COQUITLAM COLLEGE
Established 1982

COURSE OUTLINE

Effective: August 2018

COURSE INFORMATION

Course Title: Introduction to Computer Design

Course Number: CSCI 150 **Credits:** 3

Total Weeks: 14 (Fall, Spring)
12 (Summer)

Total Hours: 39

Course Level: ☒ First Year ☐ Second Year
☐ New ☐ Revised Course
☐ Replacement Course

Department: Computer Science **Department Head:** M. O'Connor

Former Course Code(s) and Number(s) (if applicable): N/A

Pre-requisites (If there are no prerequisites, type NONE): NONE

Co-requisite Statement (List if applicable or type NONE): NONE

Precluded Courses: N/A

COURSE DESCRIPTION

In this course students will be introduced 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. Assembly language programming will also be introduced.

LEARNING OUTCOMES

Upon successful completion of the course, students will 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 trade-offs.
- 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 data paths.
- Describe two simple computers: a single-cycle computer and a multiple-cycle computer and their functionality.

INSTRUCTION AND GRADING

Instructional (Contact) Hours:

Type	Duration
Lecture	39
Seminars/Tutorials	
Laboratory	
Field Experience	
Other (*specify):*	
Total	39

Grading System: Letter Grades ☒ Percentage ☐ Pass/Fail ☐ Satisfactory/Unsatisfactory ☐ Other ☐

Specify passing grade: 50%

Evaluation Activities and Weighting (total must equal 100%)

Assignments: 5%	Lab Work: %	Participation: 10%	Project: %
Quizzes/Test: 15%	Midterm Exam: 30%	Final Exam: 40%	Other: %

TEXT(S) AND RESOURCE MATERIALS

Provide a full reference for each text and/or resource material and include whether required/not required.

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.

COURSE TOPICS

List topics and sequence covered.

Week	**Topic**
Week 1	Introduction to digital system and Number systems
Week 2	Number system, Binary arithmetic, BCD, Alphanumeric codes, Gray Codes
Week 3	Binary Logic and gates, Boolean algebra, Algebraic manipulation
Week 4	Standard form, Minterms and Maxterms, Karnaugh map optimization, More gate types
Week 5	Combinational logic design, design procedure, functional blocks, Decoders, Encoders and Multiplexers
Week 6	Iterative combinational circuits, Arithmetic functions and HDLs, Adders, Complements, subtraction using 2s complement
Week 7	Sequential circuit definitions
	Midterm Exam
Week 8	Latches, Flip-flops, Sequential circuit analysis
Week 9	The design space, Introduction to Integrated circuit, CMOS circuit technology
Week 10	Introduction to Registers, Register transfers and Register transfer operations, Microoperations, Register cell design
Week 11	Memory Definitions, Introduction to Random-Access Memory, SRAM Integrated circuits, DRAM ICs, DRAM and its types
Week 12	Computer design basics, Introduction to Datapaths, Arithmetic/Logic unit, Introduction to Shifter
Week 13	Datapath representation, Instruction formats and specifications
Week 14	**Final Exam**

NOTES

1. Students are required to follow all College policies. Policies are available on the website at: Coquitlam College Policies
2. To find out how this course transfers, visit the BC Transfer Guide at: bctransferguide.ca

Last Revised: August 2018
Last Reviewed: September 2024