DeVRY UNIVERSITY

Course Syllabus **Fall 2007**

Course Title:	Digital Circuits and Systems with Lab
Course number:	ECET230
Credit/Contact hour:	5-1-4
Course Dependency:	COMP-122, ECET-100, and ECET-210. Corequisite: ECET-220
Class Schedule:	
Instructor:	Tom Wheeler E-mail: twheeler@devry.edu Voice Mail: 816.941.0430 x5211
Office Hours:	Mon 1-1:50 pm; Wed 3-3:50 pm; Thur 12-12:50 pm Other times possible by appointment

Course Description

This course introduces design and analysis of digital circuits – the basis for all computer systems and virtually all other electronic systems in use. Topics include combinational and sequential logic, programmable logic devices and hardware description languages. Students use development and analysis software and instrumentation for circuit verification

Textbooks and Materials

Title:	**Ed**	**Author**
Digital Electronics with VHDL	**4th**	Williasm Kleitz
(Prentice Hall)		
ECET230 Lecture Notes	**-**	Norman Grossman - DeVry University
(Download from eCollege course shell)		
Quartus II Design Software	**> 5.0**	Altera Corporation
ECET230 Lab Kit with "eSOC" FPGA Board		
Multisim		Electronics Workbench

Other helpful items:

- The TTL Data Book (any edition) -- this volume contains the pinouts and operational data for all standard TTL integrated circuits. There's no substitute for being able to thumb through this volume when you're thinking about logic circuit design. We may have it in the library (if you don't already own a copy).

- The web site http://www.datasheetarchive.com/ can be used to look up data sheets for just about any electronic part including the TTL parts in your lab kit.

Terminal Course Objectives (TCOs):

Following are the objectives for this course. Individual faculty, based upon their experience and expertise may add to these objectives to meet local campus needs. Any such additions will be communicated to the class. While the instruction remains focused in helping students, accomplishing these objectives is a shared responsibility of students and faculty. The outcomes of this course will depend upon the motivation and capabilities of the students, sufficient time allocation for studying, and the effectiveness of that effort.

DeVry University is committed to the continual improvement of its curriculum and instruction and to meet the needs of students and employers in a rapidly changing global economy. Students, faculty, and the university must all be actively involved to accomplish these objectives, as well as the objectives of this particular course.

Every class is to some extent a unique interactive experience, which may cause some variance within the stated objectives, in either content or level. Individual faculty, based on their experience and expertise, are encouraged to add objectives, as they deem appropriate, and to communicate these directly to the class. The outcomes of the course will depend on the design of the course, the quality of instruction, and the motivation and capabilities of the students, including time available for studying and the effectiveness of the effort.

1. Given a pair of binary numbers, design a multiple bit adder/subtractor.

2. Given a truth table or operational description of a decoder, encoder, multiplexer, or demultiplexer, implement and verify the logic design using Boolean operators and/or truth tables.

3. Given a digital circuit, such as a combination of AND, OR and XOR functions, create a description of the circuit using a high-level hardware description language (HDL), such as VHDL, and implement the circuit design on a programmable logic device.

4. Given the logic diagram of a latch or a flip-flop, list the function table and predict the behavior of the device given a set of inputs and verify the prediction by building and testing the circuit.

5. Given a multiple flip-flop circuit using no more than four flip-flops, predict, measure and verify the output timing waveform for the specified synchronous and asynchronous inputs.

6. Given the state diagram or the state table of a sequential counter, design the circuitry using programmable logic devices.

7. Given an application requiring the use of a shift register, design, build and verify the operation of the required circuit.

8. Given a system monitoring analog inputs and generating analog outputs, predict the behavior of the circuitry using analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).

9. Given prescribed technical documentation guidelines, develop written reports and oral presentations

EET/CET Program Objectives and Outcomes:

(Student competencies achieved at the time of graduation)

1. Conduct experiments involving electronic systems using modern test equipment, interpret test results and use them to improve products or methodologies.
   - 1.1. Performs Needs Analysis – define the problem
   - 1.2. States goals and objectives of the experiment
   - 1.3. Identifies resources to conduct experiment (parts, equipment, data sheets, etc.)
   - 1.4. Develops a procedure and collect data using modern test equipment
   - 1.5. Analyzes test results and draw conclusions.

2. Create, implement high-level and Assembly language programs in support of technical activities.
   - 2.1. Analyzes the problem logically
   - 2.2. Designs the solution
   - 2.3. Implements the solution
   - 2.4. Tests and debugs the software

3. For EET: Use the principles of science, mathematics, and engineering technology to design, implement, and evaluate hardware and software solutions to complex technical problems,
   - 3.1. Selects and defines a meaningful problem taking safety, ethical, social, economic, and technical constraints into consideration.
   - 3.2. Devises process to solve problem
   - 3.3. Applies appropriate knowledge of scientific, mathematical, and engineering design tools toward the design and analysis of problem solutions.
   - 3.4. Identifies key issues in designing and building a prototype
   - 3.5. Builds, tests and troubleshoots prototype
   - 3.6. Optimizes prototype with a commitment to quality, timeliness, and continuous improvement.

For CET: Use the principles of science, mathematics, software engineering, and engineering technology to design, implement, and evaluate software solutions to complex technical problems.
   - 3.1 Identifies a meaningful problem and defines preliminary solution specifications taking safety, ethical, social, economic, technical constraints, and user requirement into consideration
   - 3.2 Designs and implements appropriate data structures and algorithms
   - 3.3 Prepares a plan of action to implement the system
   - 3.4 Applies scientific, mathematical, software, and engineering design tools toward the design and analysis of problem solution
   - 3.5 Writes and tests readable and maintainable code
   - 3.6 Optimizes code with a commitment to quality, timeliness, and continuous improvement

4. Communicate effectively both orally and in writing.
   - 4.1 Communicates effectively in wiring
   - 4.2 Communicates effectively orally

5. Work effectively in a team environment.
   - 5.1 Exhibits good dialoguing skills
   - 5.2 As part of a small group project, when assigned roles, performs roles effectively

6. Apply applied research and problem-solving skills to support learning at DeVry as well as life-long personal and professional development.
   - 6.1 Recognizes the need to know information beyond one's own expertise and has the ability to gather and synthesize the necessary information into the solution of a problem
   - 6.2 Uses engineering problem-solving methodology in solving problems

7. Evaluate the broader effects of technology and to identify connections between technology and economics, politics, culture, ethical responsibility, social structure, the environment and other areas.
   - 7.1 Identifies linkages and causal relationships between technology and social, political, economic, cultural, and environmental conditions.
   - 7.2 Works effectively in diverse environments and adapts technical solution to solution a diverse audience
   - 7.3 Pursues technical work within guidelines for professional, ethical, and social responsibility

Class Policies and Procedures:

Attendance

Each student is required to attend every lecture and laboratory session in which he or she is enrolled. A swipe-card terminal (ATS) in each classroom is used to record attendance electronically. Students are responsible for arriving before class begins, sliding their identification card through the wall-mounted reader, and remaining for the duration of the course meeting. Students who are absent for two or more days should notify their Professor or assigned Academic Advisor in advance. Students who miss more than five (5) consecutive days of school are in violation of the DeVry attendance policy and will be dismissed. **Unexcused absence in excess of 5 hours will result in a reduction of the final course grade by one letter**.

Homework Expectations

Homework is due at the beginning of class (xx00 UTC). *Late homework is not accepted unless mitigating circumstances are present (documentation will be required), and is not accepted more than one week past the due date.* Homework carries the weight of one major exam (100 points) in the course. Failure to do homework will do severe damage to your grade. (UTC=Universal Coordinated Time, or Standard World Time.)

Homework Performance Standards

- Unless specifically noted, all homework is to be done individually. If you need help solving a problem, it is acceptable to ask the instructor or a fellow student for assistance as long as you do your own work.

- For problems involving calculations, all work must be shown. If a numerical answer is obtained without doing a calculation, state clearly that this is the case. For example: "By inspection, the potential is 25 Volts."

- When showing work for numerical problems, all defining equations will be stated first. The last step in the problem will be substitution of values into the equations. For example:

  Given V = 20V and R = 5 Ohms, find the current I.

  $I = \frac{V}{R}$ (Comment: The defining equation, Ohm's law, is stated.)

  $I = \frac{20V}{5\Omega} = \underline{\underline{4A}}$ (Comment: Note that units are clearly displayed for the answer.)

- When a numerical answer is given, it must be boxed or underlined and have correct units attached.

- For program listings, your name must appear at the top of the listing. Each function must have a comment header stating the function name, purpose, arguments, and return conditions. Each major idea within the code must be properly commented.

- Programs that that lack appropriate division of functionality will receive a grade of zero (0). An example of such code would be a program performing all of its functionality within a single function such as main() when it would be more appropriate to divide the workload among several related functions.

(Homework Performance Standards are continued on next page)

Homework Performance Standards (Continued)

No credit will be given for any problems that have not been worked according to these instructions, or any additional instructions given by the instructor.

Homework will be kept in a 3-tab flexible folder, with the latest assignment in front. Your name, the course number, and the instructor's name must appear in clearly-readable form on the front of the folder.

Make-Up Exams

No make up exams are given in ECET230 for any reason.

Course Grading Standards

There are three major exams, various homework assignments, and a final examination given in the 15th week of the course. Your grade will be determined as follows:

2 Major Exams	200 points (18% each, 36% total)
Homework, Team Performance	100 points (18%)
Labs	100 points (18%)
Final Exam	150 points (28%)
	550 points total for course

Note: No makeup exams are given. All examinations will be announced at least 1 week prior to administration. All students must take the final exam. A passing grade in lecture and laboratory is necessary in order to pass the course.

A final letter grade is to be awarded to each enrolled student in accordance with the 4.00 grading system shown below:

Letter Grade	***Percent of Total Points***	***Grade Points***
A	90 – 100%	4.00
B	80 – 89%	3.00
C	70 – 79%	2.00
D	60 – 69%	1.00
F	Below 60%	0.00

Academic Integrity Policy

Ideas and learning form the core of the academic community. In all centers of education, learning is valued and honored. No learning community can thrive if its members counterfeit their achievement and seek to establish an unfair advantage over their fellow students. The academic standards at DeVry are based on a pursuit of knowledge and assume a high level of integrity in every one of its members. When this trust is violated, the academic community suffers injury and must act to ensure that its standards remain meaningful. The vehicle for this action is the Academic Integrity Policy outlined in the *Student Handbook*.

The Academic Integrity Policy is designed to foster a fair and impartial set of standards upon which academic dishonesty will be judged. All students are required to read, understand, and adhere to these standards, which define and specify the following mandatory sanctions for such dishonest acts as copying, plagiarism, lying, unauthorized collaboration, alteration of records, bribery, and misrepresentation for the purpose of enhancing one's academic standing:

- The ***first recorded offense*** will result in the student receiving zero credit for the entire paper, exam, quiz, lab, homework assignment, or other graded activity in which the incident of academic dishonesty occurred. No partial credit may be given. Where the incident involved a graded assignment normally subject to a "drop" option, the student may not exercise that option.

- The ***second recorded offense*** will result in the student receiving a failing grade for the course in which the second offense occurs. The second offense need not be in the same course, program, or term as the first offense to invoke this sanction.

- The ***third recorded offense*** will result in the student being permanently expelled from the DeVry system. Again, the third offense need not be in the same course, program, or term as either the first or second offense to invoke the sanction.

Changes to Syllabus:

The contents of this syllabus are subject to change with appropriate notice to the students.

Weekly Course Schedule:

Week	Topics	TCO's	Team Activity and Responsibility	Reading Assignment	What's Due
1	Introduction. Boolean algebra. Binary number systems and binary arithmetic circuits.	1,2	Lecture 1 Homework 1	Chapters 1, 2, 3 (Review); Chapters 6,7 (New material)	Homework 1 Lab 1
2	Decoders and Multiplexers; **Exam #1**	1,2	Homeworks 2,3 Lecture 2	Chapters 5,6 (Review); Chapters 8 (New material)	Homeworks 2,3 Labs 2,3 Team Eval #1
3	VHDL (Combinatorial Circuits)	3	Homeworks 4,5 Lecture 3 (This is a big one!)	Chapter 4, Chapter 5 (VHDL)	Homeworks 4,5 Labs 4,5
4	VHDL (Combinatorial Circuits, Continued); **Exam #2**	3	Homework 6 Lecture 3 (Finish)	Chapter 4, Chapter 8 (VHDL)	Homework 6 Labs 6,7 Team Eval #2
5	Sequential Circuits (Latches and Flip-Flops)	4,5	Homeworks 7,8 Lecture 4	Chapters 10, 11	Homeworks 7,8 Labs 8,9
6	Counter Circuits	2,6	Homework 9 Lecture 5	Chapter 12	Homework 9 Labs 9,10
7	Counter Applications & Design, Wrap-up	3,7,8	Lecture 6 Lecture 7,8	Chapter 13	Labs 10,11
8	**Final Examination**	ALL		C-6	

Notes:

- **Lecture Notes** for each topic are located under the LECTURE NOTES link provided under each TOPIC (left-hand button) in the eCollege shell.
- Student teams will be accountable at the end of each review period for the materials specified under "Team Activity and Responsibility." The instructor will evaluate this. Team reports are due weeks 2 and 4. (There may also be other team reports due based on other, out-of-class performance exercises.)
- **Laboratory exercises and homeworks are to be completed individually and will be due at the end of the last class meeting each week. NO late homeworks will be accepted. Labs more than one week past due will not be accepted.**

* This schedule is tentative and subject to change to meet the needs of the class members.

Assumptions About You:

- You are probably working at least part time (and probably full-time) while attending school. Your time is very valuable and must not be wasted.
- You have the ability and motivation to be successful in a highly-complex field (Engineering Technology) and you are willing to put in the time and effort to grow.
- You possess a great deal of knowledge already as well as the ability to think critically. You will be building upon and adding to this knowledge.

About This Course:

- This is a compressed course and a lot of material is covered in a very short time span. Missing a day of school is very much like missing an entire week of a conventional lecture course. Therefore, attendance is very important.
- You will be very busy during this course. The average student will need to spend two hours outside of class studying each day to keep up. This requires dedication to the task and a willingness to stick with it when the going gets tough. Your instructor will do everything possible to help you succeed, but you are ultimately responsible for your own learning.
- If you are having trouble please ask the instructor for help. Don't put it off!
- This course will be student-centered. Traditional lecture will be used but it will be kept to a minimum.
- You will work as part of a learning team this semester. This may be a new experience for you. Your team will depend on all of its members to be successful. By definition, a team is successful when all of its members have mastered the material. Your entire team will be accountable for success of each of its members.

About Me:

- I have more than 30 years of experience in the field of electronics, and more than 20 years of teaching experience. I have high expectations for my students. At the same time, I realize that each one of us is an individual and brings a unique perspective and skill set to our class. My goal is to help you be as good as you are able in this subject.
- I believe that learning must be a lifelong process, and that one of the primary purposes of school must be to help all of us become better learners. Fundamental topics in technology are an enabler of lifelong learning.
- I expect to learn much along with you in this course.