7. SUBJECT DETAILS

7.2. EMBEDDED SYSTEMS

7.2.1 Objective and Relevance

7.2.2 Scope

7.2.3 Prerequisites

7.2.4 Syllabus

i. JNTU

ii. GATE

iii. IES

7.2.5 Suggested Books

7.2.6 Websites

7.2.7 Experts' Details

7.2.8 Journals

7.2.9 Findings and Developments

7.2.10.1 Session Plan

7.2.10.2 Tutorial Plan

7.2.11 Student Seminar Topics

7.2.12 Question Bank

7.2.1 OBJECTIVE AND RELEVANCE

The objective of this course is to help the students to learn the concepts of embedded systems. The course content discusses the characteristics, applications of embedded systems, microprocessor architecture, , basic principles and issues related to real time operating systems, upon which, much embedded software is based.

A basic understanding of the various processors architectures helps the students to write better code for embedded systems. Also, the details of various operating systems, programming languages, and development tools are presented in the syllabus.

The course covers the concepts of PSOC architecture, programming and its applications which is an advanced architecture for building embedded systems.

7.2.2 SCOPE

Embedded systems is a fast growing platform in the technological field as it is used in real-time applications. The syllabus covers the fundamentals necessary to take up embedded software development, with a sound understanding of the course contents, the students can dive into the details of embedded software programming by running the applications.

7.2.3 PREREQUISITES

Computer Organisation
Operating Systems
Microprocessor / Microcontroller Architecture

7.2.4.1 SYLLABUS: JNTU

UNIT-I
OBJECTIVE
At the end of the unit student will be able to understand

i. What is an embbeded software characteristics, implementation and application of embedded systems.
ii. Architecture for embedded systems
iii. Embedded Software development environments

SYLLABUS
Embedded Computing : Introduction, Complex Systems and Microprocessor, The Embedded System Design Process, Formalisms for System Design, Design Examples. **(Chapter 1 from Text Book 1, Wolf).**

UNIT- II
OBJECTIVE
At the end of the unit student will be able to understand 8051 & its architecture and hardware also.

SYLLABUS
8051 Architecture : Introduction, 8051 Micro controller Hardware, Timers and Counters, I/O Ports and Circuits, Serial data Communication, External Memory, Interrupts. (**Chapter 3 from Text Book 2, Ayala and Gadre**)

UNIT- III
OBJECTIVE
At the end of the unit student will learn the complete instruction set of 8051 and know how to write the basic assembly language programming.

SYLLABUS
8051 Programming : Assembly Language Programming Process, 8051 Instruction Set : Data Transfer, Arithmetic, Logical and Branch Instructions, Decimal Arithmetic, Interrupt Programming.
(**Chapters 4-8 from Text Book 2, Ayala and Gadre**).

UNIT -IV
OBJECTIVE
After the completion of unit student will understand the PSoc Architecture and Programming.

SYLLABUS

PSoC Architecture and Programming: PSoC as a Single-Chip solution for Embedded System Arthmetic, analog, Digital and controller (8051) Blocks in PSoC, Hardware Programming through PSoC creator, I/O Pin Configurability **(Text Book 3, Robert Ashby).**

UNIT- V

OBJECTIVE

At the end of the unit student will understand the implementation of applications using PSoC.

SYLLABUS

Applications : Blinking an LED, Cap Sense, Digital Logic, Precision Analog and Serial Communications **(Test Book 4, Robert Ashby)**

UNIT- VI

OBJECTIVE

At the end of the unit student will be able to know various real time operating systems and there key features.

SYLLABUS

Introduction to Real – Time Operating Systems : Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment. (**Chapter 6 and 7 from Text Book 3, Simon**).

UNIT- VII

OBJECTIVE

At the end of the unit student will understand the basic design concepts of RTOS with development tools.

SYLLABUS

Basic Design Using a Real-Time Operating System : Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory and Power, An example RTOS like uC-OS (Open Source); Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System. **(Chapter 8,9,10 & 11 from Text Book 3, Simon).**

UNIT- VIII

OBJECTIVE

At the end of the unit student will know advanced ARM and SHARC embedded processors

SYLLABUS

Introduction to advanced architectures : ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus; Internet-Enabled Systems, Design Example-Elevator Controller. (**Chapter 8 from Text Book 1, Wolf**).

7.2.4.2 GATE SYLLABUS

Not Applicable

7.2.4.3 IES SYLLABUS

Not Applicable

7.2.5 SUGGESTED BOOKS

TEXT BOOKS :

T1. Computers and Components, Principles of Embedded Computing System Design, Wayne Wolf, Elseveir. (2nd Edition)
T2. The 8051 Microcontroller, Kenneth J.Ayala and Dhanunjay Gadre, Thomson
T3. The PSoC Controller (paper Back Edition), Rober Ashby, Newens
T4. My First Five PSoC Designs, Robert Ashby, E-Book

REFERENCES :

R1. Embedding system building blocks, Labrosse, via CMP publishers.
R2. Embedded Systems, Raj Kamal, TMH.
R3. Micro Controllers, Ajay V Deshmukhi, TMH.
R4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
R5. Microcontrollers, Raj kamal, Pearson Education.
R6. An Embedded Software Primer, David E. Simon, Pearson Education.
R7. PSOC 3: CY8C38 Familty Data sheet, Cypress semicondutor corporation.

7.2.6 WEBSITES

1. www.embedded.com
2. www.hp.com
3. www.techonline.com
4. www.eembc.org
5. www.instantweb.com
6. www.cs.ucr.edu/esd

7.2.7 EXPERTS' DETAILS

INTERNATIONAL

1. Mr. David .E.Simon
   University of Caliphorinia
   Email :mikh@awl.com

2. Professor Steve Heath
   Univesity of MIT
   Email : cepubpublicity @awl.com

NATIONAL

1. Professor Amitabh Mukharjee
   IIT Kanpur

2. Professor A.K.Mishra
   NIIT Allahabad,
   Email: akpcsald@niitalt.com

REGIONAL

1. Professor A.K.Pujari
   University of Hyderabad
   Email : akp@uoh.ernet.in

2. Dr.Jawahar
   IIIT Hyderabad
   Email : drj@iiit.ac.in

7.2.8 JOURNALS

1. IEEE Transactions on Computer (available in college library).
3. STM Journal (available in college library).
4. CSI Communications (available in college library).
5. Inventi Impact Robotics (available in college library).

7.2.9 FINDINGS AND DEVELOPMENTS

1. Detection of unattended objects by video analysis, Prof. H.K. Kaura, Prerana Gupta, Vasundhara Mane, Sunny Chowdhari & Ashish Das, IJ-CA-ETS, Oct. 2013-Mar. 2014, Vol 6, Issue no.1, Page no. 54-57.

2. A Brief Review of machine learning techniques for forecasting, Darshana D.Chande & Prof. M.Vijayalakshmi, IJ-CA-ETS,Oct. 2013-Mar.2014, Vol.6, Issue no.1,Page no. 41-46.

3. Unseen to seen with cryptography, steganography and watermarking, Baisa L Gunjal & Dr. Suresh N Mali, CSI Communications,Feb. 2014, Vol. 37, Issue no.11, Page no. 22-24.

4. Evaluation of embedded cost and distribution factor methods used in deregulated electricity market, Niharika Yadav, Yog Raj Sood, Shashank Shekhar Singh, RRJoESA, STM Journal, Jan-April 2013, Page no. 10-18.

5. Speech emotion recognition using an enhanced kernel isomap for human-robot interaction, Shiqing Zhang, Xiaoming Zhao & Bicheng Lei,Inventi Impact Robotics, Oct.-Dec. 2013, Vol. 13, Issue no.4, Page no. 226-232.

7.2.10.1 SESSION PLAN

7.2.10.2 TUTORIAL PLAN

7.2.11 STUDENT SEMINAR TOPICS

1. Recent trends in Embedded System.
2. Humanoids Robotics
3. Embedded zero tree
4. Security in embedded systems
5. Embedded web technology
6. Remotely queried embedded microsensors
7. Bluetooth based smart sensor networks
8. Moletronics- an invisible technology

7.2.10.1 SESSION PLAN

S no.	Topics in JNTU syllabus	Modules and Submodules	Lecture no.	Suggested books	Remarks
UNIT – I (Embedded Computing)					

1	Introduction	What is an embedded system Components of embedded system	L1	T1-Ch-1	
2	Complex systems and microprocessors	Embedding computers Characteristics of embedded computing applications Why use microprocessor Challenges in embedded computing system design	L2,L3	T1-Ch-1 R2-Ch-1 R4-Ch-1	
3	The embedded system design process	Levels of abstraction Requirements in design Specification Architecture design Designing hardware and software components System integration	L4,L5	T1-Ch-1	
4	Formalisms for system design	Structural description Behavioral description	L6,L7	T1-Ch-1	
5	Design examples	Model train controller Requirements Conceptual specifications Detailed specifications	L8,L9	T1-Ch-1	
UNIT – II (8051 Architecture)					
6	Introduction	Introduction to microcontrollers What is a microcontroller What are the components in a microcontroller	L10	T2-Ch-3 R3-Ch-1 R5-Ch-1,2	
7	8051 microcontroller	Architecture of 8051	L11,L12	T2-Ch-3	

	hardware	All internal registers Memory organization Pin diagram Special function registers		R3-Ch-2 R5-Ch-3	
8	Timers and Counters	Counter and timer registers Modes of timer operation	L13	T2-Ch-3 R3-Ch-6 R5-Ch-3	
9	I/O ports and circuits	Input and output ports circuits	L14	T2-Ch-3 R3-Ch-3 R5-Ch-3	
10	Serial data communication	Function of serial port registers Modes of serial operation	L15	T2-Ch-3 R3-Ch-6 R5-Ch-3	
11	External memory	External memory connectivity	L16	T2-Ch-3 R5-Ch-3	
12	Interrupts	Types of interrupts	L17	T2-Ch-3 R3-Ch-6 R5-Ch-3	
S. No.	Topics in JNTU syllabus	Modules and Submodules	Lecture no.	Suggested books	Remarks
UNIT – III (8051 Programming)					
13	Assembly language programming process	Understanding the assembly language syntax Understanding the assembler program Understanding the problem to be solved and design the program	L18	T2-Ch-4,5 & 6 R3-Ch-4,5 R5-Ch-4,9	

		Flow charts Writing and testing the program			
14	8051 Instruction set	Lines of code 8051 instruction syntax Addressing modes	L19	T2-Ch-4,5&6 R3-Ch-4,5 R5-Ch-4	
15	Data transfer	Data transfer instructions (internal and external data moves)	L20	T2-Ch-4,5 & 6 R3-Ch-4 R5-Ch-4	
16	Arithmetic	Instructions affecting Flags Incrementing and decrementing instructions Unsigned and signed addition Unsigned and signed subtraction Multiplication Division	L21	T2-Ch-7,8 R3-Ch-4 R5-Ch-4	
17	Logical and Branch instructions	Bit and byte level logical operations Rotate and swap instructions The jump and call program range Jumps – bit , byte unconditional jumps, Calls and subroutines	L22	T2-Ch-5,6,7,8 R3-Ch-4 R5-Ch-4	
18	Decimal arithmetic	Operation performing decimal arithmetic	L23	T2-Ch-7,8 R3-Ch-4 R5-Ch-4	
19	Interrupts	Interrupts and returns	L24	T2-Ch-7,8	

	programming	More detail on interrupts. IE special function register IP special function register Interrupts and interrupt handler subroutines		R5-Ch-4,5	
S no.	Topics in JNTU syllabus	Modules and Submodules	Lecture no.	Suggested books	Remarks
UNIT – IV (PSoC Architecture and Programming)					
20	PSoC as a Single-Chip solution for Embedded System Arithmetic	PSoC as a Single-Chip solution for Embedded System Arithmetic	L25	R7-Ch1	
21	Analog Digital and controller (8051) Blocks in PSoC	Analog Digital and controller (8051) Blocks in PSoC	L26-29	R7-Ch7,8	
22	Hardware Programming through PSoC creator	Hardware programming through PSoC creator	L30-31	R7-Ch9	
23	I/O Pin Configurability	I/O Pin Configurability	L32	R7-Ch6	
UNIT – V (Applications)					
24	Blinking an LED	Blinking an LED	L33	R7-Ch10	
25	Cap Sense	Cap Sense	L34	R7-Ch10	
26	Digital Logic	Digital Logic	L35	R7-Ch10	
27	Precision Analog and Serial Communications	Precision Analog and Serial Communications	L36	R7-Ch10	
UNIT – VI (Introduction to real time operating systems)					
28	Tasks and task states	Tasks Task states	L37	R2, Ch-9 R6,Ch-6,7	
29	Tasks and data	Tasks	L38	R6,Ch-6,7	

		Data			
30	Semaphores and shared data	RTOS semaphores Initializing semaphores Reentrancy and semaphores Semaphore as a signaling device Multiple semaphores Semaphores problems and variants Ways to protect shared data	L39	R2, Ch-8 R6,Ch-6,7	
31	Message queues, mail boxes and pipes	Message queues Mail boxes Pipes	L40	R2, Ch-8 R6,Ch-6,7	
32	Timer function, events	Timer functions Events	L41	R4, Ch-4 R6,Ch-6,7	
33	Memory management	Introduction Memory management	L42	R4, Ch-5 R6,Ch-6,7	
34	Interrupt routines in an RTOS environment	Introduction Interrupt routines in an RTOS environment	L43	R4, Ch-5 R6,Ch-6,7	
UNIT – VII (Basic design using a real – time operating system)					
35	Principles , Semaphores and Queues	Principles Semaphores Queues	L44,L45	R2, Ch-8 R6, Ch-8	
36	Hard real – time scheduling considerations	Hard real – time scheduling considerations	L46	R2, Ch-8 R6, Ch-8	
S no.	Topics in JNTU syllabus	Modules and Submodules	Lecture no.	Suggested books	Remarks

37	Saving memory and power	Saving memory and power	L47	R6, Ch-9	
38	An example RTOS like uC-OS (Open Source)	An example RTOS like uC-OS (Open Source)	L48	R6, Ch-9	
39	Embedded software development tools: host and target machines	Embedded software development tools: host and target machines	L49	R6, Ch-9	
40	Linkers/locators for Embedded software	Linkers/locators for Embedded software	L50	R6, Ch-9	
41	Getting embedded software into the target system	Getting embedded software into the target system	L51	R6, Ch-9	
42	Debugging techniques: testing on host machine, using laboratory tools	Testing on host machine Using laboratory tools	L52	R6, Ch-10	
43	An example system	An example system	L53	R6, Ch-11	
UNIT – VIII (Introduction to advanced architectures)					
44	ARM and SHARC	ARM SHARC	L54	T1, Ch-8 R5, Ch-15	
45	Processor and memory organization and	Processor Memory organization	L55	T1, Ch-8 R5, Ch-15	
46	Instruction level parallelism	Instruction level parallelism	L56	T1, Ch-8 R5, Ch-15	
47	Network embedded systems: Bus protocols	Network embedded systems: Bus protocols	L57	T1, Ch-8 R5, Ch-7	
48	I^2C bus and CAN bus	I^2C bus and CAN bus	L58	T1, Ch-8 R5, Ch-7	
49	Internet-enabled systems	Internet-enabled systems	L59	T1, Ch-8	

50	Design example – elevator controller	Design example – elevator controller	L60	T1, Ch-8	

7.2.10.2 TUTORIAL PLAN

S.No	Unit	Topic	Salient topics to be discussed
1	I	Design examples	Model train controller Requirements Conceptual specifications Detailed specifications
2	II	Counter and timers	Programs involving timer and counter in different modes of operation
3	II	Serial data input/ output	Programs to operate microcontroller in different serial modes of operation
4	III	Data transfer instructions	Programs involving various data transfer instructions
5	III	Logical instructions	Programs involving bit / byte level logical operations and rotate/ swap instructions
6	III	Arithmetic operations	Programs involving addition, subtraction, multiplication and division instructions
7	III	Jump and Call Instructions	Programs involving jump and call instructions
8	III	Further details on Interrupts	Programs using timer/ counter and serial interrupts
9	IV	PSoC architecture and programming	PSoC architecture and programming
10	V	PSoC Applications	Programs for applications using PSoC.
11	VI	Timer function, events	Discussion of timer functions and events
12	VII	Debugging techniques: testing on host machine,	Testing on host machine Using laboratory tools

		using laboratory tools	
13	VIII	Design example – elevator controller	Design example – elevator controller

7.2.12 QUESTION BANK

UNIT - I

1. Explain in detail the embedded system design process. **(Nov 13)**

2. Write about formalisms for embedded system design in detail. **(Nov 13)**

3. i. What a suitable example explain the various stages involved in th design of embedded system.
(Dec 12)

4. i. Define the terms "System and an "Embedded System"
ii. Explain the components of an embedded system hardware.
iii. Give the classification of Embedded systems **(Nov 11)**

5 i. Explain how a media processor differ from a DSP processor.
ii. What are the techniques of power and energy management in an embedded system? **(Nov 11)**

6. i. How UML is used in Embedded System Design process? Briefly explain.
ii. Describe the following:
a. An object in UML notation
b. A class in UML Notation **(Nov 11, 10)**

7. i. List out the 7 layers of OSI model and explain.
ii. Explain
i. Crossbar Network
ii. Multistage Network. **(Nov 11)**

8. Discuss different network configurations suitable for serial data communications in respect of reliability, speed, fault finding, cost, etc.

9. i. List the advanced microprocessors and microcontrollers used in the embedded systems.
ii. What are the functional circuits in a chip or core of microcomputer in an embedded system? Explain them in brief. **(Nov 11, 10)**

10. i. Describe digital computer system organization and operation.
ii. Explain the function of the CPU and memory. **(Nov 10)**

11. Explain the following types of relationships exist between objects and classes.
i. Association
ii. Aggregation
iii. Composition
iv. Generalization. **(Nov 10)**

12. Describe the following:
    i. Machine language
    ii. Assembly language
    iii. High level language. **(Nov 10)**

13. i. Explain which bits in which registers must be set to give the serial data interrupt to the highest priority.
    ii. When used in multiprocessing, explain which bit in which register is used by a transmitting 8051 to signal receiving 8051s that an interrupt should be generated. **(Nov 10)**

14. Compare the features in an exemplary family chip or core of each of the following.
    i. Microprocessor
    ii. Microcontroller
    iii. RISC processor
    iv. Digital Signal Processor. **(Nov 10)**

16. i. What are the levels of abstraction in a embedded system design process.
    ii. What are the major components of an embedded system hardware. **(Nov 09)**

17. i. Define an embedded system? List out the software tools needed on designing an embedded system. Discuss about any one of them.
    ii. Compare top down and bottom up design **(Nov 09)**

18. i. What are the basic functional circuit chips in an embedded system? Explain them in brief.
    ii. What are the techniques of energy and power management in an embedded system? **(Nov 09)**

19. i. Classify embedded systems.
    ii. What are the advantages and disadvantages in having fixed point arithmetic unit and additional floating point arithmetic processing unit. **(Nov 09)**

20. i. What is an embedded computer system? Give an example. **(Nov 08)**
    ii. Explain the characteristics of embedded computing applications.

21. i. Explain the challenges in embedded computing system design. **(Nov 08)**
    ii. Briefly describe the distinction between specification and architecture.

22. i. What are the reasons for using microprocessor in digital systems? **(Nov 08)**
    ii. "External constraints are one important source of difficulty in embedded system design". Explain.

23. Explain in detail the embedded system design process. **(Nov 13, 08)**

24. What are embedded systems? Define hard-real time and soft-real time embedded systems. Give any two examples for each of these two categories and justify why they are hard/ soft real time embedded systems. **(Feb07)**

25. What are the important general requirements of embedded systems? Explain each one of the requirements and discuss in which application that requirement is more important. **(Feb 07)**

26. Explain the role of operating systems and the programming languages for the development of embedded systems. **(Nov 06)**

27. Write short note on the following parts of embedded systems.
    i. Processors

ii. Memory
iii. Operating System
iv. Programming Languages **(Nov 06)**

28. Discuss various steps involved in the development of an embedded system with an example. **(Nov 06)**

29. i. What is an embedded system? Why is it so hard to define?
ii. List the applications of embedded systems. **(Jun 06)**

30. Explain the characteristics of an Embedded Systems.

31. Explain the basic principles of real time operating systems. Explain how real time systems are related to embedded systems.

32. Explain about the embedded software development environment and give a overview of embedded software.

33. List and explain the characteristics of embedded system that distinguish such systems from other computing system.

34. List the advantages of embedded systems and explain them

35. Briefly describe the distinction between requirements and specification.

UNIT II

1. Discuss about the interrupts and serial I/O ports of 8051. **(Nov 13)**

2. Explain the mode – 2 operations in serial data communication of 8051 with an assembly language program. **(Nov 13)**

3. i. Explain the I/O port configuration of 8051.
ii. Write briefly about modes of timers and counters in 8051. **(Dec 12)**

4. i. What are the 16-bit data addressing registers of the 8051 microcontroller and explain their functions.
ii. Tabulate the special function registers by making four columns as register, bit, primary function and bit addressable. **(Nov 11)**

5. Write short notes on the following with reference to 8051 microcontroller hardware:
i. 8051 oscillator and clock.
ii. Program counter and Data pointer. **(Nov 11)**

6. i. Explain the following, with respect to the 8051 microcontroller registers Organization.
a. PC and DPTR
b. PSW.
ii. Sketch and explain internal RAM organization of the 8051 microcontroller **(Nov 11)**

7. i. Explain about TCON and TMOD function registers relevant to counters and timers of the 8051 microcontroller.
ii. Draw and explain the timer/counter logic in which the resultant timer clock is gated to the timer circuit.

8. i. Why a low-address byte latch for external memory is needed.
   ii. How an I/O pin can be both an input and output. **(Nov 10)**
   iii. Evaluate the execution time of a single cycle instruction for a 6MHz crystal.

9. Draw the block diagram of the 8051 microcontroller and describe in detail about its CPU components. **(Nov 10)**

10. Write short notes on bit-addressable control registers. **(Nov 10)**

11. With the help of a neat block diagram explain the architecture of 8051 **(Nov 09)**

12. Explain different modes of serial communication interface in 8051, explain each of the modes with an example each. **(Nov 09)**

13. i. Draw the program model of 8051, Explain the function of special function registers of 8051
    ii. Explain the interrupt handling capacity of 8051 **(Nov 09)**

14. i. Explain the Timer Counter unit operations of 8051.
    ii. List the internal memory contents and their functions. **(Nov 09)**

15. Draw the figure showing the connections between an 8051 and an external memory configuration consisting of 16k of EPROM and 8k of static RAM. Explain the timing associated with an external memory access cycle. **(Nov 08)**

16. Give the formats of the following function registers of 8051. **(Nov 08)**
    i. SCON
    ii. PCON
    iii. TCON
    iv. TMOD

17. Discuss in detail about the serial data communication circuit in 8051. **(Nov 08)**

18. i. Explain various Timer modes of operation of 8051. **(Nov 08)**
    ii. What is the function of IP function register? Specify the purpose of each bit in the register.

19. i. Explain the general structure of 8051 syntax. **(Nov 08)**
    ii. Discuss atleast four different methods to copy the byte in TCON to register R2.

20. Write about the evolution of microcontrollers. What are the other names attributed to them.

21. What is the architectural difference between microprocessor and microcontrollers.

22. Discuss about interrupt structure of 8051 microcontroller specify the priority of interrupts.

23. Explain the various serial data transmission and reception modes for 8051 microcontrollers.

24. Write about program memory and data memory of 8051 microcontroller.

25. Explain the following
    i. SP ii. SBUF iii. T0

26. Write about synchronous and asynchronous modes of transmission and receptions.

27. Explain about 8051 oscillator and clock circuits.

28. Explain about the stack organization in 8051 microcontroller.

29. How many special function registers are present in 8051 microcontroller. Discuss atleast five of them.

30. Draw the pin diagram of 8051 microcontroller and explain.

31. Write about input/output pins, ports and circuits of 8051 microcontroller.

32. Draw the schematic diagram showing the external memory connections to 8051 microcontroller.

33. Explain in detail about the following

i. IE ii. IP

34. Explain in detail about the following

i. ACC ii. DPTR iii.B iv. SP v. PC vi.P0 vii.PSW

UNIT III

1. Explain about data transfer and logical instructions with examples. **(Nov 13)**

2.i. What are the multiplication instructions available in 8051 Assembly language and explain with an example.
ii. What are the Division instructions available in 8051 assembly language and explain with an example. **(Nov 13)**

3.i. Write a program to check the status of ON/OFF condition of 8 machines using 8051.
ii. Explain any two programming tools used for Assembly Language Programming. **(Nov 13)**

4.i. Write a assembly language program to display how many positive, negative and zeros are present in a array of 20 numbers.
ii. Write a assembly language program to generate a square wave of frequency 2KHz when an interrupt is recognized by the controller. **(Nov 13)**

5. i. Write a program to check whether the data 50 is present in the memory location from 60h to 70h. If it is present then load its location in R4 store a value '0' in it.
ii. Write a program to move a block of 20 data from 4200 to 421F. **(Dec 12)**

6. Briefly explain the following Addressing modes with reference to the 8051 Microcontroller:
i. Immediate Addressing mode
ii. Register Addressing mode
iii. Direct Addressing mode
iv. Indirect Addressing mode. **(Nov 11)**

7. i. Explain with suitable example, how to perform bit jumps using relevant mnemonics.
   ii. Write an assembly language program for the data given below: The number A6h is placed somewhere in external RAM between locations 0100h and 0200h. Find the address of that location and put that address in R6(LSB) and R7(MSB). Place comments on each line of code. **(Nov 11)**

8. i. Explain with suitable example, how to perform decimal arithmetic operation using relevant mnemonics.
   ii. Write an assembly language program to get hex data in the range of 00-FFh from the port 0 and convert it to decimal. Save the digits in R7, R6 and R5, where the LSB is in R7. Place comments on each line of code. **(Nov 11)**

9. i. What determines the address of the first instruction in memory?
   ii. Write an assembly language program for moving the data in addresses 0010H to 001AH to addresses 0020H to 002AH. **(Nov 11)**

10. Write the hardware and software for transmitting one character -`A' to a serial output device using 8051-based system under interrupt driven i / o mechanism. **(Nov 11)**

11. i. Explain how to understand the assembly language syntax.
    ii. What are the flow chart elements and action box elements? Discuss about them. **(Nov 11)**

12. i. Explain with suitable example, how to perform unsigned multiplication using relevant mnemonics.
    ii. Write an assembly language program to multiply the unsigned number in register R3 by the unsigned number on port 2 and put the result in external RAM locations 10h(MSB) and 11h(LSB). Place comments on each line of Code. **(Nov 11, 10)**

13. Write an assembly language program to increment the contents of RAM locations 13h, 14h and 15h using an indirect addressing. Place comments on each line of code. **(Nov 10)**

14. Write an assembly language program to find a number that when XORed to the A register results in the number 3Fh in A. Also write comment on this. **(Nov 10)**

15. Write an assembly language program to copy a block of 8 bytes of data to RAM locations starting at 50H from RAM locations 30H. Also write comment on this. **(Nov 10)**

16. Explain with suitable example, how to perform increment and decrement the contents of registers and RAM using relevant mnemonics. **(Nov 10)**

17. Explain the commands that place data in registers, internal memory and external memory. **(Nov 10)**

18. Explain the following Instructions:
    i. INC destination.
    ii. DEC destination.
    iii. ADD destination, source.
    iv. ADDC destination, source.
    v. SUBB destination, source.
    vi. MUL AB.
    vii. DIV AB.
    viii. DA A. **(Nov 10)**

19. Explain the necessary details on interrupts while writing interrupt-driven programs. **(Nov 10)**

20. i. Write an assembly language program to 8051 to generate an interrupt after a time delay of 4ms the crystal frequency is 12MHZ.
    ii. Explain how signed arithmetic's is carried out in 8051. **(Nov 09)**

21. i. Write a brief note in SJMP, LJMP and AJMP instructions in 8051.Give an example for each instruction use.
    ii. How is DPTR register used is 8051? Explain
    iii,. Briefly explain the port 3 functions in 8051. **(Nov 09)**

22. i. Explain different branch instructions in 8051 with an example each
    ii. Write an assembly language program to 8051 to keep incrementing R1 and R decrementing R2 register of register Bank 3 of 8051 till they become equal. **(Nov 09)**

23. i. Write an assembly language program to search for consecutive zeros in internal RAM locations 60H to 7FH
    ii. Explain with suitable examples the conditional and unconditional Jump instructions in 8051 **(Nov 09**

24. i. Explain the shift and rotate instructions of 8051 with examples.
    ii. Write an assembly language program to 8051 to rotate R1R0 registers to left by two positions treating R1R0 together as a 16-bit register **(Nov 09)**
25. i. Write an assembly language program to add two 16 bit numbers stored in R1R0
    ii. Write a brief note on shift and rotate operations of 8051. **(Nov 09)**

26. i. Explain different addressing modes of 8051 microcontroller with an example.
    ii. Explain data transfer instructions of 8051. **(Nov 09)**

27. i. Explain different ALU instructions in 8051 with an example.
    ii. Write a brief note on addressing modes of 8051. **(Nov 09)**

28. i. Why the programmer must know about the CPU in order to program in assembly language
    ii. Explain about various data addressing modes. **(Nov 08)**

29. i. Identify four reasons to program a CPU in assembly language. **(Nov 08)**
    ii. Describe how data may be pushed and popped using a stack.

30. i. List four types of utility programs. **(Nov 08)**
    ii. What are the four addressing modes used to access data? Explain.

31. i. Write a program to increment the contents of RAM locations 13h,14h and 15h using indirect addressing only. **(Nov 08)**
    ii. What are the sequence of events involved in CALL instruction.

32. i. Explain in detail about different types of jump instructions with suitable examples. **(Nov 08)**
    ii. Discuss about decimal arithmetic with example.

33. Write a program to count the number of 1s in any number in register B and put the count in R5.**(Nov 08)**

34. i. Write a program to multiply the data in RAM location 22h by the data in RAM location 15h; put the result in RAM locations 19h (low byte) and 1Ah (high byte).
    ii. Discuss how the CPU uses the stack to store call opcode return addresses. **(Nov 08)**

35. Explain about the assembly language programming process What is the need for using assembly language.

36. Write a program to exchange the contents of the SP and the PSW.

37. Write a program to swap the bytes in timer 0: put TL0 in TH0 and TH0 in TL0.

38. Write a program to exchange both low nibbles of registers R0 and R1: put the low nibble of R0 in R1, and the low nibble of R1 in R0.

39. Write about the mechanics of programming.

40. Write about the basic computer concepts.

41. Explain in detail about the programming tools and techniques.

42. Specify and explain the methods for testing the program.

43. Explain in detail about the various addressing modes of 8051 microcontroller.

44. What is the subroutine. Why it is needed.

45. Write about the basic concepts of interrupts.

46. Assuming the crystal frequency is 10 megahertz, write a program that will use timer 1 to interrupt the program after a deley of 2ms.

47. Write an assembly language program to find factorial of a number?

48. Write an assembly language program to find the largest of n numbers?

49. Write a program to generate the fibonacci series?

50. Write a program to evaluate the expression $(x^2+2x+3)/2$?

51. Write a program to evaluate the expression $x+x^2+x^3$?

52. Write a program to count the number of positive numbers from n numbers.

53. Write about the jump and call program range of 8051 microcontroller. And discuss the bit jump / byte jump instructions of 8051 microcontroller.

UNIT IV

1. Describe the function of various blocks of PSoC **(Dec 12)**

2. What is PSOC? Explain advantages of PSOC over other technologies?

3. Compare and contrast the features of PSOC1, PSOC3 and PSOC5.

4. List and explain the characteristics common to PSOCs.

5. Draw and explain the architecture of PSOC3?.

6. Explain the CPU subsystem of PSOC3?

7. List the various features provided by the PSOC3.

8. Explain the features of DMA and PHUB in the CPU subsystem?

9. Discuss the Static RAM and EEPROM of memory subsystem.

10. Draw the memory map and explain about external memory interface.

11. Explain the following two blocks in the PSOC architecture.
    i. Clocking system
    ii. Power System

12. Explain the Programmable SC/ CT Blocks in PSOC3?

13. What are UDBs? Explain the features and their configuration?

14. What is Delta-Sigma ADC? Explain the features available and their configuration?

15. Explain any two of the following
    i. CAN
    ii. USB
    iii. IIC

16. Explain the LCD direct drive and comparators used in PSOC3?

17. Explain in detail the analog subsystem blocks?

18. Explain in detail the digital subsystem blocks?

19. Explain the PIN configuration of PSOC3?

20. Explain any two of the following
    i. JTAG
    ii. SWV
    iii. SWD

21. Explain any two of the following
    i. PWMs
    ii. DFB
    iii. Debug and Trace features.

22. Explain how the I/O system and routing concept in PSOC3?

23. Explain the mechanism of reset in PSOC3? .

24. Explain the cpu system in PSOC3?

25. Explain the addressing modes and specify the types of instructions used in PSOC3?

UNIT V

1. i. Explain how serial communication from one I/O to another I/O device is carried out using PSoC?
   ii. Explain any one applicaton of PSoC? **(Dec 12)**

2. Explain the steps involved in adding the components to blink an LED using PSOC creator?

3. Explain the steps involved in adding and configuring a capsense component using PSOC creator?

4. Explain the steps involved in adding and configuring a control register in digital logic using PSOC creator?

5. Explain the steps involved in adding and configuring components for UART using PSOC creator?

6. Explain the steps involved in adding and configuring in precision analog using PSOC creator?

7. Explain how to connect components and chip resources to blink an LED using PSOC creator?

8. Explain how to assign the pins to blink an LED using PSOC creator?

9. Write a program to blink an LED.

10. Explain how to assign pins and configure clocks for UART using PSOC creator?

11. Write a program to transmit and receive data serially through UART.

12. Explain how to assign the pins in capsense application?

13. Explain how to assign the pins in precision analog using PSOC creator?

14. Explain the steps involved in connecting and adding lookup table, more registers and hardware delay in digital logic using PSOC creator?

15. Explain the steps involved in building and debugging the project?

16. Explain the working procedure for an application in PSOC creator?

17. Explain the features of PSOC creator?

18. Distinguish between the PSOC designer and PSOC creator.

19. Explain the features of UART in PSOC3?

20. Explain the concept of capsense in PSOC3?

21. Explain the features of analog subsystem?

22. Explain the features of digital subsystem?

23. Explain the limitations of PSOC designer?

24. Explain the steps involved in adding and configuring the timers and counters?

25. Explain the steps involved in configuring the IIC bus?

UNIT VI

1.i. Discuss how shared data problem is taken care of in RTOS.
ii. Write a note on memory management **(Nov13)**

2.i. Describe different types of data in an RTOS-based Real-Time System with their characteristics.
ii. What do you understand by shared data problem? Explain with an example. **(Nov13)**

3. Describe how semaphores, queues and message boxes are usd for synchronization in RTOS environment. **(Dec 12)**

4. i. What are Reentrant functions? Explain how to decide a given piece of function code is reentrant.

ii. Verify whether the following function is reentrant with justification? If not, modify the code to make it reentrant using semaphores or any other mechanism

```
Static int iValue;
{int iFixValue(int iParm)
f int iTemp; iTemp = ivalue; iTemp +=iParm * 17;
If (iTemp 4922 )
iTemp = iParm;
iValue = iTemp;
iParm = itemp+179;
if (iParm < 2000)
return 1;
else
return 0;
}
```

(Nov 11)

5. Outline three different plans by which RTOS finds out that an interrupt routine is executing. Compare these three plans. **(Nov 10)**

6. Design Underground Tank Monitoring Systems(UTMS) for four tanks to read temperatures and float levels, printing when required, and alarming under extreme conditions. Use a keyboard interface, display interface, printer interface, etc. and suitable processor. Assume suitable data wherever necessary.**(Nov 10)**

7. Explain how a seperate task helps to control shared hardware like hash memory in the design of embedded software with a suitable C-pseudocode using POSIX standard for RTOS interface such as mq-open, mq-send, mq-receive, and nanosleep. **(Nov 10)**

8. Compare and contrast three methods of protecting shared data with suitable examples. **(Nov 10)**

9. i. Explain different kernel objects in an RTOS.
   ii. Explain the inter task communications through message queues, pipes, mailboxes **(Nov 09)**

10. Compare semaphores, events and queues for implanting inter task communication with an example. **(Nov 09)**

11. i. Compare, binary semaphores, Mutex and counter semaphore
    ii. Describe the function relevant to *u* cos operating systems. **(Nov 09)**

12. Explain how scheduling takes place in preemptive scheduling algorithm. Compare it with non- Preemptive scheduling **(Nov 09)**

13. What is the need to encapsulate the message queue, explain with an example on flash memory read & write operation. **(Nov 09)**

14. Explain in detail the basic functions in developing a RTOS. Explain for one RTOS used in embedded system design. **(Nov09)**

15. i. What is a semaphore? What are the various operations on semaphores? How does semaphore make a function reentrant? **(Nov 08)**
    ii. Explain about memory management in RTOS.

16. i. What is a recentrant function? Is the following function reentrant? Jusity your answer. **(Nov 08)**

```
int CErrors;
void vcount Errors (int CNewErrors)
{
CErrors+=CNewErrors;
}
```

    ii. Compare and contrast various methods for intertask communication.

17. i. Explain the following intertask communication technique: **(Nov 08)**
    a. Message queues
    b. Mail boxes
    ii. Explain with an example how semaphores solve the shared-data problem.

18. i. Give a note on Timer functions. **(Nov 08, Apr 05)**
    ii. Explain different ways of protecting shared data.

19. Why do we need timer functions in RTOS? Briefly discuss how they are provided. **(Feb 07, Nov 05)**

20. What are the rules to be followed by the interrupt routines in RTOS? Why? **(Feb 07, Nov 05)**

21. What are events? Explain the role of events in RTOS. **(Feb 07, Apr 06)**

22. Explain the need of special architecture for pipelining and parallelism. **(Jun 06)**

23. How memory management is done by an RTOS? Why is memory management not used in embedded systems? **(Nov 06)**

24. Explain the following in embedded systems view:
    i. Program and Data memoryspace.
    ii. Registers.
    iii. I/O.
    iv. Interupts. **(Jun 06)**

25. What is shared-data problem in an embedded system? Explain with an example**.** **(Nov 06, Apr 06)**

26. Discuss the relative merits and demerits of various shared - data protection mechanisms? **(Nov 05)**

27. Explain the functional blocks and the specification of the software of a GPS system?. **(Nov 06)**

28. Explain the methods used to save memory space required for data and code in embedded system? **(Apr 06)**

29. Explain the characteristics of 'reentrant' function? Where and why do we need 'reentrant' functions? **(Apr 06)**

30. Explain the terms "Atomic" and "Critical Section" in the context of a code for embedded systems. Explain with an example one solution to solve the shared - data problem.**(Apr 06)**

31. What are the advantages and disadvantages of using a large number of tasks in an Embedded System.

32. Write short notes on
    i. Message Queues
    ii. Mailboxes
    iii. Pipes.

33. Write short notes on
    i. Events
    ii. Timers
    iii. Heart beat timer.

34. What are the important criteria of selecting a software architecture?

35. How a reentrancy and Semaphores work together in real time environments and explain multiple Semaphores.

36. Each Semaphores are signaling device and how semaphores problems can be taken to accounts of the task of micro processes.

37. It is not good idea to create and destroy tasks as the system is running. All tasks must be created at the beginning. Explain?

38. What is timer function. Explain delaying task with the RTOS delay function.

39. Explain why to write short interrupt routines?

40. What are the constraints for interrupt routines in a RTOS environment.

41. What are the main features of a RTOS?

42. The building block of software written under an RTOS is the TASK. Explain?

43. Write short notes on
    i. Scheduler
    ii. Task states
    iii. Shared data problem

44. Point out the differences between a RTOS and an ordinary operating system.

45. Discuss the various methods of protecting shared data.

46. Draw a diagram showing the transitions among the three task states in a RTOS environment.

47. Write short notes on
    i. Semaphores
    ii. RTOS semaphores.

48. Explain the Real - Time Operating System Architecture and its advantages.

UNIT-VII

1. Discuss the development of μC-OS. **(Nov 13)**

2. Write notes on
    i. Semaphores and queues in RTOS
    ii. Hard Real-Time Scheduling Considerations (**Nov 13)**

3. Explain the role played by PROM programmer, Incircuit emulator and ROM Emulator in the embedded system development cycle. **(Dec 12)**

4. Outline the use of script files and output files in debugging process of embedded software by giving sample script file and sample output file. Assume suitable data. **(Nov 11)**

5. i. Explain how to perform testing programs using a personal computer.
   ii. Explain how to perform testing programs on a single-board computer.
   iii. What is importance of testing programs? **(Nov 11)**

6. Enumerate various timer function call services associated with C /OS RTOS with their function prototypes and applications. **(Nov 11)**

7. Write the C-pseudocode for Nuclear Reactor's problem of detecting equality of two temperatures using C /OS RTOS's function prototypes by passing pointers on queues. **(Nov 11)**

8. i. Describe relevant function prototypes of C /OS for initializing and using semaphores.
   ii. Explain using C /OS and C-pseudo code, how semaphores protect data in the Nuclear Reactor's problem of detecting equality of two temperatures **(Nov 10)**

9. Assume that a message is to be printed line by line after formatting it. Develop C-pseudo code using C /OS RTOS's function prototypes by using a semaphore as a signaling device. Assume one printer task function and one printer interrupt function. **(Nov 10)**

10. i. Discuss the hard real-time scheduling considerations in hard real-time systems
    ii. List and explain different approaches for saving power for embedded software design using RTOS. **(Nov 10)**

11. List and explain COS library functions used in task monitoring system. **(Nov 09)**

12. i.Using VRTX RTOS develop C – Pseudocode for handling interrupts for a typical embedded systems.
    ii. Explain how resource sharing is carried out in a typical embedded systems design. **(Nov 09)**

13. i. Give a note on Linker/Locators for Embedded software. **(Nov 08)**
    ii. Give a brief note on ROM emulators.

14. Explain with an example the basic design of an embedded system using a Real time operating system. **(Nov 08)**

15. Write notes on: **(Nov 08)**
    i. Encapsulating semaphores
    ii. Hard Real-time scheduling considerations
    iii. Saving memory space.

16. Explain in detail about embedded software development tools. **(Nov 08)**

17. Discuss the important features of various software architectures adopted for embedded systems. **(Feb 07)**

18. Explain the differences between an ‘Host Computer System’ and a ‘Target System’ in terms of their hardware and software. **(Feb 07)**

19. Why in general an Host machine is used for the developments of an embedded system software. Explain various software development tools provided by a Host system? **(Feb 07, Nov 05)**

20. Compare the characteristics of various software architectures for embedded applications. Explain how do you choose a particular architecture for your application?**(Feb 07,Nov 05)**

21. What are hybrid architectures? What are their advantages. **(Feb 07)**

22. Write short notes on the following
    i. Hard real-time systems
    ii. Soft real -time systems
    iii. Time-slicing
    iv. Encapsulation **(Feb 07)**

23. Explain the functions of a scheduler in a RTOS and how does the scheduler carryout those functions. **(Feb 07, Nov 05)**

24. Discuss about serial communication programming. **(Apr 06)**

25. What are the main goals of software development for embedded systems? Explain how an host system meets these goals? **(Apr 06, Nov 05)**

26. Explain the following software development tools
    i. A Cross-Compiler
    ii. A Cross-Assembler
    iii. A Linker
    iv. A Loader/ Locator **(Nov 06)**

27. Explain the need for encapsulating semaphore and quenes with an example. **(Nov 05)**

28. Discuss various methods adopted to reduce power consumption in embedded applications. **(Nov05)**

29. Explain the hard real - time scheduling considerations **(Nov 05)**

30. Describe each tool that has enabled the elevation of software design and hardware design to higher abstraction levels.
    (Jun 06)

31. Explain the function and use of the following test equipment for embedded system development
    i. Multimeter
    ii. Oscilloscope
    iii Logic Analyzer
    iv. In - Circuit Emulator **(Apr 05)**

32. Discuss the goals of the typical testing process in embedded systems.

33. Write short notes on
    i. Logic Analyzer
    ii. Lab debugging tools for embedded systems software.

34. Explain the different phases of software development cycle for embedded system

35. Write short notes on Encapsulating Semaphores and Encapsulating queues.

36. Discuss the design issues of hard real time systems.

37. Discuss the applications of hard real time systems.

38. Embedded System software design is an art as much as it is science. Discuss.

39. What are the main issues of Embedded Software design?

40. Discuss why software testing is critical in Embedded Systems?

41. What is the role of linkers / locators for embedded systems. Explain by taking address relocation into account?

42. Explain objections, limitations and short comments of a real time embedded systems?

UNIT-VIII

1. Write short notes on SHARC processor and Internet enabled system. **(Nov 13)**

2. Explain memory organization of ARM processor is different from conventional general purpose processors memory organization. **(Nov 13)**

3. Describe the problems faced in designing an RTOS. What techniques are used to overcome it. **(Dec 12)**

4. i. List out Fixed point ALU operations in SHARC processor and explain. **(Nov 11)**
   ii. How many General purpose registers are there in the SHARC processor and explain.

5. Give hardware and software at functional level for designing elevator controller using basic design principles using a RTOS. **(Nov 11)**

6. Write two applications of ARM processor-based systems with functional block diagram for each application and explain its working.

7. i. Compare and contrast ARM Bus and SHARC Bus.
   ii. Describe ARM two stage Address translation. **(Nov 11)**

8. i. What are the data types the SHARC support explain
   ii. Write SHARC assembly code to first read and then write a device memory mapped to location 0x400110. **(Nov 10)**

9. Describe a 10 base-T Ethernet at the following OSI complaint levels of detail.
   i. Physical
   ii. Data link
   iii. Network
   iv. Transport. **(Nov 10)**

10. Describe the various architectural features of one of the SHARC processors of your choice with its functional block diagram. **(Nov 10)**

11. Describe the general operation of a typical telegraph system in which network port and serial ports communicate via tasks for printing serial data received using DDP and ADSP protocol stack. Assume suitable data with a functional block diagram. **(Nov 10)**

12. Write a brief note on
    i. Memory organization of ARM processor
    ii. Fixed point ALU in SHARC **(Nov09)**

13. Write a brief note on
    i Distributed embedded architecture
    ii. IP packet structure. **(Nov 09)**

14. Write a note on
    i. Architectural features of ARM
    ii. I2C bus **(Nov 09)**

15. Write a brief notes on
    i. CAN Bus architecture
    ii. Programming model of ARM. **(Nov 09)**

16. Explain in detail about distributed Embedded Architectures. **(Nov 08)**

17. Write notes on: **(Nov 08)**
    i. CAN bus
    ii. SHARC Link ports.

18. i. Explain in detail instruction level parallelism. **(Nov 08)**
    ii. Give a note on Internet-enabled systems.

19. Write notes on the following: **(Nov 08)**
    i. I^2C Bus
    ii. SHARC Link ports.

20. Why serial communication facility is required in embedded systems? What are the communication parameters and explain the steps involved in typical serial data transmit and receive programs with the help of flow charts. **(Nov06)**

21. Discuss about serial communication programming. **(Apr 06)**

22. Describe a PC serial interface at the following OSI-compliant levels of detail:
    i. physical
    ii. data link

23. Describe an I^2C bus at the following OSI-compliant levels of detail:
    i. physical
    ii. data link
    iii. network
    iv. transport

24. Write about ARM architectures.

25. Write about SHARC architectures.

26. Why we build network embedded systems.

27. Explain distributed embedded architectures and state why they are needed.

28. Explain in detail about networks for embedded systems.

29. Write in detail about I^2C bus.

30. Write in detail about CAN bus.