

MANIPAL INSTITUTE OF TECHNOLOGY

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2017

SUBJECT: MECHATRONICS SYSTEM DESIGN [MTE 4101] (16/11/2017)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer All the questions.
- ✤ Missing data may be suitable assumed.
- 1A. Encoder values for five robotic arm positions are stored in memory locations starting from 4 0x8000 (reflect this in your code). Write an ARM Assembly Language Program to check 3 if the array contains a value 0x00000050. If the value is present, store 0x000000FF in register R7, else, store 0x00000000 in register R10. Use suitable directives to segregate code memory and data memory.

1B. Describe briefly the following structural units present in a processor. 4 (i) Instruction Register 1 (ii) Data Cache 1 (iii) Atomic Operation Unit 1 (iv) Memory management Unit 1

1C. Illustrate the concept of data dependency in pipelining. How can this issue be resolved?
2
2A. For the following conditional C code, construct an ARM assembly level program:
3 if (a < b)

```
{

x = 5;

y = c + d;

}

else

{

x = c - d;

}
```

Assume a, b, c and d are stored in Registers R1, R2, R3 & R4 respectively. Store results x, y in memory locations.

2B. Cite any four differences between the ARM and Thumb instruction set. When is Thumb 3 code preferred over ARM code?2

2C.	Elucidate the following architectural elements of the ARM Cortex M3 controller (i) Nested Vector Interrupt Controller (ii) Embedded Trace Macrocell (iii) Memory Processing Unit (iv) Thread & Handler modes	4 2
3A.	 A switch is connected to pin P5 of an LPC1768 controller. Write a high level program (C++ program) to perform the following task at the pin P18: If the switch is high, generate a square wave of peak to peak 2V, frequency 1 KHz, 50% duty cycle. If the switch is low, generate a triangular wave of 1V peak to peak. 	4 3
3B.	What is meant by multiprocessing? Explain the terms SIMD & MIMD with respect to a multiprocessor. List the advantages of multiprocessing.	4 4
3C.	In an ARM processor, identify the factors affecting the total time of execution of a program and relate them. Suggest different ways to improve the performance.	2 2
4A.	A CCTV camera's movement (0 to 180°) is to be controlled by LPC1768 via serial communication using USB protocol. The position control of the servo motor (connected at pin P21) is done by taking inputs serially from a keyboard. Pressing a specific character rotates the camera in a specific direction as follows: 'M' – Middle, 'L' – Full Left, 'R' – Full Right. Develop an mbed program to perform this task.	3 3
4B.	Why are coprocessors necessary? Justify this with an example. Also, trace the actions taking place when ARM encounters a coprocessor instruction.	4 2
4C.	Write short notes on Microwire protocol. Also explain the term 'Baud Rate' with respect to serial communication.	3 1
5A.	Why is design methodology important for a given embedded system? Describe any six metrics used to optimize the challenges faced in the design of an embedded system.	4 1
5B.	Prior to execution of a particular ARM program the following are the data stored in specified registers and memory locations: R0 = 0x00000000 ; R1 = 0x00090000 mem 32 [0x00009000] = 0x01010101; mem 32 [0x00009004] = 0x02020202 Find the contents of registers R0 and R1 after execution, for each of the following instructions given. (i) LDR R0, [R1, #4] (ii) LDR R0, [R1], #4 (iii) LDR R0, [R1, #4]!	32
5C.	With suitable examples, describe following ARM instructions.(i) STMIA R1, {R0, R2, R4}	3 2

- (ii) SWP R0, R1, [R2]
- (iii) MOVEQ R1, #10