C A M O S U N C O L L E G E

ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

ELEN 132 MICROCOMPUTER FUNDAMENTALS

COURSE OUTLINE

CALENDAR DESCRIPTION

Microcomputer Fundamentals introduces microcomputer hardware and software concepts, emphasizing the 68000 microprocessor and associated devices. Topics include programming basics, hardware interfacing, and troubleshooting.

CREDIT:	3
IN-CLASS WORKLOAD:	3 lecture hours, 3 labs hours (2 x 1 ½ sessions)
OUT-OF-CLASS WORKLOAD:	6 hrs/week
PREREQUISITES:	Admission in the Control System's Technician Program or the Electrical Technician Program

Instructor: Gurbinder Dhade

Office: CBA 122B

Phone: 250-370-4450

Email: dhadeg@camosun.bc.ca

OBJECTIVES:

This course provides the theoretical and practical background to enable students to test, troubleshoot, and maintain systems using microprocessors and associated circuitry. Basic microcomputer concepts are introduced while basic software and hardware skills are acquired.

Students completing this course will have gained a basic understanding of the Motorola 68000 family of microprocessors and associated peripherals. They will be able to:

- explain basic microcomputer concepts, practice with binary and hexadecimal data formats and data codes.
- write short diagnostic programs in assembly language.
- demonstrate the process of assembling, linking, and downloading software to a 68000-target system.
- explain 68000-microprocessor architecture and the components involved in constructing microcomputer systems.
- apply basic troubleshooting tools and diagnostic software.
- describe basic microprocessor interfacing for serial and parallel data transfers, and be able to compare polled, DMA, and interrupt I/O and the advantages and drawbacks of each;
- identify exception processing and exception and interrupt handling for the 68000 microprocessor;
- summarize several bus standards and other microcomputer standards for device interfacing;
- practice with diagnostic software and test equipment including oscilloscopes and logic analyzers.

Course Content:

1. **Computer Concepts**
    - 1.1 Introduction
        - 1.1.1 History of Computers
        - 1.1.2 Types of Computers
    - 1.2 Elements of a Microprocessor System
        - 1.2.1 Basic Block Diagrams
        - 1.2.2 Overview of Operation
        - 1.2.3 Typical Microcomputer Systems
    - 1.3 Microcomputer Buses
        - 1.3.1 Tristate: Interfaces
        - 1.3.2 Bidirectional Data Transfer:
2. **Microprocessor Concepts**
    - 2.1 Typical Internal Structure
    - 2.2 Execution of a Machine Language Program
    - 2.3 CPU Model - M68000 Internal Registers
    - 2.4 Memory Model
    - 2.5 Data Models
3. **Number Systems**
    - 3.1 Number Systems Review
    - 3.2 Number Conversions
    - 3.3 Addition and Subtraction in Binary
    - 3.4 Signed numbers and Two's Complement
    - 3.5 ASCII Character Set
    - 3.6 Overview of Parity
4. **Microprocessor Software Concepts**
    - 4.1 Instruction Execution and Instruction set
    - 4.2 Introduction to Addressing Modes
    - 4.3 Interpreting the Data Book (Hand Assembly)
    - 4.4 Mnemonic Representation/textual format
    - 4.5 Writing Simple Programs (Sequence Only)
5. **Programming Structures – Conditional Branching**
    - 5.1 If/Then/Else
6. **Programming Structures – Looping**
    - 6.1 While/Do While
7. **Programming Structures – Subroutines**
    - 7.1 Subroutines
    - 7.2 Stack Concepts
    - 7.3 Examples

Term Test #1

8. **Microprocessor Hardware**
    - 8.1 M68000 Pins and Signals
    - 8.2 Introduction to Timing Diagrams
    - 8.3 Bus Cycles
        - 8.3.1 Synchronous
        - 8.3.2 Asynchronous
    - 8.4 The M68000 Read Cycle
        - 8.4.1 Read Cycle Timing Diagram
        - 8.4.2 Read Cycle Operation
        - 8.4.3 Introduction of Wait States

- 8.5 The M68000 Write Cycle
  - 8.5.1 Write Cycle Timing Diagram
  - 8.5.2 Write Cycle Operation

9. **Microprocessor Memory Systems**
   - 9.1 Overview of Solid-State Memory Devices
   - 9.2 Address Space
   - 9.3 The Static RAM
     - 9.3.1 SRAM Pin Functions
     - 9.3.2 SRAM Timing Diagrams
   - 9.4 A Basic Memory Interface
   - 9.5 Address Decoding
     - 9.5.1 Address Decoding with Discrete Logic
     - 9.5.2 Address Decoding Tables
     - 9.5.3 Address Decoding ICs
     - 9.5.4 Complete (Full) Address Decoding
     - 9.5.5 Partial Address Decoding
   - 9.6 Interfacing Example

10. **Introduction to Software I/O Techniques**
    - 10.1 I/O Mapping
    - 10.2 Synchronization and Data Transfer
    - 10.3 Polling
    - 10.4 DMA
    - 10.5 Interrupt I/O

Term Test #2

11. **The Parallel I/O Interface**
    - 11.1 Concepts and Definitions
    - 11.2 The I/O Interface
      - 11.2.1 Basic Input Port
      - 11.2.2 Basic Output Port
    - 11.3 Electrical Considerations
    - 11.4 Handshaking
    - 11.5 Interface ICs

12. **Exception Handling**
    - 12.1 Concepts and Definitions
    - 12.2 User/Supervisor Concepts
    - 12.3 MC68000 Exceptions Interrupts
    - 12.4 Exception Vectors
    - 12.5 Exception Processing
    - 12.6 Interrupts and Interrupt Processing
    - 12.7 Software Initiated Exceptions
    - 12.8 Hardware Initiated Exceptions

13. **Development and Debugging Tools**
    - 13.1 Development Systems
    - 13.2 In-Circuit Emulation
    - 13.3 Logic Analyzer
    - 13.4 Signature Analysis
    - 13.5 Diagnostics
    - 13.6 Troubleshooting Techniques

Lab Exercises – Based on 2 x 1 ½ hour lab sessions per week
Schedule may change based on timing or component availability.

Week 1
Lab A – Introduction to Microprocessor Lab
Lab B – Work on Assignment #1

Week 2
Lab A – Introduction to Programming Interface
Lab B – Work on Assignment #2

Week 3
Lab A – Introduction to 68K Training Board
Lab B – Number Systems Practice

Week 4
Lab A – Addressing Modes
Lab B – Introduction to Programming Tools

Week 5
Lab A – Simple Programs – Selection (Simulator)
Lab B – Simple Programs – Selection (Hardware)

Week 6
Lab A – Simple Programs – Looping
Lab B – **TERM TEST #1**

Week 7
Lab A – Simple Programs – Subroutines (Simulator)
Lab B – Simple Programs – Subroutines (Hardware)

Week 8
Lab A/B – Introduction to Application Board (Hardware)

Week 9
Lab A/B – Application Board Programming – Multiplexing (Hardware)

Week 10
Lab A – Application Board Programming – Keypad (Hardware)
Lab B – **TERM TEST # 2**

Week 11
Lab A/B – Parallel Port Programming

Week 12
Lab A – Number Guessing Game - Simulator
Lab B – Simple Programs – Exceptions (Simulator)

Week 13
Lab A/B – Simple Programs – Graphical Exceptions (Simulator)

Week 14 – Logic Analyzer and Course Review
Lab A – Logic Analyzer
Lab B – Course Review

EVALUATION (Grading according to College policy):

Attendance is required for all classroom and lab activities. It is the student's responsibility to communicate with the instructor, preferably prior to any absence. Any absence not sufficiently justified will result in a loss of 5% of the overall course grade.

Numeric marks will be assigned to Quizzes, D2L Assignments, Term Tests, Final Exam, and Lab Exercises. These marks will be weighted according to the criteria defined in **Table 1: Evaluation Criteria** to obtain a composite percentage mark.

The percentage mark will be translated to a college standard letter grade according to **Table 2: Percentage to Letter Grade Translation**. Table 2 is applicable in this year and to this course only.

Table 1: Evaluation Criteria

Quizzes	10%
D2L Assignments	10%
Term Test 1	15%
Term Test 2	15%
Final Exam	40%
Total Theory	**90%**
Lab Evaluation	10%
Total	**100%**

- Quizzes are based on the weekly course / lecture material.
- D2L Assignments are questions based on the current week's material and are to be submitted to the correct D2L Dropbox by **Friday Midnight** of the same week.
  - **A mark of 50% will be given for any late submissions up to two days late.**
  - **A mark of 0% will be given for any submissions after two days late.**
- There will be two term tests given during the course based on the material covered up to the current week.
- There is a 3hr. final exam based on all course content during exam week.
- Laboratory evaluation is based on the following criteria:
  - 1/2 mark is given for attendance, cleanliness, deportment, group work, equipment treatment of your lab grade for each lab period.
  - 1/2 mark is given for completion of lab activities based on lab preparation and demonstration of your working code for each lab period.

Please note the following:

1. A grade of 60% or better is required in all assignments, quizzes and term-test to be able to pass the course.
2. A grade of 50% or better is required in the final examination to be able to pass the course.
3. No late materials will be accepted past midnight of the last day of the course.
4. A student is required to inform the instructor prior to being late or missing a class, or as soon as possible.

Table 2: Percentage to Letter Grade Translation

GRADING (in accordance with College policy):

A+	90 – 100%	**B-**	70 – 72%
A	85 – 89%	**C+**	65 – 69%
A-	80 – 84%	**C**	60 – 64%
B+	77 – 79%	**D**	50 – 59%
B	73 – 76%	**F**	< 50%

TEXT BOOKS AND REFERENCES:

- Access to Camosun D2L online course content – Both Text and Lab Files
- Motorola M68000 Instruction Set (Provided during Exams)
- Motorola M68000 Programmer's Reference Manual
- Motorola M68000 User's Manual

Additional References:

Clements, Alan. Microprocessor Systems Design: 68000 Hardware, Software, and Interfacing, 2nd Edition. PWS: Boston. 1992.