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Question Paper Code : 21307

B.E. / B.TECH. DEGREE EXAMINATIONS, NOVEMBER / DECEMBER 2024

Seventh Semester

Information Technology

19IT701 – EMBEDDED SYSTEMS PROGRAMMING

(Regulations: Mepco – R2019)

Duration: 3 Hours

Max. : 100 Marks

Answer ALL Questions

BTL, CO

PART A – (10 × 2 = 20 Marks)

- U, CO1 1. The number of ports in PIC18F458 microcontroller is _____. Also, the status of the ports is _____ upon reset. Justify your answer.
- A, CO1 2. What value should be loaded into the TMR0L register to get a 100 µs delay. Assume XTAL = 10 MHz.
- A, CO2 3. The output of DAC0808 is in _____ (current / voltage). The output of DAC0808 is ideal to drive a motor. Say True or False. Justify your answer.
- U, CO2 4. In keyboard interfacing, indicate an advantage and disadvantage of using an IC chip instead of a microcontroller for keyboard scanning and decoding.
- R, CO3 5. Among the following methods, which method helps to protect shared data in RTOS? Justify your answer.
- A) Disabling interrupts B) Taking Semaphores
- C) Disabling task switches D) All of the above
- U, CO3 6. Compare and contrast hard real-time system and soft real-time system.
- U, CO4 7. The software in an embedded system is usually fixed and cannot be easily changed; for this reason, it is called as _____.
- U, CO4 8. What is meant by a linker? Mention its role.
- R, CO5 9. What is the purpose of the setup() function in an Arduino sketch?
- A) To perform actions repeatedly
- B) To initialize variables and configure settings
- C) To read data from sensors D) To display output on a screen
- Justify your answer.
- A, CO5 10. Write an Arduino sketch to toggle an LED connected to pin 13 of an Arduino UNO every 1 second.

PART B – (5 × 16 = 80 Marks)

- A, CO1 11. a) i. Write a PIC18 C program to design a pulse-counting system using the PIC18F458 microcontroller with the following specifications: An external 1-Hz clock signal is being fed into pin T0CKI (RA4). Utilize Timer 0 in mode 1 (16-bit mode) to count the incoming pulses. The high byte of the timer (TMR0H) should be displayed on PORTD, and the low byte (TMR0L) should be displayed on PORTB. Draw a suitable Hardware diagram. (10 Marks)
- U, CO1 11. a) ii. You are studying the functionality of interrupts in the PIC18F458 microcontroller, with a focus on the PORTB Change Interrupt. This interrupt feature triggers an interrupt when there is a change in the state of any of the RB4 to RB7 pins. Write a short note discussing the key characteristics of the PORTB Change Interrupt. Additionally, explain the relevant control registers and flags involved in configuring and handling this interrupt. (6 Marks)
- OR**
- A, CO1 11. b) i. Write a PIC18 C program to develop a communication system using the PIC18F458 microcontroller with the following specifications: The system should send two messages, "Normal Speed" and "High Speed," to the serial port. A switch (SW) is connected to pin PORTB/0, and the baud rate for the serial communication should be set based on the status of the switch. If SW = 0, the baud rate should be 9600; if SW = 1, the baud rate should be 38400. Assume the microcontroller is operating with a 10 MHz crystal oscillator. Draw a suitable Hardware diagram. (10 Marks)
- A, CO1 11. b) ii. In the context of embedded systems, precise time delays are often required for various tasks, such as debouncing switches, generating PWM signals, or timing events. The PIC18 microcontroller features several timers that can be used to generate these time delays. Enlist the procedure explaining how the timers in the PIC18 microcontroller can be configured and utilized to create accurate time delays. Also, show how the timer values are calculated to achieve the desired delay. (6 Marks)
- A, CO2 12. a) i. Write a suitable PIC18 program for to develop a temperature monitoring system using the PIC18F458 microcontroller with the following specifications: The system must interface with an LM35 temperature sensor connected to pin RA1 of the microcontroller. The temperature readings should be displayed on an LED Bargraph connected to Port D. Additionally, the system must control two LEDs: a green LED should turn on when the temperature is less than 40°C, and a red LED should turn on when the temperature is 40°C or higher. Draw a suitable Hardware diagram. (10 Marks)

- A, CO2 12. a) ii. Consider a scenario where you need to store the word “WISDOM” in the EEPROM of a PIC18F458 microcontroller, ensuring that the quote can be retrieved and displayed later. Detail the steps involved in writing the above word to the EEPROM starting at location 500H of the PIC18F458 microcontroller. (6 Marks)

OR

- A, CO2 12. b) i. Write a PIC18 C program that implements a control system for a DC motor using the PIC18F458 microcontroller. The system must interface with a switch (SW) connected to pin RD7 of the microcontroller. The DC motor's direction of rotation is determined by the status of the switch: if SW = 0, the motor rotates clockwise; if SW = 1, the motor rotates counterclockwise. Draw a suitable Hardware diagram. (10 Marks)

- A, CO2 12. b) ii. You are required to interface an LCD with a PIC18F458 microcontroller and send data using the delay method. Detail the steps, including LCD initialization, configuration of control and data lines, and how delays ensure proper timing and synchronization when sending characters or strings to the LCD. (6 Marks)

- A, CO3 13. a) Describe the role of mailboxes in message queuing, synchronization, and ensuring message integrity. Discuss how mailboxes handle blocking of tasks when the mailbox is either full or empty. Also, write a μ C/OS RTOS program to read and display the status of switches on LEDs using mailbox communication. The program should involve tasks that read the status of switches connected to the microcontroller and communicate this status via a mailbox. Another task should retrieve the status from the mailbox and control the corresponding LEDs to reflect the switch states. (16 Marks)

OR

- A, CO3 13. b) Design an Elevator Control System using RTOS design principles to manage the operation of an elevator, including floor selection, door operation, and safety protocols. Ensure the system incorporates efficient task prioritization, scheduling, and synchronization to maintain smooth operation, while implementing real-time safety features such as emergency stop, door obstruction detection, and overload protection. (16 Marks)

- A, CO4 14. a) Examine the various methods for loading embedded software into a target system. Also, discuss the associated debugging techniques, to ensure proper functionality and performance of the embedded system. Investigate a 2-bit magnitude comparator circuit, and demonstrate the debugging process using appropriate laboratory tools. (16 Marks)

OR

- A, CO4 14. b) Design a stand-alone meteorological data acquisition system that predicts weather conditions by processing and analyzing data from various sensors, including temperature, humidity, and pressure ensuring accurate and reliable weather predictions based on the collected readings. (16 Marks)
- A, CO5 15. a) i. Design a safety monitoring system using an Arduino UNO and a smoke detector sensor. Write an Arduino sketch to detect smoke levels based on a specified threshold. Explain how the system will respond to smoke detection, including how it will display results and trigger an alarm using a buzzer when the threshold is exceeded. (10 Marks)
- U, CO5 15. a) ii. Write a short note on Arduino libraries. (6 Marks)
- OR**
- A, CO5 15. b) i. You are tasked with interfacing an LCD with an Arduino UNO board. Develop a Arduino sketch to accomplish two specific tasks:
(A) Display the text "Chandrayaan-3" at the 0th row and 0th column for 1 second, clear the display for 1 second, and repeat this sequence.
(B) Display "Chandrayaan-3" at the 0th row and 0th column and implement a scrolling effect to the right. (10 Marks)
- U, CO5 15. b) ii. Write a short note on communication using SPI protocol in Arduino. (6 Marks)