# SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

## SAULT STE. MARIE, ONTARIO

### COURSE OUTLINE

**COURSE TITLE:** MICROPROCESSOR PROGRAMMING

**CODE NO.:** CET 127 - 4

**PROGRAM:** ELECTRICAL & ELECTRONIC

TECHNICIAN / TECHNOLOGIST

**SEMESTER:** THREE

**AUTHOR:** PETER SAVICH

**DATE:** MAY 23, 1992

**PREVIOUS OUTLINE
DATED:** JANUARY 3, 1990

**APPROVED:** _L M Chazutt_        92-06-03

        DEAN               DATE

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TOTAL CREDIT HOURS:   64

LENGTH OF COURSE:          4 HOURS PER WEEK FOR 16 WEEKS
                           TWO 1 HOUR THEORY CLASSES PER WEEK
                           ONE   2 HOUR LAB CLASS PER WEEK

PREREQUISITE(S):           NONE

HOWEVER, THE STUDENT IS EXPECTED TO HAVE GENERAL COMPUTER KNOWLEDGE
EQUIVALENT TO THE CET 110 COURSE OFFERING. SPECIFICALLY, IT IS
ASSUMED THAT THE STUDENT IS ABLE TO:

1. FORMAT DISKS, CREATE SUB-DIRECTORIES, COPY, DELETE FILES AND USE
OTHER DOS COMMANDS AS PART OF THE OPERATING SYSTEM FOR PC'S OR
MICROCOMPUTERS.

2. HAVE KEYBOARDING SKILLS MEASURABLE IN WORDS PER MINUTE.

3. DESIGN PROGAMS WRITTEN IN GWBASIC. USE PSEUDO-CODE OR FLOW
CHARTS FOR WRITTING  SIMPLE PROGRAMS.

4.   USE AN EDITOR SUCH AS "EDIT" OR "TED" FOR TEXT EDITING (
SOMETIMES CALLED DOS TEXT, OR ASCII TEXT).

5.   USE WORDPERFECT 5.1 AND LOTUS 123 APPLICATION PROGRAMS FOR
REPORT WRITING AND SPREARDSHEET CALCULATIONS.


I.    PHILOSOPHY / GOALS


THE OBJECTIVE OF THIS COURSE IS TO ENHANCE THE STUDENT'S KNOWLEDGE
OF MICROPROCESSOR THEORY, PRACTICE AND APPLICATIONS.
THE COURSE USES THE 8088 ASSEMBLY LANGUAGE TO PROVIDE THIS
KNOWLEDGE OF MICROPROCESSORS. THE CET228 COURSE OFFERING IN FOURTH
SEMESTER WILL FOLLOW UP ON HARDWARE INTERFACING AND INTERRUPTS. THE
STUDENT OF THE CET127 COURSE WILL BE GIVEN TIME TO ACQUIRE THE
EDITING, ASSEMBLING, LINKING, DEBUGGING SKILLS FOR RUNNING ASSEMBLY
PROGRAMS. THIS REQUIRES THE STUDENT TO FIRST UNDERSTAND THE VARIOUS
ADDRESSING MODES AND INSTRUCTION SETS AVAILABLE.

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II. STUDENT PERFORMANCE OBJECTIVES

UPON SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE
TO:

1.    PERFORM, BY HAND CALCULATION, ARITHMETIC OPERATIONS INVOLVING
NUMBERING SYSTEMS THAT ARE: SIGNED/ UNSIGNED; BYTE, WORD, DOUBLE OR
QUAD WORD SIZE; BINARY, DECIMAL, HEXADECIMAL OR OCTAL RADIX (OR
BASE). CONVERT DECIMAL NUMBERS INTO HEXADECIMAL, BCD, BINARY OR
OCTAL NUMBERS BY HAND. CONVERT FROM ANY RADIX TO ANOTHER RADIX BY
HAND USING ONLY PAPER AND PEN ( NO CALCULATORS).

2. DEMONSTRATE KNOWLEDGE OF THE ADDRESSING MODES, INSTRUCTION SET,
AND REGISTERS OF THE 8088 MPU BY CORRECTING AND IMPROVING ASSEMBLY
LANGUAGE PROGRAMS PRESENTED TO HIM/HER.

3. DEMONSTRATE KNOWLEDGE OF THE ADDRESSING MODES, INSTRUCTION SET,
AND REGISTERS OF THE 8088 MPU BY **WRITTING ASSEMBLY LANGUAGE
PROGRAMS TO SOLVE ENGINEERING PROBLEMS.**

4. USE "DEBUG" TO SAVE, RETRIEVE, ASSEMBLE, UNASSEMBLE, TRACE, AND
EXAMINE SIMPLE ASSEMBLY PROGRAMS.

5. USE THE DOS 5.0 VERSION "EDIT" OR THE PUBLIC DOMAIN SOFTWARE
"TED" EDITOR TO EDIT  SIMPLE ASSEMBLY LANGUAGE PROGRAMS.

6. USE MICROSOFT CORPORATION MICROSOFT ASSEMBLER OR "MASM" TO
ASSEMBLE PROGRAMS WRITTEN USING EDITORS.

7. USE DOS VERSION SUPPLIED "DEBUG" AND/OR LICENCED SOFTWARE
"CODEVIEW" TO  RUN SIMPLE ASSEMBLY PROGRAMS.

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III. TOPICS TO BE COVERED

1. GENERAL COMPUTER CONCEPTS:
     REVIEW THE  DOS COMMANDS
       MICROCOMPUTERS COMPONENTS
       MICROPROCESSORS

2. NUMBERING SYSTEMS:
     BINARY, DECIMAL, OCTAL, HEXADECIMAL RADIXES ( OR BASES)
     2'S COMPLEMENTARY, 1'S COMPLEMENTARY NUMBERING SYSTEMS
     SIGNED AND UNSIGNED NUMBERS

3. REGISTERS, ADDRESSING MODES, AND INSTRUCTION SET OF THE 8088

4. HOW TO USE DEBUG TO LOAD (RETREIVE) AND WRITE (SAVE) SIMPLE
     ASSEMBLY PROGRAMS

5. HOW TO USE TEXT EDITORS TO CREATE  SIMPLE ASSEMBLY PROGRAMS

6. ASSEMBLING USING "MASM", LINKING, AND RUNNING ASSEMBLY
     PROGRAMS

ADDITIONAL TOPICS WORTHY OF STUDY (TIME PERMITING)

7. INPUT/OUPUT (I/O) USING DOS INT 21

8. ARITHMETIC INSTRUCTIONS USING THE 8088 MPU AND THE
     8087 CO-PROCESSOR FLOATING POINT INSTRUCTION SET

IV. LEARNING ACTIVITIES

LEARNING ACTIVITIES                    REQUIRED RESOURCES

1.0  REVIEWING BOOTING UP/LEARNING MS DOS

UPON SUCCESSFUL COMPLETION OF THIS UNIT,      TEXT CH. 1 & 2
THE STUDENT WILL BE ABLE TO:

1.1  DEMONSTRATE KNOWLEDGE OF GENERAL
     COMPUTER CONCEPTS BY DEFINING WHAT IS:
     DATA, INFORMATION, HARDWARE, SOFTWARE,
     OPERATING SYSTEMS, APPLICATION PROGRAMS

1.2  DESCRIBE THE COMPONENTS OF A COMPUTER:
     INPUT, OUTPUT, STORAGE, PROCESSING.

1.3  DISCUSS HOW MEMORY IS CONSTRUCTED OF TWO TYPES:
     ROM AND RAM, AND HOW DATA IS STORED IN THE
     COMPUTER

1.4  DRAW A BLOCK DIAGRAM OF A BASIC
     MICROCOMPUTER AND IDENTIFY THE
     COMPONENTS

1.5  PRICE A PARTICULAR MICROCOMPUTER GIVEN SUGGESTED COSTS FOR
     VARIOUS COMPONENTS SUCH AS: PRINTERS, MODEM'S, RAM MEMORY
     SIZE, HARD DRIVE SIZE, MONITOR AND CARD, AND FINALLY THE
     MICROPROCESSOR (8088, 8086, 80286, 80386, 80486).

1.6  BOOT UP THE IBM PC'S USING WARM BOOT
     AND COLD BOOT PROCEDURES.

1.7  FORMAT FLOPPY DISKS AND COPY TEXT FILES. GIVE
     THE DISK ORGANIZATION FOR DOUBLE DENSITY,
     DOUBLE SIDED DISKS, AND RECITE THE RULES
     FOR "DISKETTE CARE"

1.8  FAMILIARIZE AND PRACTICE USING THE FOLLOWING         HANDOUT
     SHORT LIST OF DOS COMMANDS: DIR, CD, MD, DATE,
     DEL, COPY, TYPE, FORMAT, DISKCOPY, CHKDSK,
     PRINT

1.9  USE PATHWORKS TO USE THE COMPUTER NETWORK

1.10 DISCUSS HOW THE INTERNAL STRUCTURE OF        TEXT CH. 1 & 2
     THE 8086 MICROPROCESSOR IS "16 BIT" ARCHITECTURE
     AND THE 80386 IS "32 BIT" ARCHITECTURE

1.11 DEFINE THE FOLLOWING TERMS: MICROPROCESSOR,
     MICROCOMPUTER, CLOCK, MEMORY DEVICE, I/O
     DEVICE, RAM, ROM, INSTRUCTION, MACHINE CODE,
     BYTE, WORD, DOUBLE WORD, REGISTER, ADDRESS

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2.0  NUMBERING SYSTEMS

UPON SUCCESSFUL COMPLETION OF THIS UNIT,     TEXT & HANDOUTS
T H E     S T U D E N T   W I L L   B E   A B L E
TO:

2.1  COMPLETE ARITHMETIC OPERATIONS SUCH AS
     ADDING AND SUBTRACTING USING THE FOLLOWING
     BASES OR RADIXES:
     BINARY, HEXADECIMAL, DECIMAL, OCTAL

2.2  CALCULATE  2'S COMPLIMENTARY, AND
     1'S COMPLIMENTARY NUMBERS AND DESCRIBE
     THE PURPOSE OF EACH SYSTEM.

2.3  PERFORM ARITHMETIC OPERATIONS ON:
     BYTE SIZE DATA, WORD SIZE, DOUBLE WORD SIZE,
     AND QUAD WORD SIZE DATA.

2.4  CHECK THE RESULTS OF ARITHMETIC OPERATIONS
     FOR OVERFLOW, CARRY/BORROW FOR BOTH SIGNED
     AND UNSIGNED DATA

2.5  DISCUSS WHY ASSEMBLY LANGUAGE PROGRAMMING
     IS USEFUL AND IMPORTANT

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## 3.0 REGISTERS, ADDRESSING MODES, AND INSTRUCTION SET OF 8088

UPON SUCCESSFUL COMPLETION OF THIS UNIT,
THE STUDENT WILL BE ABLE TO:                          TEXT CH. 2

3.1   DEMONSTRATE KNOWLEDGE OF: SEGMENTED
      ADDRESSING, SEGMENT REGISTER, AND OFFSET
      REGISTER BY CONVERTING A LOGICAL ADDRESS
      TO A PHYSICAL ADDRESS. ( 20 BIT ADDRESS).

3.2   USE DEBUG TO DEMONSTRATE UNDERSTANDING
      OF THE 16 BIT WIDE REGISTERS. USE THE "R"
      COMMAND TO DISPLAY THE HEX CONTENTS OF
      THE 14 DIFFERENT REGISTERS

3.3   SET THE CONDITIONS OF THE FLAG REGISTER
      AND VERIFY CHANGED CONDITIONS USING
      DEBUG.

3.4   USE THE SEVEN DATA ADDRESSING MODES IN DEBUG        HANDOUTS

3.5   KNOW THE JMP INSTRUCTION AND ALL ITS DERIVATIVES

3.6   KNOW THE STACK ADDRESSING INSTRUCTIONS: PUSH AND POP

3.7   RELATE SOME OF THE INSTRUCTIONS STUDIED TO THE
      ADDRESSING MODES, REG/MEM, TO THE NUMBER OF CYCLES
      NEEDED, AND NUMBER OF TRANSFERS                    HANDOUT

3.8   USE DEBUG AND TRACE SIMPLE PROGRAMS
      REQUIRING THE LOGICAL: AND, OR, NOT INSTRUCTIONS;
      THE SHIFT AND ROTATE INSTRUCTIONS; AND THE I/O
      INSTRUCTIONS IN , OUT.

## 4.0 HOW TO USE DEBUG TO LOAD AND WRITE SIMPLE ASSEMBLY PROGRAMS

UPON SUCCESSFUL COMPLETION OF THIS UNIT,        TEXT CH. 3
THE STUDENT WILL BE ABLE TO:                    HANDOUTS

4.1   USE ALL OF THE DEBUG COMMANDS:

4.2   USE THE DEBUG COMMAND "A" TO ASSEMBLE AND
      THE "W" COMMAND TO WRITE ( SAVE) A SERIES
      OF SIMPLE ASSEMBLY INSTRUCTIONS AS A FILE.

4.3   WRITE SIMPLE PROGRAMS THAT ILLUSTRATE
      DIFFERENT ADDRESSING MODES TO SOLVE A SIMPLE
      ARITHMETIC PROBLEM.


## 5.0 HOW TO USE AN EDITOR  TO CREATE  SIMPLE ASSEMBLY PROGRAMS

UPON SUCCESSFUL COMPLETION OF THIS UNIT,        HANDOUT
THE STUDENT WILL BE ABLE TO:


5.1   WRITE SIMPLE PROGRAMS USING THE EDITOR

5.2   KNOW THE ASSEMBLY DIRECTIVES NEEDED AND THE
      PROGRAM INITIALIZATION

5.3   USE THE EDITOR PROGRAMS TO SPEED UP THE
      WRITING OF ASSEMBLY LANGUAGE PROGRAMS.
      SPECIFICALLY: CUT AND PASTE, MARK.

5.4   SAVE, RENAME, RETRIEVE SOURCE CODE

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6.0 ASSEMBLING USING "MASM", LINKING, AND RUNNING ASSEMBLY PROGRAMS

UPON SUCCESSFUL COMPLETION OF THIS UNIT,      HANDOUT
THE STUDENT WILL BE ABLE TO:                  TEXT CH. 4

6.1   ASSEMBLE USING "MASM", CORRECTLY
      KNOW THE ERROR MESSAGES IF INCORRECT, AND
      THEN RE-ASSEMBLE

6.2   LINK THE OBJECT CODE TO PRODUCE EXECUTABLE
      CODE. KNOW THE ERROR MESSAGES

6.3   RUN THE EXECUTABLE CODE WITHIN DEBUG      HANDOUT
      OR CODEVIEW

6.4   SOLVE PROBLEMS OF SUITABLE COMPLEXITY BY
      DESIGNING PROGRAMS USING PSEUDO-CODE OR
      FLOW CHARTS, EDIT, ASSEMBLE, LINK, TEST
      IN CODEVIEW, ALTER, RE-TEST IN CODEVIEW.

ADDITIONAL TOPICS WORTHY OF STUDY (TIME PERMITTING)

7.0 DOING KEYBOARD I/O USING DOS INT 21

UPON SUCCESSFUL COMPLETION OF THIS UNIT,      HANDOUT
THE STUDENT WILL BE ABLE TO:

7.1   PERFORM SIMPLE OUTPUT TO THE SCREEN
      USING DOS INT 21

7.2   PERFORM SIMPLE INPUT TO THE COMPUTER
      VIA THE KEYBOARD USING DOS INT 21

## 8.0 ARITHMETIC INSTRUCTIONS USING THE 8088 MPU AND THE 8087 CO-PROCESSOR FLOATING POINT INSTRUCTION SET

UPON SUCCESSFUL COMPLETION OF THIS UNIT, HANDOUT
THE STUDENT WILL BE ABLE TO:

8.1   USE "CODEVIEW" TO EXAMINE WORD, SHORT,
      AND LONG INTEGERS; EXAMINE SHORT, LONG
      AND TEMPORARY REAL NUMBERS

8.2   UNDERSTAND THE FLOATING POINT INSTRUCTION
      SET OF THE 8087: FADD, FSUB, FMUL, FDIV.
      WRITE PROGRAMS USING THESE (AND OTHER)
      FLOATING POINT INSTRUCTIONS.

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V.    METHOD(S) OF EVALUATION

1.

THE STUDENT WILL BE ASSESSED THROUGH A SERIES OF THREE (3) WRITTEN
TESTS. THESE TESTS WILL EACH BE WEIGHTED TO 20% OF THE FINAL MARK.

THE TENTATIVE DATES ARE: OCT 2 /92
                         NOV 6 /92
                         DEC 18/92

THESE TEST DATES WILL BE RE-ANNOUNCED APPROXIMATELY ONE WEEK IN
ADVANCE.

2.

THE STUDENT WILL BE ASSESSED THROUGH A SERIES OF UNANNOUNCED
QUIZZES. THE TOTAL WEIGHT OF THESE QUIZZES ARE NOT TO EXCEED 10% OF
THE FINAL MARK. IF TEN QUIZZES WERE GIVEN THEN EACH QUIZ WOULD BE
WORTH 1%  OF THE FINAL.

3.

THE STUDENT WILL BE ASSESSED THROUGH A SERIES OF LAB ASSIGNMENTS.
COLLECTIVELY THESE ASSIGNMENTS WILL BE WEIGHTED TO 25% OF THE FINAL
MARK. SOME ASSIGNMENTS MAY BE MANDATORY TO SUBMIT.

4.

THE STUDENT WILL BE ASSESSED ON HIS/HER ABILITY TO ANSWER QUESTIONS
ABOUT THE LAB ASSIGNMENT ONCE SUBMITTED. THE STUDENT'S RESPONSE TO
THESE LAB DEMONSTRATION QUESTIONS WILL BECOME PART OF HER/HIS
"PRACTICAL DEMONSTRATION" MARK. THIS MARK WILL BE WEIGHTED TO 5% OF
THE FINAL MARK. THREE SEPARATE EVALUATION SESSIONS ARE EXPECTED
THROUGHOUT THE YEAR. INDIVIDUAL TIMES WILL BE POSTED AND THE
STUDENT MAY BE SCHEDULED OUTSIDE OF REGULARILY
SCHEDULED CLASS OR LAB TIME.

5.

THE STUDENT ATTENDING MORE THAN 80% OF THE TIME WILL RECEIVE A
BONUS OF 2%.

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### SUMMARY OF FINAL MARK

| | | |
|---|---|---|
| 1. | TESTS | 60% |
| 2. | QUIZZES | 10% |
| 3. | ASSIGNMENTS | 25% |
| 4. | DEMOS | 5% |
| | | ---- |
| | | 100% |

| | | | |
|---|---|---|---|
| 5. | ATTENDANCE | 2% | BONUS ONLY |

### COURSE GRADING SCHEME

| | | | |
|---|---|---|---|
| A+ | 90+ | | OUTSTANDING ACHIEVEMENT |
| A | 80 - 89 | | ABOVE AVERAGE ACHIEVEMENT |
| B | 70 - 79 | | AVERAGE ACHIEVEMENT |
| C | 55 - 69 | | SATISFACTORY ACHIEVEMENT |
| | | | |
| U | | | UNSATISFACTORY GIVEN AT MIDTERM ONLY |
| S | | | SATISFACTORY GIVEN AT MIDTERM ONLY |
| | | | |
| R | | | REPEAT |
| | | | |
| X | | | A TEMPORARY GRADE THAT IS LIMITED TO INSTANCES WHERE SPECIAL CIRCUMSTANCES HAVE PREVENTED THE STUDENT FROM COMPLETING OBJECTIVES BY THE END OF THE SEMESTER. AN "X" GRADE MUST HAVE THE DEAN'S APPROVAL AND HAS A MAXIMUM TIME LIMIT OF 120 DAYS. |

NOTE:    IF A STUDENT HAS BORROWED AND FAILED TO RETURN ANY
         TEXTBOOKS, LAB EQUIPMENT, ETC. "NO MARK RECORDED" WILL
         BE ENTERED.

3.    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 THE STUDENT'S PERFORMANCE WARRANTS IT. ATTENDANCE AND ASSIGNMENT COMPLETION WILL HAVE A BEARING ON WHETHER UPGRADING WILL BE ALLOWED. A "REPEAT" GRADE ON ALL TESTS WILL REMOVE THE OPTION OF ANY UPGRADING AND AN "R" GRADE WILL RESULT. THE HIGHEST ON A RE-WRITTEN TEST OR ASSIGNMENT WILL BE 56%.

THE METHOD OF UPGRADING IS AT THE DISCRETION OF THE TEACHER AND MAY CONSIST OF ONE OR MORE OF THE FOLLOWING OPTIONS:

        ASSIGNED MAKE-UP WORK
        RE-DOING PROJECTS
        RE-DOING OF TESTS
        WRITING OF COMPREHENSIVE SUPPLEMENTAL EXAMINATION

VI.   REQUIRED STUDENT RESOURCES

THE TEXT REQUIRED TO BE PURCHASED BY THE STUDENT IS:

1.

"THE 8086/8088 FAMILY DESIGN, PROGRAMMING, AND INTERFACING"
BY JOHN UFFENBECK, PRENTICE-HALL PUBLISHING

2.

THE STUDENTS WILL ALSO BE EXPECTED TO PURCHASE  APPROXIMATELY 10
FLOPPY DISKS 5 AND ONE QUARTER INCH, DOUBLE SIDED, DOUBLE DENSITY.
THE STUDENT MAY WISH TO PURCHASE HIGH DENSITY DISKS IN ADDITION,
HOWEVER NOT ALL COMPUTER SYSTEMS AT SAULT COLLEGE ARE CAPABLE OF
READING HIGH DENSITY DISKS.

VII. ADDITIONAL RESOURCE MATERIALS ( AVAILABLE IN COLLEGE LIBRARY)

1.

"IBM PC ASSEMBLY LANGUAGE AND PROGRAMMING"
BY PETER ABEL, PRENTICE-HALL PUBLISHING, 2ND EDITION.

2.

"IBM PC 8088 ASSEMBLY LANGUAGE PROGRAMMING"
BY AVTAR SINGH AND WALTER TRIEBEL
PUBLISHER: PRENTICE-HALL

THERE ARE MANY OTHER BOOKS ON ASSEMBLER LANGUAGE FOR THE 8086/8088
MICROPROCESSOR FAMILY.

3.

"ADVANCED MICROPROCESSORS, BY HEATHKIT EDUCATIONAL SYSTEMS"
THERE ARE 3 BOOKS: BOOK I, BOOK II , AND STUDENT WORKBOOK.

4.

"MICROCOMPUTER SERVICING PRACTICAL SYSTEMS AND TROUBLESHOOTING"
BY STUART ASSER, VINCENT STIGLIANO, RICHARD BAHRENBURG; MERRILL
PUBLISHING

5.

"THE INTEL MICROPROCESSORS - 8086/8088, 80186, 80286, 80386,  80486
ARCHITECTURE, PROGRAMMING AND INTERFACING"
BY BARRY BREY, MERRILL PUBLISHING

6.

"COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE PROGRAMMING FOR IBM
PCS AND COMPATIBLES"
BY MICHEAL THORNE, BENJAMIN/CUMMINGS PUBLISHING
PERIODICALS:   PC MAG, BYTE MAG, COMPUTING CANADA

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VIII.    SPECIAL NOTES

<u>ELECTRICAL & ELECTRONIC STUDENTS</u>: THE CET 127 COURSE BEING OFFERED
IS THE FIRST COURSE OF MANY 8088/8086 MICROPROCESSOR BASED COURSES
OF THE ELECTRICAL PROGRAM AND THE ELECTRONIC PROGRAM. THUS THE
8088/8086 MICROPROCESSOR, AND 8088/8086 ASSEMBLY LANGUAGE IS WELL
STUDIED. THE KNOWLEDGE/UNDERSTANDING GAINED IN MICROPROCESSOR
TECHNOLOGY IS REQUIRED, IN MOST CASES, FOR THE THIRD YEAR STUDENT
"RESEARCH PROJECTS".


INSTRUCTORS (PROFESSORS) RESERVE THE RIGHT TO MAKE CHANGES TO THE
COURSE OUTLINES WHERE NECESSARY.

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