lesson: Study the lesson for this module.	No	1.5 hours
Quiz: Prepare for Quiz 3.	No	2 hours
Discussion: Participate in the discussion titled "Complex Digital Encoder and Decoder Chips."	Yes	2.5 hours
Exercise: Submit the exercise titled "Combinational Logic, Networking, and Interfacing."	Yes	2.5 hours
Lab: Complete the lab titled "Standard Logic Devices to Implement Digital Solutions."	Yes	N/A
Quiz: Take Quiz 2.	Yes	N/A

Total Out-Of-Class Activities: 14 Hours

MODULE 4: BASIC SEQUENTIAL LOGIC AND REGISTERS

COURSE LEARNING OBJECTIVES COVERED

- Explain the operation and use of higher level logic such as decoders, flip-flops, shift registers, and memories.
- Perform logical simplifications and transformations between Boolean equations and circuits.
- Explain the operation of and differences between combinational and sequential logic circuits, such as decoders and counters.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.

TOPICS COVERED

- Latches
- Flip-Flops, Bistable Logic with VHDL and Verilog, and Timers
- Shift Registers, Shift Register Counters, and Security System with VHDL and Verilog

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 6 (pp. 290–321, pp. 331–339) and Chapter 7.	No	5.5 hours
Lesson: Study the lesson for this module.	No	2 hours
Quiz: Prepare for Quiz 4.	No	2 hours
Discussion: Participate in the discussion titled "Binary Data Transmission."	Yes	2.5 hours
Exercise: Submit the exercise titled "Latches, Flip-Flops, Timers, and Shift Registers."	Yes	2 hours
Lab: Complete the lab titled "Sequential Logic Using Flip Flops and Registers."	Yes	N/A
Quiz: Take Quiz 3.	Yes	N/A

Total Out-Of-Class Activities: 14 Hours

MODULE 5: USING COUNTERS AND MEMORY

COURSE LEARNING OBJECTIVES COVERED

- Explain the operation and use of higher level logic such as decoders, flip-flops, shift registers, and memories.
- Explain the operation of and differences between combinational and sequential logic circuits, such as decoders and counters.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.
- Describe the applications of logic and state machines, including memory circuits and computers.

TOPICS COVERED

- Finite State Machines
- Asynchronous and Synchronous Counters
- Memory Systems
- RAM, ROM, and Flash Memory Devices

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 8 (pp. 392–422, pp.425–428) and Chapter 10 (pp. 496–529).	No	6.5 hours
Lesson: Study the lesson for this module.	No	2 hours
Final Exam: Prepare for the final exam.	No	5 hours
Discussion: Participate in the discussion titled "Process Implementation by the State Machine."	Yes	3 hours
Exercise: Submit the exercise titled "Counters, Memory, and Storage."	Yes	3 hours
Lab: Complete the lab titled "Sequential Logic to Count."	Yes	N/A
Quiz: Take Quiz 4.	Yes	N/A

Total Out-Of-Class Activities: 19.5 Hours

MODULE 6: STATE MACHINES

COURSE LEARNING OBJECTIVES COVERED

- Explain the operation and use of higher level logic such as decoders, flip-flops, shift registers, and memories.
- Implement basic combinational and sequential logic circuits through drawings, simulations, and breadboarding.

TOPICS COVERED

- A-System and Flip Flops
- Programmable Logic
- Programmable Gate Arrays

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Floyd Thomas. L, Chapter 6 (pp. 290–312) and Chapter 9 (pp. 439–461).	No	3 hours
Lesson: Study the lesson for this module.	No	1.5 hours
Lab: Complete the lab titled "Programmable State Machine."	Yes	N/A
Final Exam: Take the final exam.	Yes	N/A

Total Out-Of-Class Activities: 4.5 Hours

EVALUATION AND GRADING

EVALUATION CRITERIA

The graded assignments will be evaluated using the following weighted categories:

Category	Weight
Discussion	10%
Exercise	20%
Lab	30%
Quiz	20%
Final Exam	20%
TOTAL	100%

GRADE CONVERSION

The final grades will be calculated from the percentages earned in the course, as follows:

Grade		Percentage
A	(4.0)	90–100%
B+	(3.5)	85–89%
B	(3.0)	80–84%
C+	(2.5)	75–79%
C	(2.0)	70–74%
D+	(1.5)	65–69%
D	(1.0)	60–64%
F	(0.0	<60%

)	

LEARNING MATERIALS AND REFERENCES

REQUIRED RESOURCES

COMPLETE TEXTBOOK PACKAGE

- Floyd, T. L. (2013). *Digital fundamentals: A systems approach (1st ed.). Upper Saddle River, NJ: Pearson Prentice Hall.*
- Floyd, T. L. (2013). *Lab manual for digital fundamentals: A systems approach (1st ed.). Upper Saddle River, NJ: Prentice Hall.*

OTHER ITEMS

- Student Toolkit (distributed in ET1210)

RECOMMENDED RESOURCES

- ITT Tech Virtual Library (accessed via Student Portal | https://studentportal.itt-tech.edu)
  - School of Study> School of Electronics Technology> Research Guides> Electrical Engineering Technology
    - Brewster, H. D. (2009). *Digital Electronics. Jaipur, India: Oxford Book Company.*
    - Holdsworth, B. (2002). *Digital Logic Design. 4th ed. Oxford: Newnes.*
  - School of Study> School of Electronics Technology> Professional organizations
    - IEEE: Institute of Electrical and Electronics Engineers
    - IEEE Technical Societies/ Councils
    - Electronics Technicians Association
  - School of Study> School of Electronics Technology> Recommended Links
    - IEEE Spectrum Online: http://spectrum.ieee.org/
    - IEEE Standards Association: http://standards.ieee.org/
    - EE Times Online: http://www.eetimes.com/programmable-logic-designline.asp

INSTRUCTIONAL METHODS AND TEACHING STRATEGIES

The curriculum employs a variety of instructional methods that support the course objectives while fostering higher cognitive skills. These methods are designed to encourage and engage you in the learning process in order to maximize learning opportunities. The instructional methods include but are not limited to lectures, collaborative learning options, use of technology, and hands-on activities.

To implement the above-mentioned instructional methods, this course uses several teaching strategies, such as discussions, exercises and labs. Your progress will be regularly assessed through a variety of assessment tools including discussions, exercises, labs, quizzes and final exam.

OUT-OF-CLASS WORK

For purposes of defining an academic credit hour for Title IV funding purposes, ITT Technical Institute considers a quarter credit hour to be the equivalent of: (a) at least 10 clock hours of classroom activities and at least 20 clock hours of outside preparation; (b) at least 20 clock hours of laboratory activities; or (c) at least 30 clock hours of externship, practicum or clinical activities. ITT Technical Institute utilizes a “time-based option” for establishing out-of-class activities which would equate to two hours of out-of-class activities for every one hour of classroom time. The procedure for determining credit hours for Title IV funding purposes is to divide the total number of classroom, laboratory, externship, practicum and clinical hours by the conversion ratios specified above. A clock hour is 50 minutes.

A credit hour is an artificial measurement of the amount of learning that can occur in a program course based on a specified amount of time spent on class activities and student preparation during the program course. In conformity with commonly accepted practice in higher education, ITT Technical Institute has institutionally established and determined that credit hours awarded for coursework in this program course (including out-of-class assignments and learning activities described in the “Course Outline” section of this syllabus) are in accordance with the time-based option for awarding academic credit described in the immediately preceding paragraph.

ACADEMIC INTEGRITY

All students must comply with the policies that regulate all forms of academic dishonesty or academic misconduct. For more information on the academic honesty policies, refer to the Student Handbook and the School Catalog.

INSTRUCTOR DETAILS

Instructor Name	
Office Hours	
Contact Details	

(End of Syllabus)