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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

II SEMESTER M.TECH. (INDUSTRIAL AUTOMATION AND ROBOTICS)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: EMBEDDED SYSTEMS [MTE 5202]

(19/04/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed with justification.

1A. In a theatre, a door is attached with a sensor to count the number of persons entering the theater. The sensor is connected to pin P3.4 of a microcontroller. Develop an embedded C program to count the people entering the theater and display the upper and lower bytes of count in registers on P1 and P2 respectively. (Use counter 0 in mode 1) Also draw the bit diagram TMOD register. **4**

1B. Discuss the relevance of bits present in Program Status Word (PSW) register of 8051 with the bit diagram. **3**

1C. An automated industry uses a robot for performing pick and place operation. The position of the robot is indicated on a display. A switch is connected to pin P3.0 of a microcontroller to identify the position of the robot. When the robot is in 'Home' position, switch = 0 and when the robot is at 'Run' mode switch is triggered to 1. Write an embedded c program to send two different strings 'Home' and 'Run' to the serial port based on the position of the robot. Assume XTAL=11.0592MHz, Baud rate of 9600, 8 bit data,1 stop bit. **3**

2A. Describe any 4 variations of ARM RISC instruction set that makes the ARM instruction set suitable for embedded applications. **4**

2B. In an ARM processor the data has to be copied from register to memory. Identify the instruction to perform this operation and with a neat diagram explain the data path activity for the same. **4**

2C. Discuss the use of sign extend hardware and coprocessors in ARM processor. **2**

3A. You are a part of a team assigned with the task of developing an embedded system for a given process. Discuss any 5 operational quality attributes of an embedded system which are necessary to ensure the quality and proper functioning of an embedded system. **5**

3B. Assume at a given time, ARM processor is running in user mode. After some time a fast interrupt request occurs by the external device attached to ARM processor. Describe the steps involved when an exception occurs and also the steps to return to user mode. **3**

3C. Define EMI and EMC. What are the main elements of EMC? **2**

4A. Three processes with process IDs P1, P2, P3 with estimated completion time 8, 5, 7 ms and priorities 1, 3, 2(0-highest priority, 3-lowest priority) respectively enters ready Q together. A new process P4 with estimated completion time 5ms and priority 0 enters the 'Ready' Q after 4ms execution of P1. Calculate the waiting time and Turn Around Time (TAT) for each process. Also calculate the average waiting time and average TAT (Assuming there is no I/O waiting for the processes) in priority based preemptive and non-preemptive scheduling algorithm. Critically evaluate the results obtained for pre-emptive and non-pre-emptive scheduling and write the inference. **6**

4B. Define the terms scheduling and scheduler. Discuss the criteria's to be considered during scheduling procedure. **2**

4C. In a manufacturing unit it is important to maintain the temperature within a predefined range. A setup is made for monitoring the temperature with the help of 8051 microcontroller. The pin P2.3 of 8051 microcontroller represents an incoming signal from the temperature sensor unit. If this pin gives high, it indicates that the manufacturing unit is hot. Monitor this pin condition continuously and whenever it goes high, blink an LED connected to pin P1.5 to draw the attention of the supervisor. **2**

5A. A 8051 microcontroller is used to monitor a pressure sensor unit continuously. 8051 is connected to 8255 to expand the pins availability. The sensor unit is connected to Port A of 8255 as shown in Fig.Q5A. A storage device is connected to Port B of 8255. Data must be continuously received from temperature sensor and must be sent to this storage device for further processing. Compute the I/O port addresses assigned to ports A, B, C and control register of 8255 and also write an embedded c program to perform this action. **4**

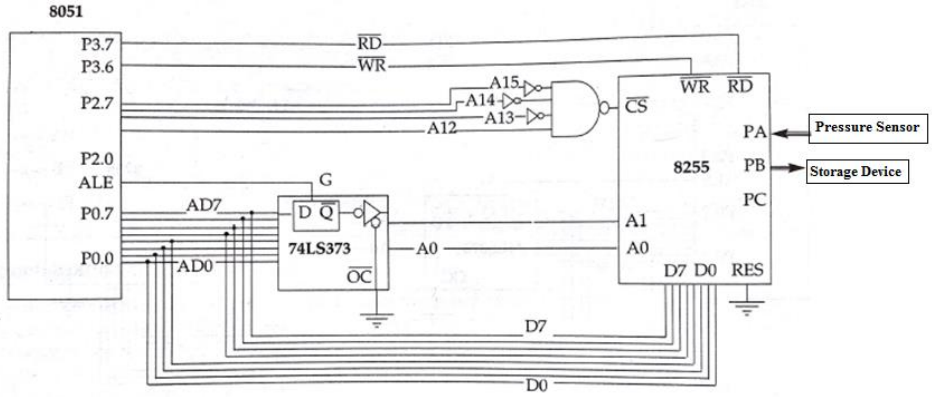

Fig. Q5A

5B. Explain all the bits and modes of Current Program Status Register of ARM with the help of a bit diagram. **3**

5C. Design an embedded system for 'automatic teller machine (ATM)' using the Finite State Model (FSM) model. **3**

i) The transaction is initiated by inserting the card.
ii) After inserting the card user needs to enter the pin number.
iii) If wrong pin is entered, transaction is canceled and card gets ejected.
iv) If correct pin is entered, machine will ask for the amount of money to withdraw.
v) After entering the specified amount, if sufficient amount is present, machine will display to collect the cash. Once the transaction is complete the card gets ejected.
vi) If sufficient amount of cash is not present, a message will be displayed and transaction is canceled and card gets ejected.