| Reg. No. |  |  |  |  |  |  |
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## VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, NOV 2019

## SUBJECT: MECHATRONICS SYSTEM DESIGN [MTE 4101]

15/11/2019

## Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

Answer **ALL** the questions.

✤ Data not provided may be suitably assumed

| 1A.          | Illustrate the performance design metric of an embedded system.   |   | CO1 |
|--------------|---|---|-----|
| 1 <b>B</b> . | • With proper explanation, sketch the design trade off of an embedded system.   |   | CO1 |
| 1C.          | C. Develop the major goals of GPS navigation system with a neat block diagram.  |   |     |
| 2A.          | Elucidate the MU0 processor with a neat diagram along with the control signals by choosing an instruction.  | 5 | CO1 |
| 2 <b>B</b> . | State the characteristics of Controller Area Network (CAN).   | 2 | CO1 |
| 2C.          | Describe how the sets of physical registers are made available in ARM7TDMI with neat sketch.  | 3 | CO2 |
| 3A.          | Elaborate the data dependency and data forwarding in 5 stage pipeline of ARM processor.   | 3 | CO2 |
| 3B.          | Compare the code density in ARM and THUMB state with an example code snippet.   | 3 | CO2 |
| 3C.          | Classify the instruction sets available in ARM7TDMI processor with an instruction format.   | 4 | CO2 |
| 4A.          | Implement the following C code using ARM assembly language assuming that data c[i] is stored in the memory 0x20000000 onwards and x[i] is stored in the memory location 0x20001000 onwards. Choose N=10. Also, store the result in the memory location 0x20002000.<br>for (i=0, f=0; i <n; i++)<br="">f = f + c[i]*x[i];</n;> | 3 | CO2 |

| 4B. | Explain the process when ARM encounters coprocessor instruction with a neat timing diagram.   | 4 | CO2 |
|-----|---|---|-----|
| 4C. | <ul> <li>Write a complete ARM assembly program such that:</li> <li>a. It will contain an array (starting from memory address 0x2000000) that will be filled with the ASCII representation of the characters in the string "Mechatronics System Design".</li> <li>b. Write this array in reverse order to the memory addresses starting from 0x200000100 by using the "offset with pre-indexing write back".</li> </ul>  | 3 | CO2 |
| 5A. | <ul> <li>Write an mbed code to implement the following.</li> <li>A keyboard is interfaced to mbed LPC1768 via USB protocol to control the speed of DC motor as follows: <ul> <li>a. When '+' is pressed, the speed of the motor increases by 10%, however the maximum speed is limited by 3.3V supply voltage.</li> <li>b. When '-' is pressed, the speed of the motor decreases by 10%, however the minimum speed is limited by the 0V.</li> <li>c. When 'r' is pressed, the motor rotates in the reverse direction with the same speed.</li> <li>d. When 's' is pressed, the motor stops rotating and switches on the light connected via relay.</li> </ul> </li> <li>Assume that the DC motor is connected to mbed through L293 motor driver IC to the pins p21 and p22. A relay is connected to the pin p23.</li> </ul> | 3 | CO3 |
| 5B. | <ul> <li>Write an embedded C program to interface the keyboard and DAC in LPC1768 (P0.26 pin) that generates analog signal with the maximum amplitude of 3.3V, minimum of 0V, and 10 bit DAC resolution.</li> <li>a. When the switch connected to port pin P1.14 is pressed, the sine wave is generated.</li> <li>b. When the switch connected to port pin P1.15 is pressed, the triangle waveform is generated.</li> <li>c. When the switch connected to port pin P1.16 is pressed, the square wave is generated.</li> </ul>   | 3 | CO3 |
| 5C. | Develop an mbed code to implement the following car parking application. In a prototype car parking system, an LDR sensor (installed at the rear end of car) is used to measure the distance between a car and wall which contains the light source. As the car approaches the wall, a voltage divider circuit constructed using LDR and potentiometer provides lower value. A buzzer is installed in the car to indicate the distance between the wall and car. The frequency of the buzzer keeps increasing as the car approaches towards the wall. If the distance is very small, the car stops moving. Assume LDR voltage is provided to p20, buzzer is connected to p21, 2 car wheels are connected to p22 and p23 respectively.   | 4 | CO3 |