COURSE NUMBER: CSCI 150 **CREDITS: 3**

COURSE TITLE: INTRODUCTION TO COMPUTER DESIGN **PREREQUISITES: None**

Weekly Hours: 4	Lecture: 2.5	Lab: 1.5	Total Hours: 4	Total Weeks: 13

COURSE DESCRIPTION: This course introduces students to the basic concepts of digital logic design, and the function and use of typical digital components belonging primarily to the small and medium scale integration (SSI, MSI) families. The design principles will be used to develop an understanding of how the functional capabilities can be provided by hardware for the operation of a microprocessor. An interactive logic simulation environment for designing and testing logic circuit design will be used for the assignments.

TEXTBOOK:

Required: Digital Design, 5th edition, M. Morris, Mano and Michael D. Ciletti, Prentice Hall, 2012, ISBN: 978-0132774208.

Recommended: Logic and Computer Design Fundamentals, 5th edition, M. Morris Mano, Charles R. Kime, and Tom Martin, Pearson/Prentice Hall, 2016, ISBN-13: 9780134080055.

LEARNING OUTCOMES:

By successful completion of this course, you should be able to:

- Describe digital systems and their types.
- Demonstrate the representation of information for digital systems.
- Define digital and analog system with examples and identify the difference between these.
- Explain number systems particularly binary, octal and hexadecimal and describe their interconversion with examples. Illustrate arithmetic operations.
- Explain BCD (Binary Coded Decimal) and its arithmetic.
- Define alphanumeric codes and their applications.
- Explain gate circuits and Boolean equations.
- Define logic gates (OR,AND,NOT,NAND,NOR,XOR,XNOR) and represent logic functions using truth tables,
- Boolean equations and logic diagrams.
- Explain Boolean algebra, algebraic and Karnaugh map optimization, the Espresso algorithm as a pragmatic CAD optimization tool and multilevel optimization.
- Describe combinational logic designs.
- Explain steps of the design process including problem formulation, logic optimization, technology mapping to NAND and NOR gates, and their verification.

- Describe the functions and building blocks of combinational design including enabling and input-fixing, decoding, encoding, code conversion, selecting, distributing, and their implementations and simulation.
- Describe arithmetic functions and hardware description languages（HDL).
- Define arithmetic functions and their implementations.
- Describe number representation, addition, subtraction, incrementing, decrementing, filling, extension and shifting for arithmetic functions and their implementation.
- Explain HDLs and Verilog HDL and state how these are used to describe combinational logic and arithmetic logic.
- Explain sequential circuits and their types.
- Analyse, design and simulate sequential circuits.
- Describe latches, master-slave flip-flops and edge-triggered flip-flops.
- Describe state machine diagrams and state table formulation.
- Explain a complete design process for sequential circuits including specification, formulation, state assignment, flip-flop input and output equation determination, optimization, technology mapping and verification.
- Define integrated circuits and levels of integration.
- Describe MOS transistor and CMOS circuits, asynchronous interactions between circuits and programmable logic technologies.
- Demonstrate synchronization of asynchronous inputs and metastability.
- Describe delay and timing for gates.
- Describe programmable logic, programmable logic arrays and programmable array logic.
- Explain registers and register transfers.
- Describe registers and their applications.
- Demonstrate how shift register and counter design are based on the combination of flip-flops.
- Define register transfers for both parallel and serial designs and describe time-space tradeoffs.
- Describe multi-function registers that perform multiple operations.
- Explain memory basics.
- Describe static random access memory (SRAM), dynamic random access memory (DRAM) and basic memory systems.
- Describe distinct types of SRAMs.
- Explain computer design basics.
- Describe register files, function units and datapaths.
- Describe two simple computers: a single-cycle computer and a multiple-cycle computer and their functionality.

COURSE CONTENT:

Week	Topic	Chapter
Week 1	Introduction to digital system and Number systems	1
Week 2	Number system, Binary arithmetic, BCD, Alphanumeric codes, Gray Codes	1
Week 3	Binary Logic and gates, Boolean algebra, Algebraic manipulation	2
Week 4	Standard form, Minterms and Maxterms, Karnaugh map optimization, More gate types	2
Week 5	Combinational logic design, design procedure, functional blocks,	3

	Decoders, Encoders and Multiplexers	
Week 6	Iterative combinational circuits, Arithmetic functions and HDLs, Adders, Complements, subtraction using 2s complement	4
Week 7	Midterm Exam, Sequential circuit definitions	5
Week 8	Latches, Flip-flops, Sequential circuit analysis	5
Week 9	The design space, Introduction to Integrated circuit, CMOS circuit technology	6
Week 10	Introduction to Registers, Register transfers and Register transfer operations, Microoperations, Register cell design	7
Week 11	Memory Definitions, Introduction to Random-Access Memory, SRAM Integrated circuits, DRAM ICs, DRAM and its types	8
Week 12	Computer design basics, Introduction to Datapaths, Arithmetic/Logic unit, Introduction to Shifter	9
Week 13	Datapath representation, Instruction formats and specifications	10

EVALUATION:

Class Participation	10%
Assignment/Labs	5%
Quizzes	15%
Midterm	30%
Final exam	40%
Total	100%

Midterm and Final Exam – The format for all exams is three hours, closed book and written exam.

Cheating: Students cheating on tests and exams will receive a “F” grade in this course.

If a student misses an exam, a mark of zero will be assigned unless there are extenuating circumstances. In such cases, the proportion of grade assigned to the missed exam will be added to the proportion assigned to the final exam. The final exam will be held during exam week. NO consideration will be given to any student wishing to write the exam at any other time than that assigned.

It is a student’s responsibility to know and follow the school’s policies regarding cheating on exams.

The school’s policy regarding electronic devices is that any student who has a cell phone or other unauthorized electronic device (ie. Ipad, laptop, playbook, etc.) on their person or around their desk during an exam will be guilty of cheating and will a grade of “F” for the course.