ELEC A135: SYMBOLIC LOGIC WITH DIGITAL APPLICATIONS

Item	Value
Curriculum Committee Approval Date	12/08/2021
Top Code	093400 - Electronics and Electric Technology
Units	4 Total Units
Hours	108 Total Hours (Lecture Hours 54; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	Yes
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

Introduction to logic as it applies to discrete Boolean mathematics, deductive reasoning, and digital applications including computer programming, architecture, and embedded systems. An in-depth study of obverse, inverse, AND/OR logical operations. Boolean algebra techniques are applied to simplify complex equations. Students will build, measure, test, analyze and troubleshoot series, parallel and complex circuits. Reading documentation commonly found in industry, i.e., schematics, specifications, assembly and test procedures, will also be included. ADVISORY: Math placement above MATH A030, or ELEC A047 or concurrent enrollment; and ELEC A173. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Analyze logical expressions and apply Boolean algebra methods to simplify the equation.
2. Build, test and diagnose (trouble-shoot) complex logic circuits that are the building blocks of computer architecture.
3. Design a logic circuit to solve a specific application.
4. Communicate using industry standard nomenclature (vocabulary and documentation) for technicians and engineers.
5. Discuss industry trends in computer logic applications.
6. Analyze logical expressions and apply Boolean algebra methods to simplify the equation.
7. Design a logic circuit to solve a specific application.

Course Objectives

- 1. Demonstrate an ability to convert between any two of the following number systems: decimal; binary; octal; hexadecimal; and BCD.
- 2. Develop truth tables and timing diagrams for logic gates.
- 3. Build and test logic circuits.
- 4. Build circuits from a Boolean equation.
- 5. Apply Boolean laws and rules to simplify Boolean expressions.
- 6. Apply De Morgans Theorem to simplify Boolean expressions.
- 7. Simplify Boolean expressions into sum-of-products and product-of-sum expressions.
- 8. Identify the characteristics and specifications for TTL integrated circuits.
- 9. Analyze encoder, decoder, and multiplexer circuits.
- 10. Troubleshoot circuits using test equipment and critical thinking skills.
- 11. Perform binary addition and subtraction.
- 12. Perform twos complement computations.
- 13. Describe how half and full adder circuits function.
- 14. Develop the truth tables for RS, D-type, and JK flip-flops.
- 15. Evaluate timing diagrams for flip-flops and latches.
- 16. Build, test, and analyze latches, registers, and counters.
- 17. Utilize a buss to test two circuits simultaneously.
- 18. Classify memory circuits.
- 19. Describe addressing techniques used on memory circuits.
- 20. Describe the three-buss microprocessor architecture.
- 21. Analyze a schematic of a simple microprocessor, or application specific integrated circuit, or programmable logic device, or microcontroller.
- 22. Analyze a simple assembly language or microprogram.
- 23. Identify looping and subroutines in a complex program.
- 24. Explain addressing modes, interrupts, and flowcharts.
- 25. Analyze electronic circuits from schematics.
- 26. Select test instruments and measure electronic circuits.
- 27. Diagnose errors and /or component changes.

Lecture Content

Number Systems and Codes Digital vs Analog Numbering Systems Decimal Binary Octal Hexadecimal Alphanumeric Codes Application of Numbering Systems Integrated Circuits Digital Electronic Signals and Switches Basic Logic Gates Binary Addition Boolean Laws and Rules Boolean constants and variables Truth tables Describing logic circuits algebraically OR operation with OR gates AND operation with AND gates NOT operation Evaluating logic circuit outputs NOR gates and NAND gates Boolean Algebra I Binary addition Signed numbers Operations using the 2s complement system Multiplication and division of binary numbers Integrated circuit arithmetic logic units The programmable logic operatoable multivibratorstes De Morgans Theorem Sequential Logic Circuits II NAND and NOR latches Clocked flip-flops Asynchronous inputs Timing considerations and problems Data storage and transfer Frequency division and counting Microcomputer applications Monostable and astable multivibratorstes TTL Characteristics Counters and Registers Synchronous Logic Circuits I Synchronous Logic Circuits II Computer Memory instructions Buss Architecture Programmable Devices

Lab Content

A minimum of 10 lab projects will be compled. These lab projects reinforce the lectures, teach critical thinking skills, and provide the data for the documentation and analysis in the journals submitted by the students for instructor review. Digi-designer layout/sample experiment (mandatory laboratory session) Integrated circuits, 4-input gates XOR, XNOR gate Combination logic design Half Adder Algebraic laws and rules De Morgans Theorem Decoder/driver 7-segment display Multiplexer S-R flip-flop D type latch Parallel in Parallel out Serial in Serial out 4-bit ring counter JK slip flop Ripple counter Decade counter 4-bit shift register Z80 instruction set Assembly language 1KHZ tone Loop routines Delay routines

Method(s) of Instruction

- Lecture (02)
- Lab (04)

Instructional Techniques

Lecture, lab, demonstration of concepts, discussion, group work, case studies and inclass group work, peer review, written exams, technical reports and self evaluation.

Reading Assignments

Students will be expected to read all pertinent chapters of the required textbook.

Writing Assignments

Engineering journalsTechnical reportsEngineering portfolio of all work completed

Out-of-class Assignments

Homework will be assigned from, but not limited to, the chapters in the text, handouts discussed, and Internet research. Homework will include a journal of class notes and an informal report of the procedure and data analysis for each of the projects completed. These assignments will be submitted periodically to the instructor for review and revised by the student as necessary to meet minimum requirements for accuracy and content.

Demonstration of Critical Thinking

Written Examination Pre-test, written examinations, a final exam will assess mastery of the subject. Discussion Formal and informal peer review and discussion. Formal discussions are moderated by the instructor. Informal discussions are motivated by the team working on project assignments. Instructors observe and verbally interrogate the student with: inquiry based, open ended, analytical, and hypothetical questions. The student will demonstrate proficiency with scientific calculators and test equipment during each of the lecture periods.

Required Writing, Problem Solving, Skills Demonstration

Technical Documentation The student will keep an engineering journal, prepare technical reports for the class projects, and keep an engineering portfolio of all work completed during the course. In the portfolio the student will monitor their progress against the course syllabi. Practical Examinations Construct circuits using schematics, use appropriate equipment to test and diagnose circuits.

Textbooks Resources

1. Required Klietz, William. Digital Electronics, ed. New Jersey: Prentice Hall, 2007