ELEN307 16

Course Summary

Course : ELEN307 **Title :** Digital Circuit Theory
Length of Course : 16
Prerequisites : ELEN305 **Credit Hours :** 4

Description

Course Description: This course presents digital and logic circuit analysis and design. The course covers six main parts: Boolean algebra and Boolean function simplification; basic logic gates, combinational functional blocks, and combinational circuit design using gates and functional blocks; digital circuit description by VHDL language; basic flip-flops, sequential circuit analysis and design; registers, static and dynamic memories, ROM and RAM, programmable logic devices, and field programmable gate arrays (FPGA's); and register transfer language, basic computer structure, operation and design. Students will be introduced to the concepts of digital circuit theory and design, will practice with circuit analysis software, will gain solid skills to analyze and design digital circuits for various applications, and will get familiar with the structure and operation of a digital processor. NOTE: This course requires the student to purchase additional materials that are not covered by the book grant. Please refer to the Course Materials section for additional details. (Prerequisite: ELEN305)

Course Scope:

This course covers the fundamentals of the analysis and design of digital circuits at the gate and system level. The course starts with Boolean algebra and logic gates as the basic building blocks of all digital circuits. It then introduces methods for designing combinational circuits using the basic gates. Flip-flops are then introduced as the building blocks, along with gates, of sequential circuits. Methods for designing sequential circuits using gates and flip-flops are presented. Hardware description languages, simulation and data flow programming are used throughout the course

Objectives

After completing the course, the student should be able to accomplish these Course Objectives (CO):

CO-1. Demonstrate a binary representation of data, binary codes, and conversion among data representation systems.

CO-2. Apply Boolean algebra to represent and simplify digital logic circuits.

CO-3. Design a combinational circuit using simulation software and a programmable logic

device.

CO-4. Design digital circuit using a hardware description language.

CO-5. Design an arithmetic circuit using simulation and a programmable logic device.

CO-6. Design a sequential digital system using simulation and a programmable logic device.

CO-7. Evaluate methods of digital circuit design against specified design requirements and constraints.

CO-8. Prepare effective communication material using technical data.

Outline

Week 1: Number Systems, Binary Codes, Binary Code Conversion, Digital Signals

---

Course Objective(s)

CO-1

Readings

Unit 1 Introduction Number Systems and Conversion

Assignment(s)

Week 1 Forum - Introduction

Tutorial 1: Software Installation Tutorial

Start Week 1/2 Assignment (meets CO-1), which is due in Week 2

Week 2: Basic Gates

Course Objective(s)

CO-2, CO-3

Readings

Unit 2 Boolean Algebra

Assignment(s)

Week 1/2 Assignment

Week 2/3 Forum

Tutorial 2: MultiSim Simulation Tutorial

Week 3: Boolean Algebra and Reduction Methods

Course Objective(s)

CO-2, CO-3, CO-8

Readings

Unit 3 Boolean Algebra (Continued)

Assignment(s)

Week 2/3 Forum

Lab 1: MultiSim Simulation Lab

Start Week 3/4 Assignment (meets CO-2 and CO-3), which is due in Week 4

Week 4: Sum of Products and Product of Sums

Course Objective(s)

CO-2, CO-3

Readings

Unit 4 Application of Boolean Algebra Minterm and Maxterm Expansions

Assignment(s)

Week 3/4 Assignment (meets CO-2 and CO-3)
Tutorial 3: LabVIEW Simulation (meets CO-3)

Week 4 Quiz

Week 5: Circuit Design with Karnaugh Maps

Course Objective(s)

CO-2, CO-3, CO-8

Readings

Unit 5 Karnaugh Maps

Assignment(s)

Week 4/5 Forum

Lab 2: LabVIEW Simulation (meets CO-3 and CO-8)

Start Week 5/6 Assignment (meets CO-2 and CO-3), which is due in Week 6

Week 6: Specifications

Course Objective(s)

CO-3, CO-6, CO-8

Readings

Unit 8 Combinational Circuit Design and Simulation Using Gates

Assignment(s)

Week 5/6 Assignment

Week 6/7 Forum

Lab 3: LabVIEW Programming Lab

Week 7: Hardware Description Languages (VHDL)

Course Objective(s)

CO-4

Readings

Unit 10 Introduction to VHDL

Assignment(s)

Week 6/7 Forum

Tutorial 4: VHDL Tutorial

Start Week 7/8 Assignment (meets CO-3 and CO-4), which is due in Week 8

Week 8: Arithmetic Circuits

Course Objective(s)

CO-4, CO-5

Readings

Prepare for midterm

Assignment(s)

Week 7/8 Assignment

Midterm Test

Week 8/9 Forum

Week 9: Multiplexers, Demultiplexers, Encoders and Decoders

Course Objective(s)

CO-7, CO-8

Readings

Unit 9 Multiplexers, Decoders, and Programmable Logic Devices

Assignment(s)

Week 8/9 Forum

Start Lab 4: Design Methods (meets CO-7)

Start Week 9/10 Assignment (meets CO-6 and CO-7), which is due in Week 10

Week 10: Flip-flops and latches

Course Objective(s)

CO-6

Readings

Unit 11 Latches and Flip-Flops

Assignment(s)

Week 10/11 Forum

Week 9/10 Assignment (meets CO-6 and CO-7)

Lab 4 (meets CO-6 and CO-7)

Week 11: Registers and counters schematics

Course Objective(s)

CO-6, CO-8

Readings

Unit 12 Registers and Counters

Assignment(s)

Week 10/11 Forum

Start Lab 5: Counters and Shift Registers Part 1 (meets CO-6 AND CO-8)

Start Week 11/12 Assignment (meets CO-6), which is due in week 12

Week 12: Registers and counters in VHDL and LabVIEW

Course Objective(s)

CO-6, CO-8

Readings

Units 17.1, 17.2 and 17.3 VHDL for Sequential Logic

Assignment(s)

Week 12/13 Forum

Week 11/12 Assignment (meets CO-6)

Lab 5: Registers and Counters (meets CO-6 AND CO-8)

Week 12 Quiz

Week 13: Derivation of state graphs and tables

Course Objective(s)

CO-6, CO-8

Readings

Units 13 Analysis of Clocked Sequential Circuits and Unit 14 Derivation of State Graphs and Tables

Assignment(s)

Week 12/13 Forum

Start Lab 6: State Machine Simulation

Start Week 13/14 Assignment (meets CO-6), which is due in Week 14

Week 14: State Machine Schematics

Course Objective(s)

CO-6, CO-8

Readings

Unit 15 Reduction of State Tables and Unit 16 Sequential Circuit Design

Assignment(s)

Week 14/15 Forum

Week 13/14 Assignment (meets CO-6)

Lab 6: State Machines (meets CO-6 and CO-8)

Week 15: State machines in VHDL

Course Objective(s)

CO-6, CO-8

Readings

Unit 17.4 VHDL for Sequential Logic

Assignment(s)

Week 14/15 Forum

Start Lab 7: VHDL State Machine (meets CO-7)

Week 16: State Machines in LabVIEW

Course Objective(s)

CO-6, CO-7, CO-8

Readings

Prepare for Final Test

Assignment(s)

Week 16 Forum

Labs 6, 7 and 8: State Machines

Final Test

Evaluation

This is an upper level course. All students' work is to be presented as such in terms of quality and content. The grading system will be based on your participation in the forums, assignments, tutorials, labs, quizzes, and test.

Reading Assignments: Please refer to the Course Outline section of this syllabus for the weekly reading assignments.

Week 1 Self-introductions: During Week 1 forum, each student must post a self-introduction (bio) to the class. This self-introduction is a requirement by the University, and is due by mid-night of Sunday of Week 1, along with two reply posts to other students. Your response must be at least 100 words (a requirement) and include the following information:

a. Your name
b. Your major
c. Where you are in the program of study - what percentage of the program have you completed?
d. Your academic and career goals
e. Your thoughts on what the word digital means and how digital is different from analog

Forums: There will be twelve forums (1% each), counting 12% of the final grade. The forums will consist of specific questions to be answered, broad questions to be discussed, or polls for students to post their questions on the topics covered in that week. In each forum, a student is required to contribute an initial post in all weeks. Some weeks require two reply posts to other students in class. In weeks were reply posts are required, the initial post will be 60% of the grade and each reply post will be 20% of the grade.

Assignments: There will be seven assignments (2% each) during the course worth a total of 14% of the total grade. Each weekly assignment will cover one or more chapters in the book used in this course. For all problems requiring mathematical calculations, all work must be shown.

Quizzes: There will be two quizzes (5% each), counting 10% of the final grade. Tests will be open book, and open note. Tests will be non-proctored and will be design based. Students must complete each test within its time limit.

Tests: There will be two tests (8% each), counting 16% of the final grade. Tests will be open book, and open note. Tests will be non-proctored and will be design based. Students must complete each test within its time limit.

Tutorials: There will be four tutorials (1% each), counting 4% of the final grade. Tutorials will introduce new software and hardware to the course and will require evidence of successful completion of the tutorial.

Labs: There will be eight labs (5% each), counting 40% of the final grade. Labs will require a written lab report as well as evidence of successful completion of the lab.

Grading:

Name	Grade %
Forums	12.00 %
Week 1 Forum	1.33 %
Week 2/3 Forum	1.33 %
Week 4/5 Forum	1.33 %
Week 6/7 Forum	1.33 %
Week 8/9 Forum	1.33 %
Week 10/11 Forum	1.33 %
Week 12/13 Forum	1.33 %
Week 14/15 Forum	1.33 %
Week 16 Forum	1.33 %
Assignments	14.00 %
Week 1/2 Assignment	2.33 %
Week 3/4 Assignment	2.33 %
Week 5/6 Assignment	2.33 %
Week 9/10 Assignment	2.33 %
Week 11/12 Assignment	2.33 %
Week 13/14 Assignment	2.33 %
Labs	40.00 %
Lab 1: MultiSim Simulation	5.00 %
Lab 2: LabVIEW Simulation	5.00 %
Lab 3: LabVIEW Programming	5.00 %
Lab 4: Design Methods	5.00 %
Lab 5: Registers and Counters	5.00 %
Lab 6: State Machine Schematics	5.00 %
Lab 7: State Machine VHDL	5.00 %
Lab 8: State Machine LabVIEW	5.00 %
Quizzes	10.00 %
Week 12 Quiz	5.00 %
Week 4 Quiz	5.00 %
Tutorials	8.00 %
Tutorial 1: Software Installation	2.00 %
Tutorial 2: MultiSim Simulation	2.00 %
Tutorial 3: LabVIEW Simulation	2.00 %
Tutorial 4: VHDL	2.00 %
Tests	16.00 %
Final Test	6.86 %
Midterm Test	9.14 %

Materials

Book Title: NI Student Software Suite - free access provided inside the classroom; if DVD is needed, purchase instructions are available here: https://apus.libanswers.com/coursematerials/faq/239701 (DVD not covered by the APUS Book Grant)

Author: National Instruments

Publication Info: National Instruments

ISBN: 779252-3501

Book Title: Fundamentals of Logic Design, 7th ed - the VitalSource e-book is provided inside the classroom

Author: Roth, Charles H. / Kinney, Larry L.

Publication Info: VS-Cengage

ISBN: 9781133628477

Lab Materials:

Selected Bibliography

There are numerous online resources to help you in better understanding the objectives outlined in this course. Please see the APUS Online Library, which has several circuit theory related textbooks available online.

1. Mano, M. M., Kime, C. R., Logic and Computer Design Fundamentals, 4th edition, Prentice-Hall, 2008,
2. Brown, S., Vranesic, Z., Fundamentals of Digital Logic with VHDL Design with CD-ROM, 3rd Edition, McGraw-Hill, 2008
3. Holdsworth, B., Woods, R.C., Digital Logic Design, 4th edition, Elsevier, 2003
4. Balabanian, N., Digital Logic Design Principles, John Wiley, 2000
5. Mano, M. M., Digital Design, 3rd edition, Prentice-Hall, 2002
6. Godse, A.P., Godse, D. A., Digital Logic Design, Technical Publications, 2009
7. Vahid, F., Digital Design with RTL Design, VHDL, and Verilog, 2nd edition, Wiley, 2011
8. Floyd, T. L., Digital Fundamentals, 10th edition, Pearson, 2009

Course Guidelines

Citation and Reference Style

- Attention Please: Students will follow the APA Format as the sole citation and reference style used in written work submitted as part of coursework to the University. Assignments completed in a narrative essay or composition format must follow the citation style cited in the APA Format.

Tutoring

- Tutor.com offers online homework help and learning resources by connecting students to certified tutors for one-on-one help. AMU and APU students are eligible for 10 free hours* of tutoring provided by APUS. Tutors are available 24/7 unless otherwise noted. Tutor.com also has a SkillCenter Resource Library offering educational resources, worksheets, videos, websites and career help. Accessing these resources does not count against tutoring hours and is also available 24/7. Please visit the APUS Library and search for 'Tutor' to create an account.

Late Assignments

- Students are expected to submit classroom assignments by the posted due date and to complete the course according to the published class schedule. The due date for each assignment is listed under each Assignment.
- Generally speaking, late work may result in a deduction up to 15% of the grade for each day late, not to exceed 5 days.
- As a working adult I know your time is limited and often out of your control. Faculty may be more flexible if they know ahead of time of any potential late assignments.

Turn It In

- Faculty may require assignments be submitted to Turnitin.com. Turnitin.com will analyze a paper and report instances of potential plagiarism for the student to edit before submitting it for a grade. In some cases professors may require students to use Turnitin.com. This is automatically processed through the Assignments area of the course.

Academic Dishonesty

- Academic Dishonesty incorporates more than plagiarism, which is using the work of others without citation. Academic dishonesty includes any use of content purchased or retrieved from web services such as CourseHero.com. Additionally, allowing your work to be placed on such web services is academic dishonesty, as it is enabling the dishonesty of others. The copy and pasting of content from any web page, without citation as a direct quote, is academic dishonesty. When in doubt, do not copy/paste, and always cite.

Submission Guidelines

- Some assignments may have very specific requirements for formatting (such as font, margins, etc) and submission file type (such as .docx, .pdf, etc) See the assignment instructions for details. In general, standard file types such as those associated with Microsoft Office are preferred, unless otherwise specified.

Disclaimer Statement

- Course content may vary from the outline to meet the needs of this particular group.

Communicating on the Forum

- Forums are the heart of the interaction in this course. The more engaged and lively the exchanges, the more interesting and fun the course will be. Only substantive comments will receive credit. Although there is a final posting time after which the instructor will grade comments, it is not sufficient to wait until the last day to contribute your comments/questions on the forum. The purpose of the forums is to actively participate in an on-going discussion about the assigned content.
- “Substantive” means comments that contribute something new and hopefully important to the discussion. Thus a message that simply says “I agree” is not substantive. A substantive comment contributes a new idea or perspective, a good follow-up question to a point made, offers a response to a question, provides an example or illustration of a key point, points out an inconsistency in an argument, etc.
- As a class, if we run into conflicting view points, we must respect each individual's own opinion. Hateful and hurtful comments towards other individuals, students, groups, peoples, and/or societies will not be tolerated.

Identity Verification & Live Proctoring

- Faculty may require students to provide proof of identity when submitting assignments or completing assessments in this course. Verification may be in the form of a photograph and/or video of the student’s face together with a valid photo ID, depending on the assignment format.
- Faculty may require live proctoring when completing assessments in this course. Proctoring may include identity verification and continuous monitoring of the student by webcam and microphone during testing.

University Policies

Student Handbook

- Drop/Withdrawal policy
- Extension Requests

- Academic Probation
- Appeals
- Disability Accommodations

The mission of American Public University System is to provide high quality higher education with emphasis on educating the nation's military and public service communities by offering respected, relevant, accessible, affordable, and student-focused online programs that prepare students for service and leadership in a diverse, global society.