COMPUTER ENGINEERING CURRICULUM AT OAKLAND UNIVERSITY

Sarma R. Vishnubhotla
Subramanian Ganesan
Department of Computer Science and Engineering
Oakland University, Rochester, Michigan 48309
vishnubh@oakland.edu

ABSTRACT

This paper describes the following main topics. The Computer Engineering Curriculum at Oakland University, A listing of the most important professional courses in the curriculum, A description of the computer engineering courses, hardware projects, laboratory assignments, equipment, and the Bachelor's degree requirements with majors in computer engineering and computer science.

1. INTRODUCTION

The School of Engineering and Computer Science (SECS) at Oakland university has three main departments, Computer Science and Engineering (CSE), Mechanical Engineering (ME), and Electrical and Systems Engineering (ESE). All the three departments offer B.S. and M.S. degrees, and the Systems Engineering also offers a Ph.D. degree. Each of the three departments is currently in the process of getting its own Ph.D degree program approved. All the B.S. degrees in the school are accredited by ABET. The Computer Science B.S. degree is also accredited by CSAB. The B.S curriculum design takes the ABET and CSAB criteria into account, in all the three departments.

2. COMPUTER ENGINEERING CURRICULUM

The Bachelor's degree curriculum with major in Computer Engineering has the following main features. The degree requires a minimum of 128 semester hours. It has 34 credits of mathematics and science requirements, 16 credits of computer science and engineering core, 24 credits of general engineering core, 16 credits of professional subjects, 8 credits of electives, 24 credits of general education, and 6 credits of free electives. The major in computer engineering is introduced with the purpose of providing students necessary background in the following areas. Assembler language, VLSI logic design, Switching theory, Computer architecture, Programming languages, Data structures, Microprocessors, Embedded systems design, Communications, design of computer networks. The faculty of the CSE department realizing that the distinctions between hardware, and software are increasingly vanishing, instituted strong software requirements also as a part of the computer engineering curriculum. Students are required to take CS1 (CSE 131), CS2 (CSE 231), and CS3 (CSE 261), covering basic principles of programming languages, strings, pointers, data structures, objects, and design and analysis of algorithms. These courses are run in C++ language. This sequence of courses has a large PC-based software laboratory component. The hardware concentration starts with an introduction to assembler languages and basic logic design (CSE 171). There is heavy laboratory component in this course. This course does not cover much theory. The emphasis is on logic design and assembler language principles [1, 13]. The next higher course is on logic and systems design (CSE 378) where both combinational and sequential circuits and systems design are covered [2, 12, 14]. This course also has a strong laboratory component and all the topics up to and including register transfer and micro signal formats are covered. A design of a small digital system is covered. There are other areas such as Robotics, Artificial Intelligence, Expert Systems, Data Bases, Operating Systems, Software Engineering, Verification of Computer Programs, Compiler Design, and Computer Graphics. Students depending on their interest take courses from some of these areas as electives.

3. COMPUTER ENGINEERING - CURRICULUM REQUIREMENTS

The following curriculum was designed to give strong background in the fundamentals of computer engineering and adequate knowledge in advanced topics to prosper in this ever-changing field. A balance between theory and practice is carefully incorporated into the curriculum by the faculty. The emphasis is on computer hardware and software. Refer to the Oakland University 1995-96 Undergraduate Catalog for more complete listing. The most important degree requirements are reproduced below from the above mentioned catalog.

DEGREE REQUIREMENTS:

Students must earn a minimum of 128 semester credits to qualify for the Bachelor of Science degree in Engineering with a major in Computer Engineering. They must demonstrate writing proficiency, and meet the following requirements.

		Credits
General Education (Excluding Mathematics and Science)		24
Mathematics and Science		
MTH 154-155	Calculus	8
MTH 256	Introduction to Linear Algebra	3
APM 257	Introduction to Differential Equations	3
APM 263	Discrete Mathematics	4
CHM 144	General Chemistry (CHM 164)	4
PHY 151-152	Introductory Physics	8
Approved Science Elective		4
		34

Computer Science and Engineering Core

CSE 131	Computing I	4
CSE 171	Introduction to Digital Logic and Microprocessors	4
CSE 231	Computing II	4
CSE 261	Design and Analysis of Algorithms	4
CSE 378	Computer System Architecture	4
		20

Engineering Core

EGR 101	Introduction to Engineering	1
EGR 401	Professional Engineering	1
EE 222	Introduction to Electrical Circuits	4
EE 384	Electronic Materials and Devices	4
ME 221	Statics and Dynamics	4
ME 241	Thermodynamics	4
SYS 317	Engineering Probability and Statistics	3
SYS 325	Lumped Parameter Linear Systems	3
		24

Required Professional Subjects

EE 326	Electronic Circuit Design	4
CSE 464	Computer Organization and Architecture	4
Senior Design Course		4
CSE 470	Microprocessor-Based Design	
or		
CSE 490	Senior Project	
		12

Electives - 8 Credits Chosen from:

CSE 343 Theory of Computation (4 Credits)

Any 400-level CSE course (4-8 Credits)

EE 426	Advanced Electronics (4 Credits)
EE 428	Industrial Electronics (4 Credits)
EE 437	Introduction to Communication Electronics (4 Credits)
SYS 422	Robotic Systems (4 Credits)
SYS 431	Automatic Control Systems (4 Credits)
SYS 463	Foundations of Computer-Aided Design (4 Credits)
SYS 469	Simulation in Engineering (4 Credits)
CSE 490	Senior Project (2-4 Credits)
CSE 494	Independent Study (2-4 Credits)

8

Free Electives (May be used to satisfy writing proficiency) 6

TOTAL 128

Students are required to complete a total of at least 16 credit hours of design while satisfying their overall requirements. In addition, computer engineering students must fulfill the economics requirement by completing ECN 150, 200 or 210 as a part of the general education requirements. In addition to all the requirements listed above, students must have an average grade of 2.0 in each group. Within professional subjects, at most two grades below 2.0 are permitted; at most two different courses may be repeated, and a total of three repeat attempts are permitted.

4. COURSE DESCRIPTIONS - COMPUTER SCIENCE AND ENGINEERING

The descriptions of the courses in the computer science and engineering core and the senior-level hardware courses are given below. These courses are CSE 131, 171, 231, 261, 378, 464, 470, 471, 478.

CSE 131 Computing I (4 Credits)

Introduction to computer programming using a high-level programing language such as C++. General methods of problem solving and principles of algorithmic design and object-oriented design. Basic data structures are introduced.
Co-requisite: MTH 154 (Calculus).

CSE 171 Introduction to Digital Logic and Microprocessors (4 Credits)
Introduction to digital logic using programmable logic devices. Introduction to computer organization and microprocessors. Assembly language programming.
Prerequisites: CSE 131 and MTH 154 (Calculus).

CSE 231 Computing II (4 Credits)
A second course in programming with emphasis on data abstraction and object-oriented design. The basic data structures in computer science, including stacks, queues, files, trees, and graphs, are covered in detail. Concepts of design, analysis and verification are discussed in the context of abstract data types. Examples from numeric and symbolic domain are used.
Prerequisite: CSE 131.

CSE 261 Design and Analysis of Algorithms (4 Credits)
Computer algorithms, their design and analysis. Strategies for constructing algorithmic solutions, including divide-and-conquer, dynamic programming and greedy algorithms. Development of algorithms for parallel and distributed architectures. Computational complexity as it pertains to time and space is used to evaluate the algorithms. A general overview of complexity classes is given.
Prerequisites: CSE 231, APM 263 (Discrete mathematics).

CSE 378 Design of Digital Systems (4 Credits)
Combinational and sequential logic design. Optimal two-level combinational designs. Practical circuits such as arithmetic units, encoders, decoders, multiplexers, PLAs, and FPGAs. Sequential design techniques, flip-flops, state diagrams, excitation tables. Applications to control and instrumentation. Concept of a bus, data and address bus, registers and data transfer. Introductory design of a small computer at the system architecture level.
Prerequisites: CSE 171 and major standing.

CSE 464 Computer Organization and Architecture (4 Credits)
Stored program computers, theory and design of arithmetic-logic and control units, hardwired design and microprogrammed design, performance metrics and scalability, pipeline computer design, interfacing input/output units with processors, parallel processing.
Prerequisites: CSE 378.

CSE 470 Microprocessor-based Systems Design (4 Credits)
Application of microprocessors and microcomputers to the solution of typical problems; interfacing microprocessors with external systems; programming considerations. This is a laboratory, design oriented course. Several short design projects and one large

design project will be given.
Prerequisites: CSE 378 or EE 378.

CSE 471 Design of Embedded Software Computer Systems (4 Credits)
Design of real-time systems with microcontrollers such as the 68HC11 and 68332. Object oriented software development using both assembly language and high-level language. Use of interrupts. This is mostly a project oriented course.
Prerequisites: CSE 470 or equivalent.

CSE 478 Switching Theory (4 Credits)
Combinational switching functions, duality, functional decomposition of combinational circuits, symmetric functions, unate functions, threshold functions and design with threshold elements, iterative circuits, completely and incompletely specified sequential circuits and their minimization, Moore and Mealy models, asynchronous circuits, races, sequential machine decomposition. Emphasis is on the theoretical properties of switching functions and their design.
Prerequisites: CSE 378 and APM 263 (Discrete mathematics).

HARDWARE LABORATORY COMPONENT:

CSE 171: This course has two main topics, assembler language and digital logic. There are extensive laboratory projects in both the areas. The assembler projects range from simple programs on a PC (usually older Intel versions such as 286) to asynchronous communication. The hardware projects are based on 7400 series chips initially and extended to programmable logic devices such as GAL 16V8. Students use PROLINK to program the PLDs and learn CUPL design language. Projects cover NAND/NOR circuits, adders/subtracters, magnitude comparators, decoders and encoders, multiplexer/demultiplexer, 7-segment display, up/down counters, shift register with parallel load, EPROM, decoding computer memory map and DRAM controller signals.

CSE 378: This course uses the same equipment described above and the projects in this course are more challenging and will cover more topics in digital design. Projects deal with PLD circuit realizations, ALU design, synchronous and asynchronous circuit design, control unit design for specific applications, testing and testability.

5. CONCLUSION

The objective of this paper is to describe the B.S. Computer Engineering Curriculum at Oakland University and to describe the courses in this curriculum. The CSE department also offers hardware courses on Parallel and Distributed Processing, Fault Tolerant Design, etc. But these courses are exclusively for M.S.

and Ph.D students. Our Graduate program in the CSE department is very well received by industry and academia.

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