Department of Technical Education
DIPLOMA COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING
Fourth Semester
MICROCONTROLLERS AND APPLICATION

Contact Hours/Week : 04   Contact Hours/Semester : 64

CONTENTS	No. Of Hrs.
Unit-I	
1.Introduction to Microcontrollers	02
2 8051 Architecture	09
3.Assembly Language Programming-I	10
Unit-II	
4.Assembly Language Programming-II	06
5.8051 Programming in C	08
6.I/O Port Programming`	04
Unit-III	
7.Interrupts	04
8.Timers and Counters	06
9.Serial I/O	03
10. Interfacing of 8051	08
Tests & assignments	**04**
Total	**64 Hrs**

DETAILS OF CONTENTS:

1. INTRODUCTION TO MICROCONTROLLERS.
Micro controller, types, selection of a microcontroller and applications

2. 8051 ARCHITECTURE
8051 features, other members, pin functions and block diagram of 8051, various registers, SFRs, register banks, internal memory organisation , stack & stack pointer external memory- interfacing, I/O ports-port1 details.

3. ASSEMBLY LANGUAGE PROGRAMMING –I
Programming tools, assembler directives, addressing modes, instruction set, classification, arithmetic and logical instructions, Simple programs.

4. ASSEMBLY LANGUAGE PROGRAMMING –II
Bit handling, rotate, jump, swap and call instructions-Example programs'

5. 8051 PROGRAMMING IN C
Introduction, advantages & disadvantages, data types, generalized C program for 8051, memory types and models , strings , arrays, pointers, time delay generation, use of arithmetic & logical operators, accessing SFRs and bit addressable RAM, example programs

6. I/O PORT PROGRAMMING

Byte size I/O, bit addressability, example programs with assembly & C

7. INTERRUPTS OF 8051

Polling & Interrupt methods, executing an interrupt, different types, IE and IP registers, enabling, disabling and priority setting.

8. TIMERS AND COUNTERS

TMOD and TCON registers, mode 1 & mode 2 operation of timers and counters, Time delay generation & example programs.

9. SERIAL I/O

SBUF & SCON registers, working of serial port, Serial data transmission & reception, Example programs.

10. INTERFACING THE 8051

Interfacing LED,push button switch, Seven segment Display, LCD module, ADC,DAC, DC motor & Stepper motors.

Recommended Books:

1. **The 8051 Microcontroller(1st Edition)** – Dr.Uma Rao & Andhe Paallavi
2. **Microcontrollers and its applications**- By K Shashidhar, Sapna Publications
3. **The 8051 Microcontroller & Embedded systems(2ndEdition)**
   –M.A.Mazidi ,J.C.Mazidi & R.D.McKinlay
4. **Microcontrollers & applications** – Ramani Kalpathi, & Ganesh Raja
5. **The 8051 Microcontroller(4th Edition)**- MacKenzie & Phan

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GENERAL EDUCATIONAL OBJECTIVES:

  1. **Know the architectural features of 8051 microcontroller.**
  2. **Study the Instruction set of 8051**
  3. **Study the hardware features from the programmer's point of view.**
  4. **Achieving competency in assembly as well as C programming of 8051.**
  5. **Developing simple systems(software + hardware) using 8051.**

 SPECIFIC INSTRUCTIONAL OBJECTIVES:

  1. **INTRODUCTION TO MICROCONTROLLERS.**
  Definition of microcontroller. Overview of block diagram of microcontroller.
  Description of Embedded and External memory microcontroller.(Refer to Mike
Predko)
  Criteria for selecting a microcontroller.(1.1 of Mazidi)
  List the applications of microcontrollers.

  2. **8051 ARCHITECTURE.**
  The general features of 8051 microcontroller.
  Features of other members of 8051 family(1.2 of Mazidi)
  Description of pin functions of 8051
  Block diagram description of 8051
  Understand the functions of various registers of 8051 like Program Counter,
DPTR, A and B registers.
  PSW register- discussion on various flags with simple examples.
  List the Special function registers of 8051.
  Understanding of internal memory organization of 8051- register banks & their
selection, bit/byte addressable RAM(3.6 of uma rao)
  Brief discussion on stack and stack pointer.(3.7 of umao rao)
  Brief discussion on the program memory of 8051- internal and external. Examples
to show interfacing of external RAM/ROM(3.6.3 & 3.6.4 of Umao Rao)
   2.11 To know the internal configuration of port 1.Reading from and writing to a
   port.(3.9.2, 3.9.5 & 3.9.6 of uma Rao)

  3 **ASSEMBLY LANGUAGE PROGRAMMING –I**
   3.1 Definition of assembler, cross assembler, compiler , cross compiler, linker
      and loader.
   3.2 Explanation and use of commonly used assembler directives like EQU,
      ORG, DB and END(4.4.1 of Uma Rao)
   3.3 General format of assembly instruction.(refer 2.2 of mazidi)
   3.4 Difference between assembler directives and instruction.
   3.5 Discussion on different Addressing modes of 8051 namely
      direct, indirect, register, immediate and indexed addressing(4.5 of Uma Rao)

3.6 Classification of instruction set of 8051.

3.7 Complete set of data transfer, data exchange , data transfer with stack instructions, arithmetic and byte level logical instructions. Function of each instruction with bytes, no. of machine cycles and details of flags affected has to be discussed.

3.8 Simple example programs on arithmetic and logical operations, data block movement and code conversion covering the instructions in 3.7

4 ASSEMBLY LANGUAGE PROGRAMMING –II

4.1 Bit level logical instructions, rotate, swap, jump and call instructions- Function of each instruction with bytes, no. of machine cycles and details of flags affected has to be discussed.

4.2 Example programs on looping, calling sub routines, operation on series of numbers covering the instructions in 4.1

5. 8051 PROGRAMMING IN C

Introduction to to 8051 C

Know the advantages and disadvantages of using 8051 C

Brief discussion on various data types like unsigned char, signed char, unsigned int, signed int, sfr,bit and sbit(uma rao 7.2 + mazdi 7.1)

To know the general way of writing a simple C program and discussion of some example programs(7.3 of uma rao)

To know the usage of memory types like code,data,idata,bdata,xdata,and padta and different memory models used in 8051 C(8.5 mackenzie + 7.9 of uma rao + 7.5 of mazidi)

To know the typical usage of strings, arrays and typed/untyped pointers(8.6 to 8.8 of mac kenzie + 7.2.2 of uma rao)

Understand the technique of time delay generation using loops with example programs(7.4 of uma rao + 7.1 of mazdi)

Accessing SFR registers , using bit data type for bit addressable RAM (section 7.2 of mazidi)

Understand the usage of different arithmetic and logical operators in 8051 C with example programs(7.6 of uma rao + 7.3 of mazdi)

Write simple code conversion programs in 8051 C(7.4 of mazdi + 7.8 of uma rao)

6 I/O PORT PROGRAMMING

6.1 Simple programs in assembly involving I/O operations with ports(section 4.1 of mazidi)

6.2 Discussion on single bit addressability of ports with example assembly programs. (section 4.2 of mazidi)

6.3 Understand the method of programming ports of 8051 with simple programs in C including byte size I/O, bit addressable I/O with simple programs (section 7.5 of uma rao + section 7.2 of mazidi)

7.0 INTERRUPTS OF 8051

7.1 Comparison of Interrupt method & polling(section 11.1 of mazidi).

7.2 Steps in executing an interrupt. (section 11.1 of mazidi).

7.3 Know the different Interrupts of 8051. (section 11.1 of mazidi).

7.4 Know the bit structure of IE and IP registers. (section 11.1 of mazidi).

7.5 Examples showing enabling ,disabling and priority setting of different
   interrupts.

8. TIMERS AND COUNTERS *
   8.1 Know the structure of TMOD register with examples on selecting different
   modes
   8.2 Know the bit structure of TCON register.
   8.3 Mode 1 & mode 2 operations of timers.(section 5.2 of Ramani Kalpathi)
   8.4 Delay generation programs using timers in assembly & C. (8.2 of
                                             UmaoRao)
   8.5 Mode 1 & mode operations of counters(Section 5.3 of Ramani Kalpathi)
   (* Chapter 9 of Mazidi can also be referred)

9 SERIAL I/O
   9.1 Know   the structure of SCON and function of SBUF registers.
   9.2 Mechanism of working of serial port(8.5.3 of Uma Rao)
   9.3 Procedure to program 8051 to transmit/receive data serially(8.5.4 & 8.5.5
   of Uma Rao) with example programs in assembly & C

10. INTERFACING THE 8051
   10.1 Interfacing LED with schematic, algorithm & program(9.2.2 Ramani
                                             Kalpathi)
   10.2 Interfacing multiplexed 7 segment display with schematic, algorithm &
         program(9.5 Ramani Kalpathi)
   10.3 Interfacing LCD with schematic, algorithm & program(section 10.2.2
         Uma Rao)
   10.4 Interfacing a single key(push button) to 8051 with schematic, algorithm
         & program(section 10.3 Uma Rao)
   10.5 Interfacing stepper motor to 8051 with schematic, algorithm &
         program(section 10.5 Uma Rao)
   10.6 Interfacing DAC0808 to 8051 to generate different waveforms with
         schematic, algorithm & program(section 10.6 Uma Rao)
   10.7 Interfacing ADC 0804 to 8051 with schematic, algorithm &
         program(section 10.8.2 Uma Rao)
   10.8 DC motor interfacing using optoisolator for speed control using PWM
         with schematic, algorithm & program(section 10.7.2 & 10.7.3Uma Rao)

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MICROCONTROLLERS & APPLICATIONS
Model Question Paper

Time : 3 Hours   **Max . Marks: 100**

Instructions: (1) Section-I is compulsory

(2) Answer any **two** full questions from each of the remaining sections

SECTION –I

1(a) Fill in the Blanks   5 X 1 = 5

(i)   _____instruction is used to interchange the nibbles of register A.

(ii)   With_____ addressing mode, the program memory can be accessed.

(iii) Each machine cycle in 8051 takes _____ clock periods.

(iv)   The 8051 address bus has _____ address lines.

(v)   The ACALL instruction is limited to _____ bytes from the present PC.

(b) List the criteria to be used while selecting a microcontroller.   5

SECTION-II

2 (a) Explain with a block diagram, the architecture of 8051 micro controller 9

(b) Explain the scheme of interfacing 8051 with 8K ROM   6

3(a) Describe the internal configuration of port 1 of 8051   5

(b)Explain the different types of addressing modes supported by 8051 with an example for each.   10

4(a) Explain the general format of an assembly instruction.   4

(b) Write an ALP to add the contents of external M.L 0800H & 0801H & place the result in external M.L 0B00   5

© Explain the meaning of (i) MOVX @Ri, A   (ii) MOVC A, @A+PC   4

(d) What is the function of ALE pin of 8051   2

SECTION-III

5(a) Explain the meaning of (i) SWAP A (ii) RLC A. Give the number of bytes, Flags affected and no. of machine cycles.   6

(b) What is the value of register A after each of the following instructions are executed.   CLR A

SETB C

RRC A

SETB C

RRC A   5

© Write an ALP to transfer data stored in internal RAM location 60H to external M.L 0B00H. Length of the series is 6,

4

6(a) List the advantages and disadvantages of programming 8051 in C.   5

(b) Explain the result of the following C statements.

(i) P0 = 0x35 & 0x0F (ii) P0 = 0x06 << 4   4

© Write a C program to find the number of 1s in an 8 bit data item   . 6

7(a) Write a C program to convert a hexadecimal number FD to decimal (Unpacked BCD) and display the digits on P0,P1 and P2   6

  (b) Write an ALP to create square wave of 50% duty cycle on bit 0 of port 1   5

  (c)   Explain the use of ORG and DB assembly directives   4

SECTION-IV

8(a) What is an interrupt ? Give a brief account of different interrupts supported by 8051.   6

  (b) Explain the bit structure of TMOD register   6

  © Differentiate between polling method and interrupt methods.   3

9(a) Explain the working of Timer 0 in mode1 with a schematic.   8

  (b) Write an ALP to transmit a character 'J' continuously at a Baud rate of 9600 from serial port using mode 1.   7

10(a) Write a program to generate a time delay of 10 ms using timer 1 in mode 1 when crystal frequency is 11.0592 MHz   6

  (b) Explain the method of interfacing stepper motor with 8051. Give the Schematic and write the algorithm.   9

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