The Academy

ECET…Electrical & Computer Engineering Technologies (E/C)

Grade 10 (Sophomore Level)
Digital Electronics Syllabus
(Equivalent Program to the MCC ELT111 course offering)

Prepared By:
Enzo Paterno – ECET Instructor
MCACADEMY DIGITAL ELECTRONICS SYLLABUS

CLASS HOURS

Lectures + Lab activities 45 days @ 88 min = 66 hours Room 105 + CAD lab

INSTRUCTOR:

Mr. E. Paterno
Email address: paternoe@mail.mcvts.net
Phone: 732.452.2600

EXTRA HELP INFORMATION

Students can contact the instructor via the email presented above. Furthermore, a student can meet with the instructor for extra help prior to class and after class as long as the student has made arrangements with the instructor in advance.

COURSE INFO

Grade Level: Sophomore (10)
Course Name: Digital Electronics
Class / Laboratory Hours: 88 minutes x 45 days (i.e. One Marking Period) = 66 hours
** If more time is needed to complete the material, additional hours will be accommodated as necessary **

PREREQUISITE

Basic Digital Electronics (Given at the Freshman level)

TEXT AND SOFTWARE

- Introductory Digital Electronics (Nigel Cook)

Software Simulation packages

- CircuitMaker® Simulation software - Free student version
- PSpice software – the current free version is 9.1, go to http://www.electronics-lab.com/downloads/schematic/013/ Note the link at the bottom of the page that says Download the PSpice 9.1 Student Version

REFERENCES

The world Wide Web – The instructor encourages the students to perform further research on the various topics covered in class via the internet. The internet offers an infinite amount of resources relating to the various covered topics – resources can vary from tutorials, application notes, technical papers, Java applets, datasheets, etc....
WEBSITES URLs


ELECTRONIC BOARD (eBOARD)

All lecture material (Power Point slides), reference documents, assignments and exam information will be placed on the MCVTS Academy eBoard accessed via the link below:

http://www.mcvts.net/schools/acad-assignments.html

Click on the Mr. Paterno ECET10 link

ZERO TOLERANCE POLICY

- Any students demonstrating negative behaviors (whatever shape and form) preventing a positive learning environment will be dealt accordingly.
- Students absent for a particular lecture are responsible for the material and as such need to obtain the missed material via the eBoard and/or other means.
- No food or drink is allowed into the classroom or laboratory.
- Cell phones are to be turned OFF (i.e. or placed in the vibrating mode)

CHEATING POLICY

Cheating is not an acceptable learning tool and as such will not be tolerated. In the same token, plagiarism is not acceptable. However, using someone else’s material when preparing a document is acceptable IF and ONLY IF the source of information and authors are acknowledged.

Any student caught cheating the first time will be subjected to the MCAcademy cheating/Plagiarism policy.

EMERGENCY CLOSINGS

Students will be informed if any School emergency closings are in effect.

HARDWARE / SOFTWARE REQUIREMENTS

Due to the nature of homework assignments, students are expected to be equipped at home with a personal computer and a printer. CircuitMaker and PSPICE free software simulations packages are required. Furthermore, Microsoft office (Power Point, Excel, Word) and Adobe Reader software tools are required.
COURSE SUMMARY

A study of digital electronic circuits and systems. Introduction to number systems and Boolean Algebra topics. Digital electronic circuits and systems are analyzed and designed. Topics covered are: logic gates, Flip-Flops, registers, counters, arithmetic logic circuits, memories, and various logic families. Theory is supplemented with laboratory experiments.

COURSE OBJECTIVES

The student will be able to:

1. Describe and explain the organization of digital computer and fundamentals of rectangular waveforms
2. Demonstrate knowledge of number systems
3. Demonstrate knowledge of Boolean algebra and its application to digital circuits
4. Analyze and implement designs with logic gates
5. Analyze and implement designs with functional logic blocks (Encoders, Decoders, Multiplexers, Demultiplexers, Comparators)
6. Analyze and implement designs with Programmable Logic Devices (PLD). Specifically the GAL16V8 and GAL22V10 Gate Array Logic Devices.
7. Analyze arithmetic logic circuits
8. Analyze Flip-Flops and timing circuits
9. Analyze and design counters and registers
10. Explain and describe the fundamentals of codes, coders, and decoders
11. Describe the use of computer memories and analog-to-digital converters
12. Describe and compare characteristics of the various logic families
13. Demonstrate a practical knowledge of digital systems through laboratory experiments

GRADING CRITERIA (TEMPTATIVE AND SUBJECT TO CHANGES)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exams</td>
<td>30 %</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Lab Activity</td>
<td>20%</td>
</tr>
<tr>
<td>Lab reports</td>
<td>10%</td>
</tr>
<tr>
<td>Project</td>
<td>10%</td>
</tr>
<tr>
<td>Presentation</td>
<td>10%</td>
</tr>
<tr>
<td>Participation</td>
<td>10%</td>
</tr>
</tbody>
</table>
**GRADE DISTRIBUTION**

A = 90 or Greater  
B = 80 to 89%  
C = 70 to 79%  
D = 60 to 69%  
F = Less than 60%

**PRESENTATION**

Each project group is responsible to give a power point presentation based on the assigned project. The team is to present a 12-15 minutes Power Point presentation on the topic.

**LABORATORY**

1. The students will be divided, by the instructor, into groups of 2 and group work will be done according to the section titled “Laboratory Procedures.”

2. To be graded, every lab report submitted must:
   
   (a) be written using a word processing program  
   (b) follow the format defined in the handout “Laboratory Procedures” and other handouts.  
   (c) state clearly the responsibility of each group member.

**Laboratory Procedures**

A group of students who meet at the assigned time and then start working on a lab project are not engaging in teamwork. Planning, assigning tasks, and assuming responsibility are all requirements of effective teamwork. A little extra work at the beginning of the project or experiment will pay for itself many times in terms of knowledge gained and accomplishing the given task. Students are expected to come to the lab prepared with all necessary material for the execution of the lab experiment (i.e. chips, protoboard, wire, tools, simulated circuit, calculations, etc…..)

Properly implemented teamwork will help the students develop skills in:

- pre-lab preparation (**know what parts will be needed for the experiment before hand**)  
- working together as a group  
- oral and written communications  
- problem solving  
- leadership.

**Laboratory reports**

Lab reports must be handed in at the beginning of the next laboratory. The lab report should be based on results gathered in a lab notebook during lab work. The lab notebook is your reference source when writing the report.

There is one lab report for each experiment. There is one lab report per team or person depending on the experiment. The instructor will notify students who is responsible for a particular lab report. A lab report template will be provided by the instructor and placed on the eBoard.
Lab report Format

Cover page
Should include name, partner’s name, experiment name and number, date(s), as well as what were the responsibilities for the lab. You must alternate responsibilities (especially the writing of the report).

Table of Contents

Objectives
What are the objectives for the experiment? List the main objectives as well as additional objectives you might feel worthwhile (i.e. you might be learning new applications of an instrument even though the main purpose is demonstrating circuit theory.

Pre-lab
Discussion of what the pre-lab theory and computer simulation (if applicable) demonstrated, and what you expected prior to performing the experiment.

Description of Experiment
What was the procedure followed, the equipment used (include model number and serial number), and a schematic of the circuit(s).

Discussion of Results
What went right with the experiment, as compared to the pre-lab, and what went wrong. Why? Compare the expected results with the experiment results, and explain the difference (what were the sources of errors). Shows calculations, graphs and data tables.

Conclusion
What have you learned, and were the objectives met. Are there any recommendations to this experiment?

Laboratory Team

Following are the suggested roles for members of a laboratory team. You should alternate taking on the following roles during the semester.

Facilitator (team leader)

The facilitator is the representative of the team and is responsible for completion of the overall project or exercise, including the prelab work. The facilitator assures that the tasks are assigned equally and checks that everyone is doing his or her assigned work. Also, the facilitator is responsible for putting together the final report.

Operator

The operator determines what pieces of equipment and parts are needed, acquire them, construct the circuit and instruments for the measurements, and take the measurements.

Data Recorder

The data recorder prepares tables for data collection and records the measurements during the lab and, along with the facilitator, checks consistency with prelab calculations. The data recorder's prelab responsibility includes the layout and rough draft of the report so that it is ready for the results.
LECTURES OUTLINE:

Combinational Logic Circuits

- Active Low I/O & Active High I/O Definition & Convention
- Encoders & Priority Encoders
- Decoders
- Implementing a POS Using a Decoder
- Light Emitting Diodes (LEDs)
- 7-Segment Displays
- 16-Segment Displays
- BCD-to-7-Segment Decoders
- Liquid Crystal Displays (LCDs)
- Selectors
- Multiplexers
- Demultiplexers
- Implementing an SOP Using a Multiplexer
- Matrix Keypad Decoding Technique
- Comparators
- Cascading Multiple ICs
- Binary Addition
- One’s Complement & Two’s Complement
- Subtraction using two’s complement
- Half Adders & Full Adders

Sequential Logic Circuits

- RS Latches (Active Low, Active High)
- Clocks & Clock Edge Generation (Positive & Negative)
- Clocked RS Latches, Flip-Flops
- Level Triggered Flip-Flops
- Edge Triggered Flip-Flops (Positive & Negative Edges)
- Master-Slave Flip-Flops
- JK Flip-Flops
- D Flip-Flops
- T Flip-Flops
- Excitation Tables
- Timing Considerations (Hold Time, Setup Time)
- Parallel IN – Parallel Out (PIPO) Registers
- Parallel IN - Serial Out (PISO) Registers
- Serial IN – Parallel Out (SIPO) Registers
- Serial IN – Serial Out (SISO) Registers
- Shift Registers (Shift Left, Shift Right, Universal Shift)
- Universal Asynchronous Receiver Transmitters (UARTS)
- Mod-N Counters (Binary, Decade, Up, Down, Up/Down)
- Asynchronous Counters
- Synchronous Counters
Finite state machines (FSM)
- Comparison between Combinational & Sequential
- Feedback & Memory in Finite State Machines
- Concept of States (Present and Next State)
- Mealy Finite State Machines
- Moore Finite State Machines
- Design Process for Finite State Machines
- State diagrams
- Excitation Tables
- Transition Tables
- Design Applications of Finite State Machines
- Designing Finite State Machines Using PLDs

Memory devices & Architectures
- Primary Memories
- Secondary Memories
- Volatile & Non-Volatile Memories
- Memory Families
- Bus Concepts (Address Bus, Data Bus, Control Bus)
- Bus Configurations (Unidirectional, Bi-Directional)
- Read Only Memories: ROM, MROM, PROM, EPROM, EEPROM
- Memory Content - Intel Hex Format
- Flash Technology
- Random Access Memories – Static RAM
- Dynamic RAM Technologies: DRAM, FPM DRAM, EDO DRAM, BEDO DRAM, SDRAM, DDR SDRAM, DRDRAM, SDLAM, VRAM
- DRAM Refresh Strategies
- Memory Row/Column Address Multiplexing Technique
- Memory Expansion (Growing Memory Depth)
- Memory Expansion (Growing Memory Width)
- Memory Maps & Memory Banks
- Absolute Memory Mapping
- Address Decoding

Analog-Digital Signal Converters
- Analog Signals vs. Digital Signals
- Analog-to-Digital/ Digital-to-Analog Interfacing Needs
- Digital-to-Analog Conversion (DAC) Summing Op-Amp
- R-2R Ladder DAC
- Analog-to-Digital Conversion (ADC) Using the Staircase Approach
- Analog-to-Digital Conversion (ADC) Using Successive Approximation Technique
- ADC Step Size
- ADC Resolution
- ADC Monotonicity
- ADC Accuracy
- ADC Conversion Time
- ADC, DAC VLSIs
- Transducers
Operational Amplifiers (Op-Amp)

- Operational Amplifier Model
- Differential Amplifier Concept
- Open Loop Amplifier
- Analog Comparators & Threshold Detectors
- Closed Loop Amplifier
- Negative Feedback
- Virtual Node Concept
- Inverting Amplifier
- Non-Inverting Amplifier
- Summing Amplifier
- Unity Gain Buffer