COURSE NAME : ELECTRICAL ENGINEERING GROUP

COURSE CODE : EE/EP

SEMESTER : FIFTH

SUBJECT TITLE : Microcontroller and Applications(Elective I for EP)

SUBJECT CODE :

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

 # - External @ - Internal * On Line Examination

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

Use of microcontroller based systems has become dominant in society with broad spectrum of applications ranging from house hold appliances to complex industrial environment. A variety of microcontrollers with several on-chip peripherals are now available at affordable price and future foretells of these devices is continuing to expand.

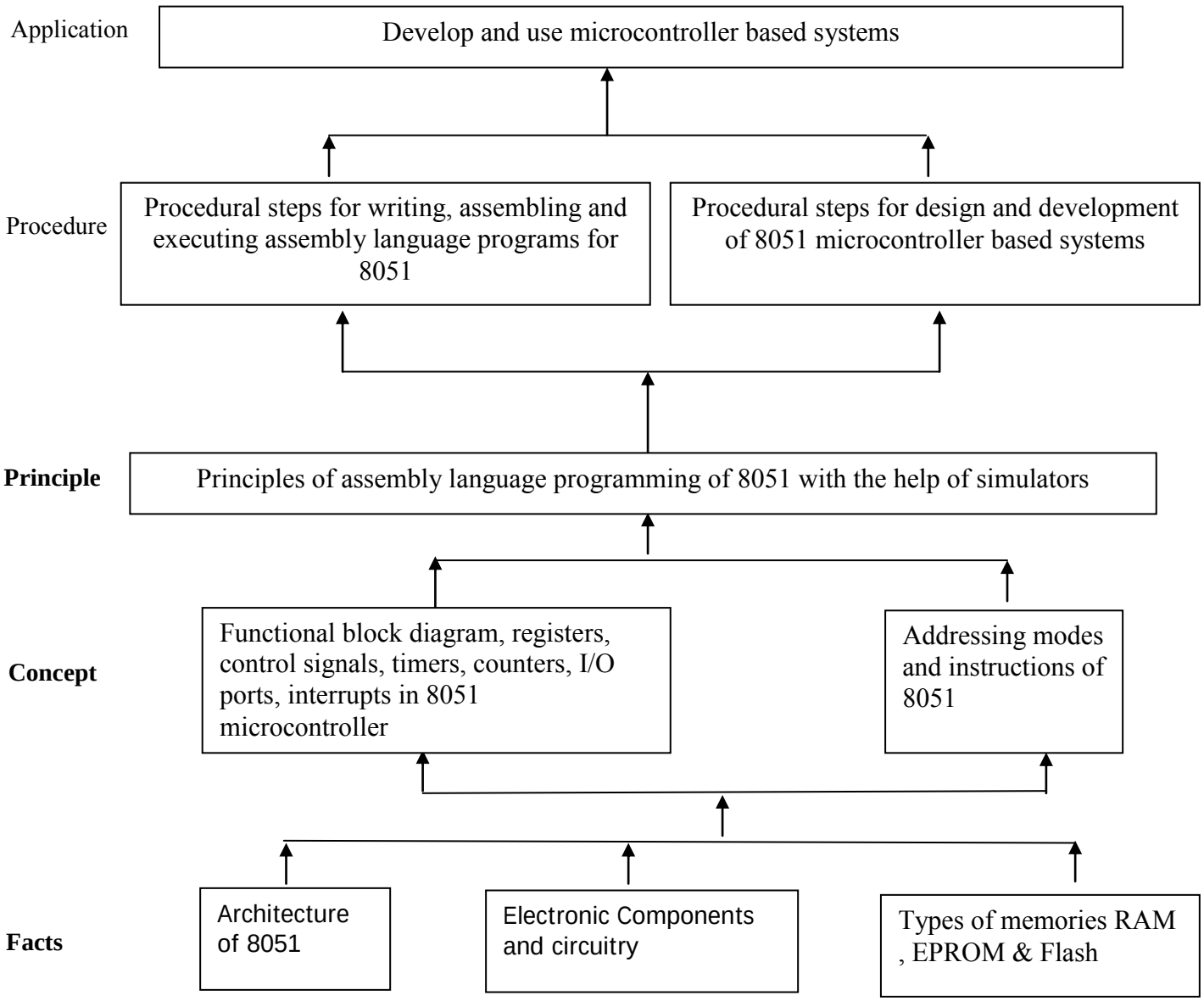
A diploma engineer must have a solid foundation of knowledge of microcontroller based systems, its programming techniques and tools. This will help him in developing innovative solutions to particular industrial problems or to emerge as an entrepreneur.

The low cost, huge range, easy availability and widespread use of the 8051 family makes it an excellent platform for developing microcontroller based systems: these same factors make it an ideal platform for learning about microcontrollers.

General Objectives:

1) Understand 8051 microcontroller architecture.
2) Understand instruction set and assembly language programming
3) Understand the use of higher level language (C programming) to develop programs for 8051 microcontroller.
4) Know the interfacing of various peripherals to 8051
5) Learn basic concepts of system design based on 8051 for typical applications.

Learning Structures:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction to microcontrollers Specific Objectives: ➢ Convert any number from base 2, base 10, base 16 to either of the two bases. ➢ Describe logical operations AND,OR, NOT, XOR, NAND, NOR ➢ Explain difference between *bit*, *nibble*, a *byte* and a *word* and definitions of *kilobyte, megabyte, gigabyte.* ➢ Define terms such as hardware, software, firmware, cpu, bus, ports, operating system. ➢ Explain Harvard and Von Neumann architecture, RISC, CISC machines. **Contents:** 1.1 Digital Primer • Binary, decimal, hexadecimal numbering system and conversion between either of the two bases. • Addition of binary and hex numbers and subtraction using 2's complement. • Review of logic gates: AND, OR, NOT, XOR, NAND, NOR. • Definitions of important terms: *bit, byte, nibble, word, kilobyte, megabyte, gigabyte, terabyte.* 1.2 Introduction to digital computer • Block diagram of a digital computer, and definitions of terms: *Hardware, software, firmware, memory, CPU, address bus, data bus, control bus, ports.* • Memory Classification: RAM (static and dynamic), ROM, PROM, EPROM, EEPROM, FLASH. • Microprocessor and features of a microprocessor based system 1.3 Microcontroller basics • Schematic block diagram of a microcontroller. • Comparison between a microcontroller and microprocessor. • Von-neumann and Harward architecture.	4	8

• RISC and CISC machines. • Features of 8051 microcontroller. • Survey of commercially available 8051 microcontrollers e.g. Atmel, Dallas.		
Topics 2: 8051 Microcontroller Architecture Specific Objectives: ➢ Draw labeled pin diagram and state function of each pin. ➢ Understand system clock characteristics and reset circuit. ➢ Describe the internal memory organization and different special functions register. ➢ Describe the functions of stack pointer and program counter ➢ Describe different interrupt sources, priorities and services. **Contents:** 2.1 Architecture • Block diagram of internal architecture • Pin diagram, function and alternate function of pins • System clock, machine cycles and reset circuit. 2.2 Memory Organization • Internal program and data memory, external memory interface • Register banks, bit and byte addressable area. • Registers: PC, DPTR, A&B, PSW and other Special function registers(SFR) • Architecture of I/O ports • Stack and stack pointer register 2.2 Timers and Counters. • Timer/counter control logic and interrupts. • TMOD and TCON SFR map. • Timer modes of operation. 2.3 Interrupts. • Interrupt sources. • IE and IP SFR map • Interrupt priorities 2.4 8052 microcontroller	12	24

• Comparison of 8051 and 8052 microcontroller		
Topic 3. Addressing modes and instructions of 8051 Specific Objectives: ➢ Explain the instruction syntax and data types. ➢ Explain instruction timings. ➢ Explain the instruction set. ➢ Define subroutines and explain its uses. ➢ Assemble and run simple assembly programs **Contents:** 3.1 Instruction syntax and data types • Opcode, Operand, label, comment, and assembler directives such as DB, ORG, EQU, END • Data types and data range 3.2 Addressing modes • Immediate, register, direct, indirect, indexed, relative, absolute, bit inherent, bit direct. 3.3 Instruction set • Definition of basic parameters: T-State, machine cycle, instruction cycle. • Instructions: data transfer, arithmetic, logical, branching, subroutines, bit manipulation. 3.4 Assembly language programming • Develop assembly language programs for the following commonly used applications. i) Addition, subtraction of two 8 bit, 16 bit signed/unsigned numbers. ii) Multiplication and division on two 8 bit/16 bit unsigned numbers. iii) Find largest and smallest number integer of an array. iv) Average of 8-bit numbers. v) Bubble sorting. vi) Data transfer from one location to other. vii) Programmable delay generation.	**12**	**24**

viii) Program to generate square wave on the port pin using timer. ix) Simple program for demonstrating interrupt service. x) Program to measure time period of a square wave using counter. xi) Program to demonstrate use of subroutine.		
Topic 4. 8051 Programming in C Specific Objectives: ➢ Examine C data types ➢ Work with C-compiler and simulator Contents: 4.1 C data types • C data types such as unsigned/signed char, unsigned/signed int, sbit, sfr. • Introduction to integrated development environment such as Keil μ-vision 4.2 C Programming • Writing simple C programs for i) Continuously toggle all bits of a port and particular port pin with some delay. ii) Bit wise shift operation. Left/right port data continuously. iii) Addition of array elements. iv) Read input port and send hex data to output port.	**04**	**12**
Topic 5. External Peripheral Interface Specific Objectives: ➢ Interface simple push button switches and output data to LEDs. ➢ Input data from matrix keyboard and output to seven segment display. ➢ Use D/A converter to generate digital/analog waveforms. ➢ Interface 8 bit/12 bit ADC. ➢ Interface character LCD display. ➢ Interface serial port. Contents: 5.1 Reading push buttons • Interfacing of a key or push button, contact bouncing, hardware and software de-bouncing, C program to read valid key status.	**8**	**16**

• Interfacing 3x3 key matrix and C program to store key status. 5.2 LED & LCD interface • Interfacing of LEDs (common anode and common cathode) and multiplexed seven segment LED displays (4 digit), C program • Parallel interfacing of 20x4 character LCD display using 8bit data transfer, C program. 5.3 ADC and DAC interface • Interfacing of 8-channel, 8 bit parallel ADC 0809 and C-program. • Interfacing of MAX 1112 serial ADC, C-Program • Interfacing of 8 bit DAC 0808, C-program. 5.4 Serial port interface • Basics of serial communication: 8bit-UART mode • Overview of serial port registers, SCON, SBUF, SMOD • C program to transmit and receive data serially from personal computer using 8bit-UART mode.		
Topic 6. Typical applications Specific objectives ➢ Develop schematic diagrams for typical applications ➢ Develop flowchart for such applications 6.1 Interfacing applications (programming not expected) • Temperature measurement using LM35 temperature sensor. • Relay and opto-isolator interface • DC motor speed control • Stepper motor control • Servo motor control	**8**	**16**
Total	**48**	**100**

Practical:

Skills to be developed:

Intellectual Skills:

1. Logical thinking process development
2. Programming skills

Motor Skills:

1. Data entry, Error Correction and Execution of assembly language programs

2. Connections

List of Practicals:

Write assembly program for (Any Five) (Simulation using Keil µ-vision simulator or equivalent)

1) Addition of 10 nos. stored in internal memory of 8051/52 and store the result in next two locations
2) Squaring the contents of R5 and store the results in R0 and R1
3) Division of number in internal RAM location 15h by data in RAM location 16h and store the result in RAM location 7Ch
4) Set every third byte from internal RAM 20h to 7Fh to zero
5) Count number of bytes in internal RAM locations from 70h to 7Fh that are greater than number stored in R3, and less than number stored in R4. Store the counts in R5, R6 registers.
6) Construct a lookup table to convert hex number stored in A to its BCD equivalent in R4(LSB),R5(MSB)
7) Convert given 10 nos. stored at 60h onwards to their ascii codes and store them at the same locations

C programming and external peripheral interface (Any Five)

1) Up-counter(0-9) and output the counter value to the port P0
2) Delay of 250ms using a function.
3) Draw schematic circuit diagram for connecting 2 LEDs at P1.0 and P1.1. Develop C program to generate square wave of 1Hz on P1.0 at 2Hz at P1.1.Observe the output at the port pins.
4) Connect 2Hz square wave at P2.0 and write a program to count rising edges in 10 seconds using a counter.
5) Draw schematic circuit and display “MSBTE” message on LCD (16x2).
6) Draw schematic circuit and develop program to send “WELCOME” on serial port continuously.
7) Draw schematic circuit to interface 2X2 matrix keyboard and display keycode on 2digit seven segment LED display.
8) Draw schematic circuit to interface 0809 ADC and display the reading on LCD display.
9) Interface Stepper Motor to Microcontroller 8051 and development and execution of the program to run stepper motor.

Learning Resources:

1. **Books:**

Sr. No.	Author	Title	Publisher
1	Kenneth Ayala	The 8051 Microcontroller	Penram International

		Architecture Programming and Applications	Publishing (India). 1996.
2	Subrata Ghoshal	8051 microcontroller- internals, instructions, programming and interfacing	Pearson
3	Ajay Deshmukh	8051 microcntroller and applications	Tata McGraw Hill
4	M. Mazidi et al.	The 8051 Microcontroller and Embedded Systems –using assembly and C	Pearson
5	K. Uma Rao	The 8051 Microcontroller- Architecture, Programming and Applications	Pearson
6	V. Udaysankara et al.	8051 microcontroller- Hardware, Software and Applications	McGrawHill
7	J. S. Parab et al.	Exploring C for microcontrollers- A hands on approach	Springer

2. Websites:

www.keil.com
www.8052 .com
www.MicroDigitalEd.com
www.8051projects.net