SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: MICROPROCESSOR CIRCUITS AND APPLICATIONS

Code No.: CET228-5 Semester: 3

Program: COMPUTER ENGINEERING TECHNOLOGY

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TOTAL CREDITS: 5

PREREQUISITES: ELN111, CET127

I. PHILOSOPHY/GOALS:

This course will expand a student's understanding of microprocessor circuits and systems and the peripheral devices used to support them, as well as strengthen his/her knowledge of digital devices in general. Microcomputer system hardware components will be studied and practical lab exercises, based on the IBM PC and the MAT (Microcomputer Application Trainer) systems, will reinforce the theory. The essential principles of operation of microprocessor-based systems are approached from the point of view of maintaining and troubleshooting such systems, modifying and designing interfaces for them, and writing software routines to test and control them.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will:

1. Describe the basic organization of typical microprocessor systems as implemented with address, data and control busses.
2. Describe the operation of the 8088 and 8086 microprocessors in detail, including the various support chips required in typical microprocessor-based systems.
3. Describe the different types of memory devices found in computer systems, their advantages and disadvantages, principles of operation.
4. Describe methods of memory and I/O address decoding.
5. Utilize an Analog-to-Digital and Digital-to-Analog converter to digitize and reconstruct an analog signal.

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6. Describe the general operation of the system board and the I/O subsystems in an IBM PC or similar computer subsystem such as the MAT system, and be able to explain the operation of and write code to control most of the major I/O devices found in such systems.

7. Utilize a Logic Analyzer to describe the operation of a computer subsystem such as the MAT system or a section of the IBM PC.

8. Describe the basic operation of microcomputer peripherals such as keyboards, floppy and hard disk systems, serial ports and the printer interface.

III. TOPICS TO BE COVERED:

1. Microcomputer System organization and bus structure.
2. Microprocessor Fundamentals
3. 8088 and 8086 CPU Architecture and Operation
4. Architecture and evolution of other Intel 80X86 microprocessors
5. Analog to Digital and Digital to Analog Converters.
6. Memory devices and Memory Systems used in microcomputer systems.
7. The operation of the I/O subsystem in typical microcomputer systems and its interaction with the CPU.
8. The organization and detailed operation of the IBM PC/XT at the chip level.
9. Peripheral Device Interfaces.
10. Memory peripherals and magnetic recording techniques.

IV. LEARNING ACTIVITIES

Note: The following Learning Activities may not be covered in the exact order specified below.

1. Microcomputer System organization and bus structure.

Learning Activities

- review the block diagram of a microcomputer

- listen to a presentation on the general nature of address data and control busses in microcomputer systems
- listen to an introduction to the Microcomputer Application Trainer (MAT) system
- participate in a LAB exercise wiring the MAT to perform simple input/output operations
- familiarize yourself with the use of a LOGIC PROBE and OSCILLOSCOPE with the MAT

Resources:
Text ch 4,5, MAT Trainer, overheads

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2. Microprocessor Fundamentals and Address Decoding

Learning Activities - text chapters identified in ()

- participate in a review of basic digital logic circuits
- listen to a presentation on the need for 3-state logic and the use of 3-state devices in computer systems in general (ch 5)
- listen to a presentation on I/O Port address decoding using the MAT I/O decoder circuit as an example
- describe the use of memory maps, memory mapped I/O and dedicated I/O (ch 8)
- discuss the nature of polled I/O, Interrupts and Direct Memory Access (DMA) Input/Output techniques and the advantages of each method
- utilize the MAT to develop an I/O address decoder circuit and demonstrate its operation use by writing test programs using DEBUG and by using a LOGIC PROBE

Resources:
Text, MAT Trainer & Schematics, overheads

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3 . 8088 and 8086 CPU Architecture and Operation

Learning Activities

- listen to a presentation on the 8088 and 8086 CPU, internal organization, timing, pin functions and operating modes
- listen to a presentation on the way bus multiplexing is accomplished in an 8088-based system
- listen to a presentation on the 8088 minimum mode bus cycle timing diagram
- participate in a class discussion on the bus cycle timing diagram

Resources:
Text ch 8, overheads

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4. Architecture and evolution of other Intel 80X86 microprocessors

Learning Activities

- listen to a presentation on the evolution of 80x86 microprocessor technology from its origins to the present day

Resources:
Text ch 16, overheads

5. Analog to Digital and Digital to Analog Converters.

Learning Activities

- listen to a presentation on the purpose of these converters and their use in a typical data acquisition and control system
- discuss the meaning of conversion time, resolution and linearity as they apply to these converters
- utilize the MAT analog-to-digital and digital-to-analog converters to sample and digitize an analog audio signal and reconstruct the original audio signal
- utilize a push button as a digital input signal

Resources:
overheads, MAT Trainer A/D & D/A and Pulser Schematics

6. Memory devices and Memory Systems used in microcomputer systems.

Learning Activities

- listen to a presentation on the characteristics of various ROM (Read-Only Memory) devices, PROMs, EPROMs and EEPROMs and the process of EPROM programming
- listen to a presentation on the principal types of static (SRAM) and dynamic (DRAM) Read/Write Memory (RAM) and describe their features, operation, advantages and disadvantages and their implementation in memory systems
- listen to a presentation on memory system address decoding techniques
- listen to a presentation on the characteristics of various Programmable Logic Devices (PLD's) including PLA's, PAL's and ASIC's.

Resources:
Text ch 7, overheads

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7. The operation of the I/O subsystem in typical microcomputer systems and its interaction with the CPU.

Learning Activities

- listen to a presentation on the architecture of the Intel 8255 Programmable Peripheral Interface (PPI)
- wire and program an 8255 in order to read digital inputs and control digital outputs
- listen to a presentation on the use of interrupts in the 8088 and the operation of the Intel 8259 Programmable Interrupt Controller
- listen to a presentation on Direct Memory Access (DMA) and its implementation with the Intel 8237A DMA Controller
- listen to a presentation on the use of the Intel 8253 Programmable Interval Timer (PIT), its operation and function.

Resources:
Text ch 10, MAT Trainer, overheads

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8. The organization and detailed operation of the IBM PC/XT at the chip level.

Learning Activities

- listen to a presentation on the configuration of major sub-systems in IBM-PC/XT computers
- listen to a presentation on the theory of operation of the following subsystems in the IBM-PC/XT computer: CPU and 8284 clock, bus subsystem, RAM subsystem, ROM subsystem, I/O Address Decoder, 8237A DMA Controller, 8253 Programmable Interval Timer, 8259 Programmable Interrupt Controller, 8255 Programmable Peripheral Interface, Speaker Interface, Keyboard Interface,
- listen to a presentation on the use of a Logic Analyzer to analyze the operation of a digital system
- utilize a Logic Analyzer to analyze one of the above IBM-PC/XT subsystems
- listen to a presentation on the nature of the power supply unit in a PC and its principles of operation

Resources:
Text ch 11, IBM-XT Trainers, IBM-XT Schematic Sets, overheads

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9. Peripheral Device Interfaces

Learning Activities

- listen to a presentation on the nature of the centronics printer

interface
- listen to a presentation on the nature of the asynchronous serial interface and the RS-232C standard

Resources:
Text ch 13, overheads

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10. Memory peripherals and magnetic recording techniques.

Learning Activities
- listen to a presentation on the principles of magnetic recording
- listen to a presentation on the nature of floppy disks, various formatting standards and digital encoding techniques used in magnetic media
- listen to a presentation on the organization and operation of floppy disk controllers and floppy disk drives.
- listen to a presentation on the characteristics of various hard drive interfaces and controllers

Resources:
Text ch 12, overheads

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V. METHOD OF EVALUATION:

3 THEORY TESTS (20% each)	60%
LAB PROJECTS/ASSIGNMENTS	35%
QUIZZES	5%

(The percentages shown above may vary slightly where circumstances warrant.)

GRADING SCHEME

A+	90	-	100%
A	80	-	89%
B	70	-	79%
C	55	-	69%
I	Incomplete		
R	Repeat		

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UPGRADING OF INCOMPLETES

When a student's course work is incomplete or final grade is below 55%, there is the possibility of upgrading to a pass when a student meets the following criteria:

1. The students attendance has been satisfactory.
2. An overall average of at least 40% has been achieved in all work to date.
3. The student has not had a grade less than 40% in all of the theory tests taken.
4. The student has made reasonable efforts to participate in class and complete assignments.

LABS:

Lab activities represent a very important component of this course in which practical 'hands-on' skills will be developed. Because of this, attendance is mandatory and the satisfactory completion of all lab activities is required. It is the student's responsibility to discuss absences from regularly scheduled labs with the instructor so that alternate arrangements (where possible) can be made to complete the lab requirements. Lab reports are due one week after completion. A late penalty of 10 % will be applied to late reports.

ATTENDANCE:

Absenteeism will affect a student's ability to succeed in this course. Absences due to medical or other unavoidable circumstances should be discussed with the instructor, so that remedial activities can be scheduled. Absenteeism for tests can only be allowed for medical reasons and should be authorized ahead of time. Unauthorized absences could result in a zero grade being assigned.

VI. REQUIRED STUDENT RESOURCES:

TEXT BOOKS:

1. "Micro Computer Theory and Servicing"

   by S. Asser, V.J. Stigliano, R.F. Bahrenburg

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE:

Microprocessor Applications Trainer Manual

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VIII. SPECIAL NOTES:

1. Students with special needs (eg. physical limitations, visual or hearing impairments, or learning disabilities) are encouraged to discuss any required accommodations confidentially with the instructor.
2. Your instructor reserves the right to modify the course as deemed necessary to meet the needs of students or take advantage of new or different learning opportunities.

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LAB REPORT FORMAT

Note: All students must write and hand-in their own lab reports. Program Listings are the only item that may be duplicated between partners.

The following guidelines should be used when writing lab reports for CET228 lab projects.

1. Title Page
   Each lab report should have a Title page which contains:
   -Descriptive Lab Title
   -Course
   Your name and the names of lab partners.
   -Date lab was begun and Date lab report submitted.

2. LAB OBJECTIVES
   A brief statement of the lab objectives.

3. PROCEDURES
   A brief description of the procedures followed. In some cases the original procedures handed out with the lab can be submitted with your lab report. This is only acceptable if it is in good condition and has not been marked up. The remaining sections of your report should refer to the various procedures by their corresponding procedure numbers.

4. BODY OF THE REPORT
   This section varies but should include the following where appropriate. All diagrams, graphs etc. MUST have a title which identifies them.
   - Schematics or wiring diagrams
   - Graphs and waveforms
   - Tables of recorded data
   - Calculations based on measured data

- Detailed description of programs written with adequate documentation
- Answers to any specific questions asked in the lab assignment. [Include the questions with the answers.]

5. CONCLUSIONS AND DISCUSSION

Every report must contain a final section which summarizes the important results in the report and draws conclusions from them. In some cases, this would take the form of a restatement of the reports highlights, a brief statement of the steps taken in successfully completing a procedure, and a description of the degree of completion of the lab. Another suggestion to include in your conclusions is a statement of what you feel are the important items learned during this LAB.

**** Lab reports are due one week after the date of completion. Penalties will be applied to late reports.