

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Microcontroller and Applications		Course Code: 15MC34T
Mode (L:T:P) : 4:0:0	Credits:4	Core/ Elective: Core
Type of Course: Lectures & Student Activities		Total Contact Hours: 52
CIE= 25 Marks		SEE= 100 Marks

Prerequisites: Knowledge of Basic Mathematics, Fundamentals of Digital Electronics and C-Programming language.

Course Objectives: Understand the architecture of 8 bit 8051 embedded Microcontroller, PIC Microcontroller and its industrial applications.

Course Outcomes: At the end of the course, the students will be able to

1. Understand the architecture of Microcontroller 8051 and PIC
2. Understand and write assembly program for a given task.
3. Know timers as event counters & delay generators through programming & serial Communication and I/O Ports
4. Know how to Interface 8051 with real world devices.
5. Apply the knowledge of microcontrollers for industrial applications.

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Understand the architecture of Microcontroller 8051 and PIC.	U	1,2	10
CO2	Understand and write assembly program for a given task.	U/A	1,2	18
CO3	Know timers as event counters & delay generators through programming & serial communication and I/O Ports	U/A	1,2	10
CO4	Know how to Interface 8051 with real world devices	U/A	1,2	07
CO5	Apply the knowledge of microcontrollers for industrial applications.	A	1,2	07
		Total sessions		52

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Microcontroller and Applications	3	3	-	-	-	-	-	-	-	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If $\geq 40\%$ of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks weightage (%)
				R	U	A	
1	Architecture Of MCS 8051	1	10	-	25	-	17.25
2	Instruction Set And Assembly Programming Of 8051	2	18	-	30	15	24.13
3	Hardware Programming	3	10	-	15	10	17.25
4	Applications Of MCS-8051	4	07	-	05	20	17.25
5	Industrial Applications Of Microcontrollers	5	07	-	-	25	17.25
	Total		52	145 Marks			100

Contents

Unit-I

Architecture of MCS 8051

Block diagram of microprocessor, microcontroller, and microcomputer, Classification of microcontroller; features of following types of microcontroller: - Embedded, External Program memory, RISC, CISC, Harvard architecture, Princeton architecture. Features of 8051 family microcontroller, Functional block diagram of 8051 and mention on chip sources, Study various register set, data memory, program memory, register banks and stacks of 8051 MCS, Pin details of 8051. Architecture of PIC Micro controllers (PIC 16F74) and its application

10 Hours

Unit-II

Instruction Set and Assembly Programming of 8051

Discuss the following terms: - Instruction, Program and Software, Addressing modes of MCS-8051, Assembly instruction format, assembler, assembler directives, linker, loader and cross compiler

Classify MCS-8051 Instruction set, Write syntax and function of each instruction with example, Simple programs to perform arithmetic, logical, looping and conditional jump operations.

18 Hours

Unit-III

Hardware Programming

Study I/O port structure for I/O operations, Study timer/counter registers for programming timer/counter, Serial communication using I/O port, Study programming using interrupts.

10 Hours

Unit-IV

Applications of MCS-8051

Introduction, Functional details of PPI 8255, Applications of 8051 to control LED, BUZZER, RELAY, and OPTOCOUPLER, Interfacing the following modules with 8051: - ADC, DAC, Seven segment display, LCD and Stepper motor.

7 Hours

Unit-V

Industrial Applications of Microcontrollers

Microcontroller based Robot arm position measuring system, Microcontroller based angular position measuring system, Explain microcontroller based angular speed measuring system, and Explain microcontroller based force measuring system

References

1. The 8051 Microcontroller and Embedded Systems by M.A.Mazdi and J.G.Mazdi
2. The 8051 Microcontroller (Architecture, Programming and Applications) by Kenneth J Ayala
3. Designing with PIC Microcontrollers by Jhon D Peatman
4. Microcontrollers [Theory and applications] by Ajay V Deshmukh (TMH publication)
5. 8051 Microcontroller, V. Uday shankara, TMH

e-References/ Urls

www.siemens.com/microcontrollers
www.microcontroller.com
www.embeddedindia.com
www.neatsite.com/micros.htm
www.Microchip.com

Student Activity

Activity No.	Description of Student Activity
1	Students can make models of Micro controller applications excluded from the curriculum.

Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by group must cover all Cos
4. Teacher should assess every student by using suitable **Rubrics** approved by HOD

Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation-- student jumps around	Cannot understand presentation-- no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	3				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
Total Score=2+3+4+5=14/4=3.5=4									

Institutional Activity

Activity No.	Description of Institutional Activity
1	Organize Seminar, workshop, Lecture, from experts Modern trends in Microcontrollers and its Applications.
2	Organize hands-on practice on a miniature applications of 8051
3	Motivate student to take case study on different Microcontrollers to inculcate self and continuous learning.

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	CIE	Three test (Average of three tests)	20	Blue books	1,2,3,4,5
		Student Activity	05	Student Activity Sheets	1,2,3,4,5
	SEE	End of the course	100	Answer scripts at BTE	1,2,3,4,5
Indirect Assessment	Student Feedback on course	Middle of the course		Feedback forms	1&2
		End of the course		Feedback forms	1,2,3, 4&5

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	I/II SEM		20
	Year:		
Name of Course coordinator : CO's: _____			Units: __
Question no	Question	MARKS	CL CO PO
1			
2			
3			
4			

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper (CIE)

Date and Time	Semester	Course	Max Marks
I Test (6 th week of sem) 10-11 Am	III SEM	Microcontroller and Applications	20
	Year: 2015-16	Course code: 15MC34T	
Name of Course coordinator : All questions carries equal marks			Units: 1,2 CO: 1,2
Question No	Question	CL	CO PO
1	Explain the block diagram of Harvard architecture OR Explain the features of CISC architecture?	U	1, 2
2	Explain the features of 8051 Microcontrollers OR Explain briefly the function of flags and status word	U	1, 2
3	WAP to multiply 25H and 10H using successive addition or repeated addition method OR WAP to set carry flag to 1 if the number in accumulator is even, set the carry flag to 0 if number in accumulator is odd	A	2, 1, 2
4	WAP to add an array of 8bit numbers and store result in internal data RAM OR WAP an ALP to move the block of data from external RAM into internal RAM locations.	A	2, 1, 2

Model Question Paper
III Semester Diploma in Mechatronics Engineering
Microcontroller and Applications

Instructions: Answer any six questions from part A and Seven full questions from part B

PART-A

Answer any six questions

5x6=30 Marks

1. Discuss the characteristics of RISC micro-controller Explain the block diagram of Harvard architecture?
2. Explain Princeton architecture with block diagram?
3. Explain briefly the function of flags and status word
4. Explain the assembler directive with examples
5. Explain instruction format of 8051 micro-controller
6. State and explain MOV 40h, #20
7. Compare the interrupt method and polling method of servicing devices
8. Explain with circuit diagram interfacing Relay
9. Explain microcontroller based force measuring system

PART- B

Answer any seven full questions.

10x7=70 Marks

1. Explain 8051 Microcontrollers with its functional block diagram **10m**
2. Explain addressing modes with examples. **10m**
3. a).Explain the classification of Instruction set with examples **4m**
b).WAP an ALP to find 2's compliment of given numbers **6m**
4. a).WAP to set carry flag to 1 if the number in accumulator is even, set the carry flag to 0 if number in accumulator is odd **5m**
b).WAP to multiply 25H and 10H using successive addition or repeated addition method. **5m**
5. a)Differentiate between timers and counters **5m**
b) Explain the significance of SBUF register **5m**
6. Write an ALP to transmit the message "YES" serially at a baud rate of 4800 **10m**
7. Explain interfacing Seven segment display with 8051 Microcontroller **10m**
8. Explain interfacing Stepper motor with 8051 Microcontroller. **10m**
9. Explain Microcontroller based Robot arm position measuring system **10m**
10. Explain Microcontroller based angular position measuring system. **10m**

Model Question Bank
III Semester Diploma in Mechatronics Engineering
Microcontroller and Applications

Unit-I

Architecture of MCS 8051

Cognitive level- Understanding

1. Explain the types of micro-controller
2. Discuss the characteristics of RISC micro-controller
3. Describe different types of memory used by micro-controller
4. Explain the features of CISC architecture
5. Distinguish between RISC & CISC architecture
6. Explain Princeton architecture with block diagram
7. Explain the embedded micro-controller
8. Discuss the advantages of micro-controller over micro-processor
9. Distinguish between program memory & data memory
10. Explain the block diagram of Harvard architecture
11. Explain briefly the function of stack pointer
12. Explain briefly the function of data pointer,
13. Explain briefly the function of program counter
14. Explain briefly the function of flags and status word
15. Explain the features of 8051 Microcontrollers
16. Explain 8051 Microcontrollers with its functional block diagram
17. Explain briefly the function of internal RAM memory
18. Draw the block diagram of special function Register (SFR)
19. Explain briefly stack and stack register with its structural diagram
20. Explain briefly the function of TCON Register
21. Explain briefly the function of TMOD Register
22. Explain briefly the function of SCON Register
23. Explain briefly the function of PCON Register
24. Explain briefly the function of IE Register
25. Explain briefly the function of IP Register
26. Explain PSW Register with Examples.

Unit-II

Instruction Set and Assembly Programming Of 8051

Cognitive level- Understanding

1. Explain assemblers.
2. Explain compilers.
3. Explain addressing modes with examples.

4. What are assembler directives give examples
5. Explain instruction format of 8051 micro-controller.
6. Explain instruction
7. Explain about algorithm
8. How instruction set is classified
9. Explain the classification of Instruction set with examples
10. State and explain MOV 40h, #20 (similar type questions can be framed)

Cognitive level- Application

1. WAP to complement higher nibble to 2AH.
2. WAP to set carry flag to 1 if the number in accumulator is even, set the carry flag to 0 if number in accumulator is odd. 5
3. WAP to multiply 25H and 10H using successive addition or repeated addition method.
4. WAP an ALP to find 2's complement of given numbers
5. WAP an ALP to move the block of data from external RAM into internal RAM locations. Assume XXH (EX. RAM) YYH(EX. Int RAM add) and also their consecutive address.
6. WAP to add two 8 bit Signed and Unsigned numbers separately
7. WAP to subtract two 8 bit Signed and Unsigned numbers separately
8. WAP to add an array of 8bit numbers and store result in internal data RAM
9. WAP to convert two digits packed BCD to unpacked BCD and vice versa
10. WAP to convert two digits packed BCD to ASCII and vice versa
11. WAP to separate positive and negative numbers in a series of N-eight bit numbers
12. WAP to count the number of ones and zeros in two consecutive internal data memory locations
13. WAP to find smallest /largest number in an array of numbers stored in external data RAM
14. WAP to generate specified time delay
15. WAP to separate Even and Odd numbers in a series of N-eight bit numbers
16. WAP to search a number in the given array of numbers stored in internal program memory
17. WAP to illustrate multiplication and division
18. WAP to clear all the bytes that have even numbers of one's stored in bit addressable internal data RAM

Unit-III

Hardware Programming

Cognitive level- Understanding

1. Compare the interrupt method and polling method of servicing devices
2. Differentiate between an ISR and a subroutine
3. Explain the bit structure of IP register

4. Explain the bit structure of IE register
5. Explain the steps involved in executing an interrupt
6. Explain the method of enabling only timer interrupts and disabling others
7. Explain the method of enabling only external hardware interrupts and disabling others
8. Differentiate between RET and RETI
9. Explain the features of timer0 and timer1 registers
10. Explain the significance of SBUF register
11. Explain the significance of SI and RI flags
12. Explain the steps involved in serial data transmission
13. Explain the steps involved in serial data reception
14. Explain the scheme of interfacing RS232 to 8051
15. Explain the uses of TCON register
16. Explain how a programmer select external hardware interrupts as level triggered interrupts
17. Explain how a programmer select external hardware interrupts as edge triggered interrupts
18. Explain the operation of timer0 in mode 1
19. Explain the operation of timer1 in mode 2
20. Explain the operation of counter0 in mode 1
21. Explain the bit structure of TMOD register
22. Explain the bit structure of SCON register

Cognitive level- Application

1. Write the schematic, algorithm and a program for 8051 to sense the push button switch and accordingly control the on/off of LED
2. Write an algorithm and a ALP program to monitor the door sensor connected to the pin P1.1 when the door opens sound the buzzer connected to P1.7. The buzzer is to be sounded by sending a square wave of a few 100Hz
3. Write an ALP program to send values 0 to 4 to port P2
4. Write an ALP program to toggle bit 1 of Port 0 25000times
5. Write an ALP program to continuously send 00h to 20h to port P0
6. Write an ALP program to toggle the bits of port P3 continuously
7. Write an ALP program to display the ASCII values characters 0,1,A and B on port P2 only once
8. Write an ALP program to toggle the bit 1 of port P0 continuously
9. Calculate the values that are to be loaded into TH1 In order to get the following baud rates (i) 2400 (ii) 9600
10. Write an ALP to receive data serially at a baud rate of 4800 and send the received data to R1
11. Write an ALP to receive data serially at a baud rate of 9600 and send the received data to P1
12. Write an ALP to transmit the letter 'A' serially at a baud rate of 2400
13. Write an ALP to transmit the message "YES" serially at a baud rate of 4800
14. Write an ALP program to generate a time delay of 50mS. Use timer1 in mode1 and a crystal frequency of 12MHz.
15. Write an ALP program to generate a square wave of on period 100microseconds and an off period of 100microseconds at P1.2 . Use timer0 in mode 2 and a crystal frequency of 12MHz.
16. Write an ALP program to generate a square wave of 10KHz at P1.2 . Use timer1 in mode 2 and a crystal frequency of 10MHz

17. Write an ALP program to generate a square wave of 25% duty cycle and an on period of 10mS at P1.4 . Use timer0 in mode 1 and a crystal frequency of 12MHz
18. Write an ALP to read the content of P0 and send it to P1 after a time delay of 100mS. Use a crystal frequency of 12MHz

Unit-IV **Applications Of MCS-8051**

Cognitive level- Understanding

1. Explain with block diagram 8255 PPI.
2. Explain with pin Details 8255 PPI.
3. Explain with modes of operation 8255 PPI.

Cognitive level- Application

1. Explain with circuit diagram interfacing Relay, buzzer, LED, opto copler.
2. Explain interfacing 8051 microcontroller ADC, DAC with neat circuit diagram.
3. Explain interfacing Stepper motor with 8051 Microcontroller.
4. Explain interfacing LCD with 8051 Microcontroller.
5. Explain interfacing Seven segment display with 8051 Microcontroller.

Unit-V **Industrial Applications of Microcontrollers**

Cognitive level- Application

1. Explain Microcontroller based Robot arm position measuring system.
2. Explain Microcontroller based angular position measuring system.
3. Explain microcontroller based force measuring system.
4. Explain microcontroller based angular speed measuring system