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Vellore Institute of Technology

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Reg. No. : 21BLC1122

Final Assessment Test (FAT) - May 2024

Programme	**B.Tech.**	Semester	**WINTER SEMESTER 2023 - 24**
Course Title	**EMBEDDED C PROGRAMMING**	Course Code	**BECE320E**
Faculty Name	**Prof. Sudhakaran G**	Slot	**G2**
		Class Nbr	**CH2023240503283**
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.

Section - I

Answer all questions (4 X 5 Marks = 20 Marks)

01. Evaluate the "C expressions" given below. [Each 1 Mark] **[5]**

A. 3 * 2 + 4 * 3

B. 17 % 9 - 20 % (26 / 7)

C. 2 + 5 + "2" + 2 + 5

D. 2.5 + 5 / 2 + (3 / 0.5)

E. 3 * (2 + 4) * 2 / 10

02. In the imaginary game "Ring the Gack" players throw rings on the antlers of a "Gack", an imaginary creature from Dr. Seuss. Players throw red, blue, and yellow rings onto the antlers. They get 10 points for every red ring that lands on the antlers, 5 points for every blue ring that lands on the antlers, and 1 point for every yellow ring that lands on the antlers. Given the count of red, blue, and yellow rings a player successfully tossed onto the antlers, Write a C program that calculates and returns the player's score. For example if a player had 3 red rings, 5 blue rings, and 2 yellow rings that landed on the antlers their score would be 30 + 25 + 2 = 57. You may assume the number of rings for each color given to the method will always greater than or equal to 0. **[5]**

03. Write an 8051 Embedded C program to send out the value 44H serially one bit at a time via P1.0. The LSB should go out first. **[5]**

04. You're tasked with designing an embedded system for controlling a set of external devices. One of the requirements is to generate a square wave with an ON time of 3 milliseconds and an OFF time of 10 milliseconds on port A. The system operates with a crystal oscillator having a frequency of 11.0592 MHz. **[5]**

Section - II

Answer all questions (5 X 10 Marks = 50 Marks)

05. Write a C Program that determines if the elements of an array of integer values alternate between positive and negative values. The method shall return true if each positive element in the array is followed by a negative element and each negative element is followed by a positive element. If **[10]**

the elements of the array do not meet this criteria the method shall return false.
Here are some examples and conditions to be incorporated in the program:
({1, -1, 3, -12}) would return true.
({1, 1, -3, 1, -2}) would return false.
({37, 0, 32, -1, 55}) would return false. (0 is not a positive value or a negative value.)
({1}) would return true. (Array of length 1.)

06. Write a C program that uses a function moveTargetToBack. This method has two parameters, an array of integers and an integer that is the target value. All elements of the array that are equal to the target value are moved to the end of the array. All elements that are not equal to the target value are moved to the front of the array and maintain their relative position. [10]
The array values and the target value should be passed as the arguments to the function and the output array should be returned to the main function.
Here is an example of an initial array.
{12, 1, 3, -5, 1, 1, 7, 1, 15}
If the target were equal to 1, the elements of the array would be rearranged as follows:
{12, 3, -5, 7, 15, 1, 1, 1, 1}
Notice the four 1s, which are equal to the target, have been moved to the back of the array and the elements not equal to 1 have been shifted forward, but have maintained their relative order.
The program should work for any target value dynamically.

07. Describe the architecture of the 8051 microcontroller, emphasizing its pin configuration and functionality. [10]

08. You've been assigned a project to design a simple LED blinking circuit using an 8051 microcontroller for a prototype. The circuit involves connecting an LED to pin P1.5 of the microcontroller. Your task is to write a program in C to control the blinking of this LED. The LED should toggle its state every 500 milliseconds, giving a blinking effect. To achieve this, you're instructed to utilize Timer 0 in auto-reload mode to generate the required time delay for toggling the LED. How would you proceed with implementing this scenario, considering the crystal frequency of 11.0592 MHz? [10]

09. Based on the guest lecture, Consider an embedded system project on your own and elucidate the diverse testing methodologies applicable in the development process of an embedded system project. [10]

Section - III

Answer all questions (2 X 15 Marks = 30 Marks)

10. You have been assigned to develop firmware for a cutting-edge smart home device by a prominent home automation company. This device, centered around an 8051 microcontroller, is designed to manage an LED indicator's behavior in response to a physical switch and facilitate remote control through serial communication. [15]

Your objective is to execute the provided C program tailored for the 8051 microcontroller. This program leverages interrupts, specifically Timer 0 configured in mode 2 with the delay of 50ms for LED toggling, and an external interrupt triggered by a keyboard press for receiving remote commands.

The LED's illumination pattern should synchronize with the switch's state. Moreover, the system should acknowledge the receipt of a spacebar key press through serial communication by responding with an "ACK" message. Additionally, upon detecting an 'Enter' key press, the LED should commence blinking at a predetermined frequency. Conversely, pressing any other key should revert the LED's behavior to its previous state, dictated by the switch. Draw the schematic diagram. Ensure to consider the crystal frequency of 11.0592 MHz and a baud rate of 9600 for serial communication.

11. You've been tasked with developing firmware for a new product at a consumer electronics company. The product is an embedded system built around an 8051 microcontroller and includes an LCD display for user interaction. The firmware must allow the system to receive characters from a serial communication interface and display them on the LCD screen in real-time. **[15]**

Your team has provided you with a scenario that configures the microcontroller's serial communication and LCD interface. The program uses Timer 1 in mode 2 for timing and includes functions for sending commands and data to the LCD.

Your task is to implement this program on the 8051 microcontroller. Upon receiving characters through the serial interface, the program should display them on the LCD screen. Use the baud rate of 4800 for serial communication. Ensure that the LCD is properly initialized and configured for 2 lines, 5x8 matrix, and 8-bit mode. Additionally, the program should clear the display screen before displaying each character received. Draw the schematic diagram.