Name:

Exam- 1 **Time : 100 minutes**

Questions 1 to 10 -1 mark each **(10 points)**

1. ADD and SUB instructions use __R____ instruction format type.

2. Which is a decision-making Instruction
   a. ADD
   b. LDRB
   c. CBZ
   d. UDIV

3. Flag that denotes Overflow is
   a. Z
   b. V
   c. N
   d. C

4. In ARM architecture which Register represents a Program Counter
   a. R12
   b. R13
   c. R14
   d. R15

5. _____ directives are used to initialize operands.

   a) INT
   b) DATAWORD
   c) RESERVE
   d) DCD

6. Memory can be accessed in ARM systems by _____ instructions.
   i) Store ii) MOVE iii) Load iv) arithmetic v) logical

   a) i,ii,iii
   b) i,iii
   c) i,iv,v
   d) iii,iv,v

7. ARM stands for _____
   a) Advanced Rate Machines
   b) Advanced RISC Machines
   c) Artificial Running Machines
   d) Aviary Running Machines

8. Each instruction in ARM machines is encoded into ____ Word.

   a) 2 byte
   b) 3 byte
   c) 4 byte
   d) 8 byte

9. The BEQ instructions is used _____
   a) To check the equality condition between the operands and then branch
   b) To check if the Operand is greater than the condition value and then branch
   c) To check if the flag Z is set to 1 and then causes branch
   d) None of the mentioned

10. A bench mark program in computer A takes 6s to run, and in computer B it takes 13s. Computer _____ is fastest by __A – 2.17_____ .

11. A program runs in 150 seconds. Multiply operations are responsible for 50 of those seconds. If extensive designer effort is applied such that multiply operations are made to run 2 times faster, what is the program's new execution time? **(2 Points)**

Execution time after improvement= $\frac{\text{Execution time affected by improvement}}{Amount\ of\ improvement}$ + Execution time unaffected

= 50 /2 +100 = 125 sec

12. If R2 has the memory address 1004, R3 has 10, and memory locations 1000, 1004, and 1008 have 20, 40, 10 respectively, what do those locations have after the following instruction? **(2 points)**

```
ADDI   R3, R3,#2
STR    R3, [R2, #4]
```

20,40,12

13. Assume that the flags are all initialized to 0 and instructions are sequential. For every instruction separately write the value in the destination register and the flags for each instruction: **(2 points)**

```
ADDS    r2,r2,#12
MOV     r4,r2,LSL #1
TEQ     r4,#64
BICEQ    r4,#0xF5
```

r2	r4	N	C	Z	V
12	0	0	0	0	0
12	24	0	0	0	0
12	24	0	0	0	0
12	24	0	0	0	0

14. Write the register values after each instruction in the below code. **(4 points)**

```
MOV r0, #0x11
MOV r1, #0x10
LSL r1, r1, #1
LSL r2, r0, #1
```

r0	r1
0x11, 17	0
0x11, 17	0x10, 16
0x11, 17	0x20, 32
0x11, 17	0x20, 32

R2: 0x22, 34

15. Assume R0 holds the value 0000000000111111. What is the value of R8 after the following instructions? **(4 points)**

```
    CMP R0,#0
    BGE els
    B DONE
els
    AND R8,R0,#5        101 or  #5
DONE
```

16.

a. Load 2 integer values 3 and 4 in registers R1 and R2 respectively. Write a program to add the numbers if R1 > R2 and subtract R1 from R2 if R2 > R1. **(5 points)**

b. Write an ARM assembly program to swap two numbers in registers R4 and R5 without using a third register. **(5 points)**

Discussed in class already

17. Translate the following loop into C (or pseudo code). Assume that the C-level integer **"i" is** held in register R3, R2 holds the C-level integer called "**result**", and R0 holds the base address of the integer in memory. **(6 points)**

```
LOOP
    LDR R1,[R0,#0]
     ADD R2,R2, R1
     ADD R0,R0,#8
     ADD R3,R3,#1
     CMP R3,#50
     BLE   LOOP
```

```
do{
result += MemArray[i];
i =i+2;
}while(i < =50);
```

18. Implement the following high-level code in ARM assembly language. Assume that the labels represent memory locations. Also write code to allocate memory for the given labels: **(10 points)**
Discussed in class already

(a)
```
int c = 5;
while (c > count)
{
 c - -;
}
```

(b)
```
if (cost > givenValue)
{
  display = cost * 2;
}
else
{
  display= cost * 2 + surcharge;
}
```
Initialize:
```
cost:20
givenValue:12
surcharge:3
display:0
```

Questions 19 and 20 show formula applied and show your calculations step by step for full points

19. Consider two different processors P1 and P2 executing the same instruction set. P1 has a 4 GHz clock rate and a CPI of 2. P2 has a 3 GHz clock rate and a CPI of 1. Which processor has the highest performance expressed in instructions per second? (**10 points**)

$$InstructionperSecond = \frac{ClockRate}{CPI}$$

P1: 4GHz / 2 = 2×10^9 instructions per second
P2: 3GHz / 1 = 3×10^9 instructions per second

So P2 has the highest performance

20. Consider the following performance measurements for a program: **(10 points)**

Measurement	Computer A	Computer B
Instruction count	12 billion	10 billion

Clock rate	2 GHz	4 GHz
CPI	1.5	1

Which computer has the higher MIPS rating?
Which computer is faster for that program?

a) MIPS(A)= $\frac{\text{Clock Rate}}{\text{CPI } X\ 10^6} = \frac{2\times 10^9}{1.5\ X\ 10^6} = 1333.333$

MIPS(B)= $\frac{\text{Clock Rate}}{\text{CPI } X\ 10^6} = \frac{4\times 10^9}{1\ X\ 10^6} = 4000$

Higher MIPS for B

b) CPU Time (A) = $\frac{Instruction\ Count \times CPI}{Clock\ Rate} = \frac{12\times 10^9 \times 1.5}{2\times 10^9} = 9\ Sec$

CPU Time (B)= $\frac{Instruction\ Count \times CPI}{Clock\ Rate} = \frac{10\times 10^9 \times 1}{4\times 10^9} = 2.5\ Sec$

B is faster