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Vellore Institute of Technology

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Reg. No. :

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BCSE305L**	Faculty Name	**Prof. Vijayakumar P**
Course Title	**Embedded Systems**	Slot	**C1+TC1**
		Class Nbr	**CH2024250100419**
Time	**3 hours**	Max. Marks	**100**

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces.
2. To summaries the functionality of any special purpose computing system, and to propose smart solutions to engineering challenges at the prototype level.
3. To examine the working principle and interface of typical embedded system components, create programme models, apply various optimization approaches including simulation environment and demonstration using debugging tools.
4. To evaluate the working principle of serial communication protocols and their proper use, as well as to analyze the benefits and drawbacks of real-time scheduling algorithms and to recommend acceptable solutions for specific challenges.

Section - I

Answer all Questions (4 × 10 Marks) *M - Marks

Q.No	Question	*M	CO	BL
01.	The majority of embedded system users are not also embedded system or even product designers. Their conception of the system is predicated on how they see users interacting with it. Because of the wide discrepancy between what the architects need to design the system and what the customers can describe about the system they want, it is frequently necessary to separate requirements analysis from specification. a. Describe the main obstacles to designing an embedded system for a consumer electronics application, paying particular attention to time-to-market limitations and Non-Recurring Engineering (NRE) costs. b. Describe the ways in which these elements affect design choices and the development process as a whole. To support your arguments, provide concrete instances of embedded applications, such as wearables, Internet of Things gadgets, and automotive systems.	10	1	2

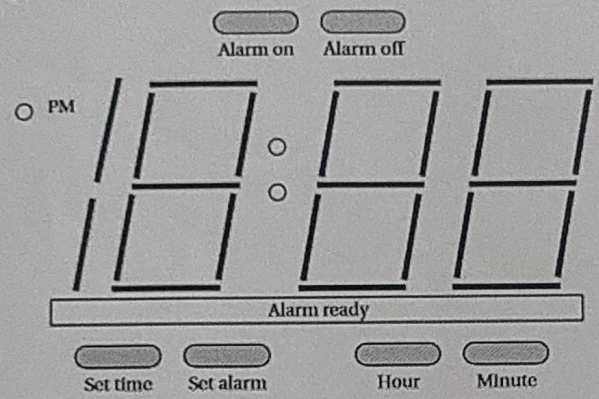
02.	An embedded system is designed to monitor environmental data in real-time using various sensors, such as temperature, humidity, and light sensors. The system has limited processing power and memory, and it must run on battery power for extended periods. The current implementation uses floating-point calculations to process sensor data and performs redundant checks, leading to higher power consumption and slow processing times. a. Identify three key optimization techniques that could be applied to this system to improve performance and reduce power consumption. b. Discuss the impact of the optimizations on power efficiency, memory usage, and processing speed in the context of this application.	10	2,3	1
03.	The elevator system is one of the software engineering benchmarks that are frequently used to test the expressive power, readability and convenience of various formal specification techniques. Describe and analyze the elevator control system through a concurrent process which is very similar to state transition diagrams. Suppose any product is to be installed to control n elevators in a building with m floors. The problem concerns the logic required to move elevators between floors according to the following constraints: a) Each elevator has a set of m buttons, one for each floor. These illuminate when pressed and cause elevator to visit corresponding floor. Illumination is cancelled when corresponding floor is visited by elevator b) If an elevator has no requests, it remains at its current floor with its doors closed	10	3	3
04.	Analyze how embedded systems contribute to smart home automation. How do these systems interface with sensors and actuators to support functionalities such as lighting control, security, and climate management? Use an example of a smart home system to explain the key hardware and software components involved.	10	2	3

Section - II

Answer all Questions (4 × 15 Marks)

*M - Marks

Q.No	Question	*M	CO	BL
05.	a. With a neat sketch of the functional block diagram/architecture, describe the salient features available in the ARM processor. b. Tabulate the following specifications for the microcontrollers 8051, PIC ad ARM. • Clock frequency • Bit width of the data path • Types of memory • Number of pins • Does the microcontroller contain an Analog-to-Digital Converter? If so, how many bits of precision does it have?	15	1	1

06.	Consider a microprocessor has to update the time, display and read the clock's buttons. Figure 1 depicts the alarm clock's front panel design which is showing the time in form of minute and hour, display unit. a. Utilize a light to differentiate between AM and PM, and the time is displayed as four digits in 12-hour format. To set the alarm and clock times, we press a number of buttons. b. Pressing the hour and minute buttons causes the hour and minute to advance by one, respectively. c. The set alarm button functions when we hold down the set time button while pressing the hour and minute buttons to set the time. The set alarm button functions similarly to the set time button, which we must hold down while pressing the hour and minute buttons to set the time. The alarm on and alarm off buttons are used to turn the alarm on and off. d. The alarm ready light turns on when the alarm is triggered. The alarm is audible through a separate speaker.  Figure 1: Front panel of the alarm clock. Use the condition to create a requirement table. Purpose, inputs, outputs, functions, performance, manufacturing costs, power, physical size, and weight must all be included in the requirements table. Also draw the class diagram for the alarm clock.	15	2	3
07.	Develop a control system for an autonomous drone that must execute three critical, periodic tasks to maintain safe and stable operation: **Sensor Data Acquisition (Task A)**: This task gathers data from the drone's sensors (e.g., altitude, velocity, GPS) to provide real-time feedback on its surroundings. The task has a period of 10 ms (it must execute every 10 ms) and requires 3 ms of computation time to complete. **Path Adjustment (Task B)**: Based on sensor data, this task adjusts the drone's flight path to avoid obstacles and maintain a steady course. It has a period of 20 ms and requires 5 ms of computation time. **Battery Monitoring (Task C)**: This task checks the battery status to ensure the drone has sufficient power for its flight path. It executes every 40 ms and requires 6 ms of computation time. Using the *Rate Monotonic Scheduling (RMS) Algorithm*, analyze how these tasks will be scheduled on a single processor to ensure that each completes within its specified period.	15	4	4
08.	Mention the different types of network buses used in creating the embedded computing platform. With neat sketches of standard message framing, briefly explain how data transmission takes place using the I2C bus.	15	3	2

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)