REG.NO.:

# VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

## SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

**CAT-2**

**WINTER SEMESTER 2025-2026**

**SLOT: E2 + TE2**

| | |
|---|---|
| **Programme Name & Branch** | **: B.Tech. IT** |
| **Course Code and Course Name** | **: BITE403L Embedded Systems and IoT** |
| **Faculty Name(s)** | **: Dr. Swarna Priya RM, Dr. Pounambal M** |
| **Class Number(s)** | **: VL2025260502204, VL2025260502199** |
| **Date of Examination** | **: 20/3/2026** |
| **Exam Duration** | **: 90 minutes** |

**Maximum Marks: 50**

**General instruction(s):**

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes
  CO2 : Build a hardware platform encompassing microcontrollers, sensors and peripherals
  CO3 : Make use of modern real-time operating systems in embedded systems for engineering practices.
  CO4 : Analyze complex real-world problems through challenges posed by IoT leading to new low-cost architectural models.

| Q. No | Question | M | CO | BL |
|---|---|---|---|---|
| 1. | A wearable healthcare monitoring system processes patient data using three periodic tasks. | | 3 | 4 |

| Task | Application | Execution Time | Period | Resource |
|---|---|---|---|---|
| T1 | ECG anomaly detection | 1 ms | 6 ms | Needs database buffer R |
| T2 | Data encryption for transmission | 3 ms | 8 ms | No resource |
| T3 | Data logging to storage | 3 ms | 10 ms | Uses buffer R |

Assume that T1 enters at 2 ms, T3 enters at 0 ms and T2 enters at 1 ms. Tasks are scheduled on a single processor. T3 locks resource R at the start of execution. T1 also requires R. — 10

- Determine the priority order using Rate Monotonic Scheduling.
- Show why RMS cannot guarantee schedulability and say when it is suitable.
- Construct the schedule for 0–30 ms using Earliest Deadline First Scheduling.
- Identify where Priority Inversion occurs due to the shared resource.
- Apply Priority Inheritance Protocol and redraw the schedule.
- Explain how priority inheritance prevents the blocking of the critical task.

| | | | | |
|---|---|---|---|---|
| 2. | A smart agriculture system monitors soil moisture, temperature, and humidity using hundreds of battery-powered sensor nodes distributed across a large farm. Each sensor periodically sends small data packets to a central cloud server. The system must satisfy the following conditions:<br>• Sensors have limited power and memory<br>• Data packets are very small<br>• Communication must support many devices simultaneously<br>• Sensors only send data occasionally<br>• Network bandwidth is limited | 10 | 4 | 4 |

REG.NO.:

# VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

## SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

**CAT-2**

**WINTER SEMESTER 2025-2026**

**SLOT: E2 + TE2**

| | | | | |
|---|---|---|---|---|
| | Analyze and identify IoT communication models and communication protocols to be used in each layer for perfectly handling the environment. Specify the exact protocol versions and justify why they are suitable. | | | |
| 3. | A factory safety system uses the following components connected to an 8051 microcontroller:<br>• Smoke sensor connected to External Interrupt 0 (INT0)<br>• Emergency push button connected to External Interrupt 1 (INT1)<br>• Buzzer connected to Port P2<br>• LED indicator connected to Port P1<br>Write an 8051 assembly program using interrupts such that<br>• When smoke is detected, INT0 triggers and the buzzer sounds continuously.<br>• When the emergency button is pressed, INT1 triggers and the LED blinks rapidly.<br>Configure the interrupt enable and priority registers so that the smoke alarm has higher priority than the emergency button. | 10 | 2 | 3 |
| 4. | An embedded monitoring system uses multiple sensors connected to a central controller using 9-bit serial communication. The system operates using the 8051 microcontroller with a crystal frequency of 12 MHz. The communication system must operate at a baud rate which is higher than that of 7200 bps during runtime. Write an Embedded C program. Show configurations of the Special Function registers wherever required. Requirements are<br>• Sensor nodes send 9-bit data frames.<br>• The controller must:<br>o Receive the data<br>o Verify the 9th bit<br>o Display the received 8 bit value on Port P1 LEDs and 9th bit in the carry flag. | 10 | 2 | 3 |
| 5. | A smart water management system uses:<br>• Water level sensor<br>• Ultrasonic sensor (backup measurement)<br>• Servo motor controlling a valve<br>• Buzzer for low water alert<br>• NodeMCU connected to ThingSpeak<br>The servo motor opens or closes the inlet valve based on water level. Design the system architecture showing sensor inputs, NodeMCU processing, servo actuation, and ThingSpeak cloud integration. Develop a control algorithm to rotate the servo motor to three positions:<br>• 0° → Valve closed<br>• 45° → Partial flow<br>• 90° → Full flow<br>based on water level thresholds. Design the ThingSpeak channel structure to store tank level, valve position and alert status. | 10 | 2 | 3 |

**********