APT 2030: DIGITAL ELECTRONICS

Pre-requisites:

MTH 2215: Discrete mathematics,

NSC 2215 Introduction to Physical Mechanics

3 credit Units

Course Rationale

This is an introductory course in Digital Circuits and Logic Design. It gives students the foundation in Boolean algebra and logic design necessary for courses in computer architecture, VLSI circuits and Digital integrated circuits.

Course Description

This course describes the basic integrated circuit building blocks from which digital circuits and systems are assembled. This unit is intended to help the students keep pace with the rapid advances made in the field of Digital Electronics.

Learning Outcomes

Upon successful completion of the course the student will be able to:

1. Explain the difference between analog and digital systems and combinational and sequential network.
2. Apply the laws and theorems of Boolean algebra to simplify, multiply out and factor an algebraic expression and to simplify a switching expression.
3. Solve for the essential prime implicants of a function from a Karnaugh map and by using the Quine-McCluskey method.
4. Design a two-level and a multi-level NAND-gate or NOR-gate network.
5. Use multiplexers, decoders, read-only memories and programmable logic arrays to implement logic functions and sets of logic functions.
6. Explain the operation of set-reset, trigger, clocked, J-K, J-K clocked and D flip flops, set up a table and derive the characteristic equation for each flip flop.
7. Sketch a timing diagram relating the input and output of set-reset, trigger, J-K, J-K clocked and D flip flops.
8. Analyze a clocked sequential network by signal tracing and timing charts.
9. Design a sequential network.
10. Describe the structure and function of the basic building blocks of digital circuits,
11. To properly understand and use the techniques of digital analysis and design on combinational and sequential circuits.

12. To understand and demonstrate the design methodologies of digital systems using CAD tools such as Pspice, Workbench, and VHDL.

13. To understand the operation of different combinational and sequential circuits and be able to synthesize them using Xilinx Foundation series,

14. To understand and practice the design of digital sequential systems using finite state machine and their synthesis with Xilinx Foundation series,

Course Content

Number systems and computer arithmetic; Logic circuits and their components; Boolean or Switching Algebra; Combinational Circuit Analysis; Combinational Circuit Synthesis; MOS gates: Electrical characteristics and timing; TTL gates; Documentation Standards; Programmable Logic Devices; Decoders; Design Methods commonly used in Digital Electronics: Heuristic Approach (SSI, MSI Chips used in rapid prototyping), Simulation (i.e. Pspice, Workbench, Xlinx). Hardware Descriptive languages: VHDL, Verilog. Introduction to VHDL; Combinational Circuits and their VHDL Models. Sequential Logic. Sequential Circuits and their VHDL Models: Registers, Counters. Memories and Programmable ASIC's (CPLDs and FPGAs). Finite State Machines: Description state diagrams, Algorithm state machines, Synthesis in VHDL. Design Considerations of Digital Systems: Examples of Digital Systems Design.

Teaching and Learning Methodologies

A combination of Lectures and Lab sessions: Use of Digital Emulators and Simulators. Assignments on the design of simple logic circuits.

Instructional Materials and Equipment

Xilinx Foundation Series 4.i (student edition)

Orcad/Pspice

Electronic Workbench (student edition included with Floyd)

4000 and 74xx Ics

Single Board Microcomputer

Breadboards

Methods of Evaluation

Laboratory Work	20%
Project	20%
Assignment	10%
Mid-semester	20%
Final semester exams	30%
Total	**100%**

Course Text

Digital Electronics by A.P.Godse, D.A.Godse – 2009

Recommended Reading

Digital Fundamentals with VHDL, Thomas L. Floyd, Prentice Hall, 2003 (recommended).

Digital Design, Practices and Principles, John Wakerly, Fourth Ed., Prentice Hall (prescribed

Digital electronics**:** principles, devices and applications By Anil Kumar Maini – 2007

Digital Electronics: Theory and Experiments by Virender Kumar - 2007