SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

V SEMESTER

EC3564 Embedded Systems and IoT Design

Regulation–2023

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AP (Sel.G)/MDE

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SUBJECT : EC3564 Embedded Systems and IoT Design

SEM / YEAR: V / III

Unit-I 8051 MICROCONTROLLERS

Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

PART-A (2 Mark)

Q.No	Questions	COs	BT Level	Competence
1.	What is a microcontroller and how is it different from a microprocessor?	CO1	BTL1	Remember
2.	List any four features of the 8051 microcontroller.	CO1	BTL 1	Remember
3.	Draw a simple block diagram of the 8051 architecture and label its main components.	CO1	BTL 2	Understand
4.	State the size of program memory and data memory in 8051.	CO1	BTL 2	Understand
5.	Compare CISC and RISC.	CO1	BTL 2	Understand
6.	Name all the addressing modes supported by the 8051 microcontroller.	CO1	BTL 1	Remember
7.	What is immediate addressing mode? Give an example.	CO1	BTL 2	Understand
8.	Differentiate between direct and indirect addressing modes in 8051.	CO1	BTL 1	Remember
9.	List out the criteria for choosing a microcontroller.	CO1	BTL 2	Understand
10.	List the timers used in 8051 microcontroller.	CO1	BTL 2	Understand
11.	Write an instruction to add the contents of registers A and R1 in 8051.	CO1	BTL 2	Understand
12.	What is the maximum size of external program memory that 8051 can address?	CO1	BTL 2	Understand
13.	How is on-chip RAM organized in 8051?	CO1	BTL 2	Understand
14.	What is the default location of the stack in 8051 microcontroller?	CO1	BTL 2	Understand
15.	How is the stack pointer (SP) initialized in 8051?	CO1	BTL 1	Remember
16.	Name the different interrupts available in 8051.	CO1	BTL 2	Understand

17.	Write the vector addresses and priority sequence of 8051 interrupts.		CO1	BTL 2	Understand
18.	What is the function of the IE register in 8051?		CO1	BTL 1	Remember
19.	How many timers/counters are present in 8051? Name them.		CO1	BTL 2	Understand
20.	What is the difference between a timer and a counter in 8051?		CO1	BTL 2	Understand
21.	Which register is used to select timer modes in 8051?		CO1	BTL 1	Remember
22.	How many serial ports are available in 8051? Mention their main use.		CO1	BTL 1	Remember
23.	What is the function of the SM2 bit in the SCON register of 8051?		CO1	BTL 1	Remember
24.	What are the different operating modes of the serial port in 8051?		CO1	BTL 1	Remember
	PATR-B				
1.	Explain the 8051 architecture with a block diagram. Describe the roles of the ALU, program counter, DPTR, and PSW register. How do the 8-bit data bus and 16-bit address bus function?	(16)	CO1	BTL 3	Apply
2.	Compare Harvard and von Neumann architectures. How does the 8051's Harvard architecture optimize program and data memory access?	(16)	CO1	BTL 3	Apply
3.	List all addressing modes in the 8051. Explain indirect addressing with an example. How does it differ from direct addressing?	(16)	CO1	BTL 3	Apply
4.	Write 8051 instructions demonstrating immediate, register, and direct addressing. Discuss their use cases in embedded programming.	(16)	CO1	BTL 3	Apply
5.	Classify the 8051 instruction set into data transfer, arithmetic, and logical operations. Provide two examples for each category.	(16)	CO1	BTL 4	Analyze
6.	Explain the role of data transfer instructions and explain with suitable examples.	(16)	CO1	BTL 4	Analyze
7.	Differentiate between on-chip ROM (4 KB) and RAM (128 B). How is external memory interfaced using Port 0 and Port 2?	(16)	CO1	BTL 4	Analyze
8.	Explain the various arithmetic instructions available in 8051 and illustrate with examples.	(16)	CO1	BTL 3	Apply
9.	Describe stack operations in the 8051. How is the stack pointer initialized? Write code to push/pop data and explain its use in subroutines.	(16)	CO1	BTL 3	Apply
10.	List out different types of interrupts available in 8051 and write a short note on them.	(16)	CO1	BTL 4	Analyze
11.	Compare polling vs. interrupts. Write an ISR for the serial port interrupt to receive data and store it in RAM.	(16)	CO1	BTL 4	Analyze
12.	Explain different modes of Timer and how timer count is calculated for a given delay.	(16)	CO1	BTL 4	Analyze

13.	Explain the various program control instructions available in 8051 and illustrate with examples.	(16)	CO1	BTL 3	Apply
14.	Illustrate serial communication interface supported by 8051 microcontroller.	(16)	CO1	BTL 4	Analyze
15.	Explain the role of SCON register and TMOD register.	(16)	CO1	BTL 4	Analyze
16.	Write an 8051 assembly program to add 10 numbers stored in RAM from 30H–39H and store the result in 40H. Use indirect addressing.	(16)	CO1	BTL 4	Analyze
17.	Interface a 7-segment display with Port 1. Write a C program to display digits 0–9 with a 500 ms delay.	(16)	CO1	BTL 4	Analyze

Unit-II Embedded Systems

Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.

PART – A

Q.No	Questions	COs	BT Level	Competence
1.	Define an embedded system.	CO2	BTL 1	Remember
2.	Identify the main components of an embedded system.	CO2	BTL 2	Understand
3.	Outline the embedded system design process.	CO2	BTL 1	Remember
4.	List the key requirements of a model train controller system.	CO2	BTL 1	Remember
5.	State the advantages of using a standard protocol for model train control.	CO2	BTL 1	Remember
6.	Specify the role of the console in a model train controller.	CO2	BTL 1	Remember
7.	List out the distinction between specification and architecture.	CO2	BTL 1	Remember
8.	summarize the role of the transmitter in a model train controller system.	CO2	BTL 2	Understand
9.	State what inertia control simulates in a model train controller.	CO2	BTL 2	Understand
10.	Specify how many trains the model train controller console can manage on a single track.	CO2	BTL 1	Remember
11.	What are assembler directives? List the examples.	CO2	BTL 1	Remember
12.	Name the analog components involved in the model train controller system.	CO2	BTL 2	Understand
13.	Define what an ARM processor is.	CO2	BTL 2	Understand
14.	Give use of "Thumb" instruction set in ARM processors.	CO2	BTL 2	Understand
15.	Name the two essential units of a processor in an embedded system.	CO2	BTL 1	Remember

16.	Distinguish between supervisor mode and user mode in ARM processors.		CO2	BTL 1	Remember
17.	Define exceptions and traps in the context of CPU operation.		CO2	BTL 1	Remember
18.	Mention the features of ARM instruction set that make it suitable for embedded applications..		CO2	BTL 1	Remember
19.	State the functions of the Arithmetic Logic Unit (ALU).		CO2	BTL 2	Understand
20.	Brief the role of the control unit in a CPU.		CO2	BTL 2	Understand
21.	Differentiate between assembly, linking, and loading.		CO2	BTL 1	Remember
22.	What is dynamic linking, and what advantage does it provide?		CO2	BTL 1	Remember
23.	Define compilation techniques in embedded systems.		CO2	BTL 1	Remember
24.	What is program level performance analysis?		CO2	BTL 2	Understand
PART-B					
1.	Describe the main steps in the embedded system design process.	(16)	CO2	BTL 3	Apply
2.	Explain how a model train controller is designed as an embedded system	(16)	CO2	BTL 4	Analyze
3.	Explain the key features of the ARM processor architecture.	(16)	CO2	BTL 3	Apply
4.	What are instruction sets? Compare RISC and CISC instruction sets with examples.	(16)	CO2	BTL 4	Analyze
5.	Explain the features and classifications of ARM instruction set.	(16)	CO2	BTL 4	Analyze
6.	Explain What is supervisor mode in ARM processors and why is it important?	(16)	CO2	BTL 3	Apply
7.	Explain exceptions and traps in embedded system CPUs.	(16)	CO2	BTL 4	Analyze
8.	Describe different programming models used in embedded systems.	(16)	CO2	BTL 3	Apply
9.	What are assembly, linking, and loading? Explain their roles in embedded software development.	(16)	CO2	BTL 3	Apply
10.	Describe compilation techniques used in embedded systems.	(16)	CO2	BTL 4	Apply
11.	Outline the significance of operating modes in ARM processor. Explain the various operating modes.	(16)	CO2	BTL 4	Analyze
12.	List and explain the common methods for testing and validating embedded systems?	(16)	CO2	BTL 3	Apply
13.	Compare top-down and bottom-up design approaches in embedded systems.	(16)	CO2	BTL 4	Analyze
14.	Explain the types and roles of memory in embedded processors.	(16)	CO2	BTL 3	Apply

15.	Analyze energy and power usage in embedded system programs.	(16)	CO2	BTL 4	Analyze
16.	List the steps and explain the tools used to develop embedded software from source code to executable	(16)	CO2	BTL 4	Analyze
17.	Explain How do CPU performance and power consumption affect embedded system design?	(16)	CO2	BTL 3	Apply

Unit-III Processes and Operating Systems

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.

PART-A

Q.No	Questions	**COs**	**BT Level**	**Competence**
1.	Define a real-time system.	CO3	BTL 1	Remember
2.	Identify the key components of a real-time system.	CO3	BTL 2	Understand
3.	Give the basic structure of a real-time system.	CO3	BTL 2	Understand
4.	Define task assignment in the context of real-time systems.	CO3	BTL 1	Remember
5.	Brief the concept of task scheduling.	CO3	BTL 2	Understand
6.	List the common objectives of task scheduling algorithms.	CO3	BTL 1	Remember
7.	Identify the difference between a task and a process.	CO3	BTL 1	Remember
8.	How multiple tasks can be managed within a single process?	CO3	BTL 2	Understand
9.	Mention the benefits of using multiple processes in a real-time system.	CO3	BTL 1	Remember
10.	Define multitasking.	CO3	BTL 1	Remember
11.	summarize the challenges in designing multirate systems.	CO3	BTL 2	Understand
12.	Identify the importance of synchronization in multirate systems.	CO3	BTL 2	Understand
13.	Define a preemptive real-time operating system.	CO3	BTL 1	Remember
14.	Point out the advantages of preemptive scheduling in real-time systems.	CO3	BTL 2	Understand
15.	List the key features of a preemptive RTOS.	CO3	BTL 1	Remember
16.	Provide examples of blocking interprocess communication and nonblocking interprocess communication.	CO3	BTL 2	Understand

17.	State how priorities are assigned to tasks in priority-based scheduling.		CO3	BTL 2	Understand
18.	What are the potential issues with priority inversion?		CO3	BTL 1	Remember
19.	Define interprocess communication (IPC).		CO3	BTL 1	Remember
20.	List common IPC mechanisms used in embedded systems.		CO3	BTL 1	Remember
21.	state the use of message queues for interprocess communication.		CO3	BTL 2	Understand
22.	What happens when deadlock occurs?		CO3	BTL 1	Remember
23.	List the challenges in designing distributed embedded systems.		CO3	BTL 1	Remember
24.	Identify what MPSoC stands for.		CO3	BTL 2	Understand
	PART – B				
1.	Describe the main parts of a real-time system and how they work together.	(16)	CO3	BTL 3	Apply
2.	Discuss How are tasks assigned and scheduled in real-time systems? also explain the three different states of tasks with state transition diagram.	(16)	CO3	BTL 3	Apply
3.	What is the difference between multiple tasks and multiple processes? Explain and Give examples.	(16)	CO3	BTL 4	Analyze
4.	Define and explain multirate systems and why are they important in real-time systems?	(16)	CO3	BTL 3	Apply
5.	What is a preemptive real-time operating system (RTOS)? Explain how preemption works.	(16)	CO3	BTL 4	Analyze
6.	Discuss How does priority-based scheduling work in real-time operating systems?	(16)	CO3	BTL 4	Analyze
7.	Explain different ways processes can communicate in real-time systems.	(16)	CO3	BTL 3	Apply
8.	What are distributed embedded systems? Describe their main challenges	(16)	CO3	BTL 3	Apply
9.	Discuss about MPSoCs and shared memory multiprocessors. How are they used in embedded systems?	(16)	CO3	BTL 4	Analyze
10.	Describe how an audio player is designed as a real-time embedded system	(16)	CO3	BTL 3	Apply
11.	Explain the real-time requirements and design of an engine control unit	(16)	CO3	BTL 3	Apply
12.	Explain How is a video accelerator designed for real-time performance in embedded systems?	(16)	CO3	BTL 4	Analyze

UNIT-IV: IOT ARCHITECTURE AND PROTOCOLS

Internet of Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

PART-A

Q.No	Questions	COs	BT Level	Competence
1.	List out the various applications of Internet of Things (IoT).	CO4	BTL 1	Remember
2.	Name any two key components of IoT architecture.	CO4	BTL 2	Understand
3.	What is the main function of the perception (physical) layer in IoT architecture?	CO4	BTL 1	Remember
4.	Identify the challenges and issues of IoT.	CO4	BTL 2	Understand
5.	What are the role of sensors and actuators in an IoT system?	CO4	BTL 1	Remember
6.	Define the network (connectivity) layer in IoT architecture.	CO4	BTL 2	Understand
7.	Mention two technologies used for IoT device connectivity.	CO4	BTL 1	Remember
8.	What is the purpose of the data processing layer in IoT architecture?	CO4	BTL 2	Understand
9.	Compare things of IoT and machines in M2M.	CO4	BTL 2	Understand
10.	Give one example each of a domain-specific IoT application.	CO4	BTL 2	Understand
11.	What is the difference between physical design and logical design in IoT?	CO4	BTL 2	Understand
12.	Name two IoT enabling technologies.	CO4	BTL 1	Remember
13.	What does M2M stand for in the context of IoT?	CO4	BTL 1	Remember
14.	What is the function of a gateway in an IoT network?	CO4	BTL 2	Understand
15.	What is NETCONF used for in IoT system management?	CO4	BTL 1	Remember
16.	What is YANG in IoT management?	CO4	BTL 1	Remember
17.	What is meant by IoT platform design?	CO4	BTL 2	Understand
18.	Which limitations make SNMP unsuitable for IoT systems?	CO4	BTL 1	Remember
19.	What is the IoT reference model?	CO4	BTL 1	Remember
20.	Define the domain model in IoT reference architecture.	CO4	BTL 2	Understand
21.	What is the communication model in IoT?	CO4	BTL 2	Understand
22.	Name two features of the IoT reference architecture.	CO4	BTL 1	Remember
23.	What is MQTT? Mention one use case.	CO4	BTL 2	Understand
24.	Name any two other IoT protocols apart from MQTT (e.g., XMPP, Modbus, CANBUS, BACNet).	CO4	BTL 1	Remember

PART-B				
1.	Describe the different layers in IoT architecture and their functions. (16)	CO4	BTL 3	Apply
2.	Explain the difference between physical design and logical design in IoT? Give examples. (16)	CO4	BTL 3	Apply
3.	Illustrate with an example of IoT service in detail that follows request response model and publish subscribe model. (16)	CO4	BTL 4	Analyze
4.	What are domain-specific IoTs? Explain and Give examples from different fields. (16)	CO4	BTL 3	Apply
5.	Discuss How does IoT differ from M2M (Machine-to-Machine) communication? (16)	CO4	BTL 3	Apply
6.	Explain the role of NETCONF in managing IoT systems. (16)	CO4	BTL 3	Apply
7.	What is YANG and Explain how does it help in IoT device management? (16)	CO4	BTL 3	Apply
8.	Explain the main steps involved in designing an IoT platform. (16)	CO4	BTL 4	Analyze
9.	What is the IoT reference model? Describe its main parts. (16)	CO4	BTL3	Apply
10.	Define and Explain domain model in IoT? Why is it important? (16)	CO4	BTL 4	Analyze
11.	With the help of a neat diagram, explain the different levels of IoT with an example. (16)	CO4	BTL 4	Analyze
12.	Describe the IoT reference architecture and its key components. (16)	CO4	BTL 3	Apply
13.	Define MQTT? Discuss the uses in IoT communication. (16)	CO4	BTL 4	Analyze

14.	Explain XMPP and how is it applied in IoT? (16)	CO4	BTL 3	Apply
15.	Explain the Modbus protocol and its use in IoT applications. (16)	CO4	BTL 4	Analyze
16.	Compare CANBUS and BACNet protocols in terms of their use in IoT and summarize their features. (16)	CO4	BTL 4	Analyze
17.	Explain main challenges in designing a secure and reliable IoT architecture. (16)	CO4	BTL 4	Analyze

	UNIT-V: IOT SYSTEM DESIGN			
	Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.			
	PART-A			
Q.No	**Questions**	**COs**	**BT Level**	**Competence**
1.	What are the basic building blocks of an IoT device?	CO5	BTL 1	Remember
2.	Name two sensors and actuators commonly used in IoT devices.	CO5	BTL 1	Remember
3.	How is Rapberry Pi different from a desktop computer.	CO5	BTL 2	Understand
4.	List two features of the Raspberry Pi board that make it suitable for IoT projects.	CO5	BTL 1	Remember
5.	What is the purpose of GPIO pins on a Raspberry Pi?	CO5	BTL 2	Understand
6.	What is the use of SPI and I2C interfaces on Raspberri Pi?	CO5	BTL 1	Remember
7.	Name two operating systems that can run on Raspberry Pi.	CO5	BTL 2	Understand
8.	Why is Linux commonly used on Raspberry Pi for IoT applications?	CO5	BTL 2	Understand
9.	What command checks the Python version on Raspberry Pi?	CO5	BTL 1	Remember
10.	How do you install a new Python library on Raspberry Pi?	CO5	BTL 1	Remember
11.	What is the role of Python in IoT system development with Raspberry Pi?	CO5	BTL 2	Understand
12.	Write a simple Python statement to print “Hello, Raspberry Pi!”.	CO5	BTL 1	Remember
13.	Which Python library is used to control GPIO pins on Raspberry Pi?	CO5	BTL 2	Understand
14.	How can you blink an LED using Python on Raspberry Pi?	CO5	BTL 1	Remember
15.	What is the use of the time.sleep() function in a Python script for IoT?	CO5	BTL 2	Understand
16.	Name one method to detect a button press using Raspberry Pi and Python.	CO5	BTL 2	Understand

17.	Give some case study examples in the context of IoT system design?	CO5	BTL 1	Remember
18.	What are the basic building blocks of an IoT device?	CO5	BTL 1	Remember
19.	Mentions the role of IoT in development of smart cities.	CO5	BTL 2	Understand
20.	What is the function of actuators in an IoT system? Give examples	CO5	BTL 2	Understand
21.	List two features of the Raspberry Pi board that make it suitable for IoT projects.	CO5	BTL 2	Understand
22.	List the impact of IoT in agriculture.	CO5	BTL 2	Understand
23.	How does the Raspberry Pi connect to the internet?	CO5	BTL 1	Remember
24.	Name two operating systems that can run on Raspberry Pi.	CO5	BTL 1	Remember
	PART-B			
1.	What are the main building blocks of an IoT device? Explain the role of each blocks. (16)	CO5	BTL 3	Apply
2.	Describe the architecture and main features of the Raspberry Pi board. (16)	CO5	BTL 3	Apply
3.	Discuss the use of Linux on Raspberry Pi for IoT? What are its advantages? (16)	CO5	BTL 4	Analyze
4.	List the interfaces available on Raspberry Pi and explain how they are used in IoT projects. (16)	CO5	BTL 3	Apply
5.	How do Python libraries help in IoT development on Raspberry Pi? Explain and Give examples. (16)	CO5	BTL 4	Analyze
6.	Explain how to connect sensors and actuators to a Raspberry Pi, with examples. (16)	CO5	BTL 3	Apply
7.	Discuss how the single master-single slave and single master multiple slave configuration of serial peripheral interconnect interface in Raspberry Pi is developed. (16)	CO5	BTL 4	Analyze
8.	Develop an automatic refrigerator light system with LED, switch using Raspberri pi hardware module and also develop a python program to support the working of the design. (16)	CO5	BTL 4	Analyze
9.	Describe the steps to build a home automation system using Raspberry Pi. (16)	CO5	BTL 4	Analyze
10.	How can Raspberry Pi be used in smart city applications? Explain and Give examples. (16)	CO5	BTL 3	Apply
11.	Explain how Raspberry Pi can be used for environmental monitoring. (16)	CO5	BTL 4	Analyze
12.	Describe how Raspberry Pi can be used in agriculture for smart farming. (16)	CO5	BTL 3	Apply
13.	Analyze and explain an IoT strategy for smart city and design the layered architecture for implementing smart cities. (16)	CO5	BTL 3	Apply

14.	Explain the design of an IoT system for weather monitoring using IoT design methodology with necessary diagrams. (16)	CO5	BTL 4	Analyze
15.	Develop a python program for sending an email, when a switch is pressed on Raspberry pi module. (16)	CO5	BTL 3	Apply
16.	List out and explain the communication protocols commonly used with Raspberry Pi in IoT systems? Give examples. (16)	CO5	BTL 4	Analyze
17.	Choose a case study (home automation, smart city, environment, or agriculture and explain a complete IoT solution using Raspberry Pi and Python. (16)	CO5	BTL 4	Analyze