Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

V SEM B. Tech (BME) DEGREE END SEMESTER EXAMINATIONS, DEC-2020/JAN-2021.
SUBJECT: MICROCONTROLLER BASED SYSTEMS (BME 3154)
(REVISED CREDIT SYSTEM)
Wednesday, 6th January, 2021; 2:00 P.M to 5:00 P.M

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer ALL questions**
2. **Draw diagrams wherever necessary**
3. **Missing data may be suitably assumed**

1. (A) It is required to have 6KB of ROM and 8KB of RAM in an 8051 microcontroller system. Using a full address decoder design a memory interface such that, the external ROM is in continuation with the on-chip ROM. Draw the interface diagram and memory allocation table. 5

   (B) Analyze the following source program written for the 8051 microcontroller, and answer the following questions: 3
   (i) What is the function carried out by the program?
   (ii) List the bugs, if any.
   (iii) Make the program readable.

```
START:  MOV A, #FFH
UP2:    MOV B0H, A
        MOV A, B0H
        MOV F0H, A
        MOV R0, A
        XRL A, E0H
        MOV R7, A
UP:     ADD A, F0H
        DA A
        JNC DOWN
        PUSH E0H
        MOV A, R7
        ADD A, #01
        DA A
        MOV R7, A
        POP E0H
DOWN:   PUSH E0H
        MOV A, R0
        ADD A, #99
        DA A
        MOV R0, A
        JZ DOWN1
        POP E0H
        SJMP UP
DOWN1:  POP E0H
        MOV 90H, A
        MOV R5, #0AH
UP1:    NOP
        DJNZ R5, UP1
        MOV E0H, R7
        MOV 90H, A
        LJMP UP2
```

(C) Why is it required to externally pull-up only Port 0 of the 8051 microcontroller? Justify your answer with appropriate circuit schematics. 2

2. (A) In an 8051 microcontroller system, two 8-bit Binary numbers are available in the external data memory locations 8000H and 8001H. Develop a logic and assembly language program to multiply the numbers without using the "MUL AB" instruction, and to send the product to the Ports P1:P0. Make the result available in the ports for 10 Seconds. 5

(B) Is it possible to control timers/counters of the 8051 using a hardware Interrupt? Justify your answer with an illustration. 3

(C) How do you realize separate 64 KB of ROM space and 64 KB of RAM space in the 8051 microcontroller system? Illustrate. 2

3. (A) Develop a memory efficient assembly language program for the 8051 microcontroller to separate even and odd elements present in an array of 2-digit BCD numbers. The source array begins at address 1000H and contains 200 elements. Store the sorted arrays containing even and odd elements at 2000H and 3000H respectively. 5

(B) Implement the "PUSH" & "POP" operations of the ARM Cortex-M3 microcontroller using the "STM" & "LDM" instructions. 3

(C) One Common anode seven-segment display is connected to Port-1 of the 8051 microcontroller, and the hardware connection is as follows: 2

Port pin	P1.7	P1.6	P1.5	P1.4	P1.3	P1.2	P1.1	P1.0
Segment	a	b	c	d	e	f	g	dp

Construct Seven-segment codes for displaying "A", "S", "9", and "P" in the seven-segment display.

4. (A) Making use of an optical sensor and hardware interrupt $\overline{INT0}$ of the 8051 microcontroller, develop a hardware for product counter capable of counting up to 9999 products, and write an appropriate program for the system such that the count is updated in P1 of the 8051. 5

(B) Making use of Timer-0 of the 8051 microcontroller, generate a delay of 0.5mS. Assume F_{OSC} = 11.0592 MHz 3

(C) How to de-multiplex the multiplexed address or data bus of the microcontroller 8051? Illustrate. 2

5. (A) Design a waveform generator using the 8051 microcontroller, and using the designed system, generate the periodic waveform shown in Fig. 1.0. 5

(B) Implement an "IF-THEN" block for the ARM Cortex-M3 microcontroller to carry out the following function: 3

```
if (R0 equal to R1)
 then
 {R3 = R4 + R5
  R3 = R3/2}
 else
 {R3 = R6 + R7
  R3 = R3/2}
```

(C) How to switch between Main Stack Pointer and Process Stack Pointer in the ARM Cortex-M3 microcontroller core? Illustrate. 2

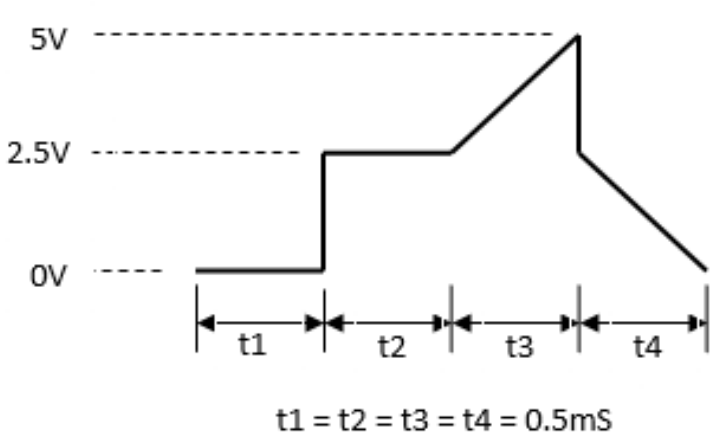

Fig. 1.0