

The University of Alabama in Huntsville
Electrical and Computer Engineering Department
CPE 221 01
Test 1
September 27, 2018

This test is closed book, closed notes. You may not use a calculator. You should have the 6 page ARM Instruction Reference. You must show your work to receive full credit.

Name: _____

1. (1 point) A _____ consists of 8 bits.
2. (1 point) A _____ logic element is a circuit whose output depends only on its current inputs.
3. (1 point) An AND gate has a controlling value of _____.
4. (1 point) The symbol for an inverter is _____.
5. (1 point) The ARM processor has _____ registers.
6. (10 points) Convert decimal +327 and +456 to binary, using the signed-2's complement representation and enough digits to accommodate the numbers.
7. (3 points) What is the decimal equivalent of 11001100_5 (assume positional notation and unsigned integer formats)?

8. (12 points) If $r1 = 0x000F\ 0FFF$ and $r2 = 4$, what is the value of $r0$ after each of the following instructions has been executed? Assume that each instruction uses the same data.

(a) `ADD r0, r1, r1, LSL #9`

(b) `ADD r0, r1, r1, ROR #5`

(c) `ADD r0, r1, r1, LSR r2`

9. (10 points) For each of the following operations on 6 bit signed numbers, calculate the values of the C, Z, V, and N flags

(a) $101111 + 001101$

(b) $110011 + 001001$

10. (15 points) For each of the following cases,
1. Explain the effect of each of the following instructions using register transfer notation.
 2. Give the value in `r2` after each instruction executes.
 3. Give the value of the effective address.
- Assume that `r2` contains the initial value `0xFF001110` and that `r0` contains `0xFFFF 8700`. Use these initial values for each instruction individually.

(a) `LDR r1, [r2]`

Register Transfer _____
r2 _____
Effective Address _____

(b) `STR r1, [r2, #2_1101]`

Register Transfer _____
r2 _____
Effective Address _____

(c) `LDR r1, [r2, #0x2C]!`

Register Transfer _____
r2 _____
Effective Address _____

(d) `STR r1, [r2], #-4`

Register Transfer _____
r2 _____
Effective Address _____

(e) `LDR r1, [r2, r0, ASR #3]`

Register Transfer _____
r2 _____
Effective Address _____

11. (25 points) Consider the following ARM program. Trace the values of the registers shown as they change during program execution. Also, trace the writes to memory by the STR instructions. There may be unused columns or rows in the tables. If you need to add columns or rows, you may do so. DCD 1 reserves one word of storage and sets it equal to 1. SPACE 3 reserves 3 bytes of memory but does not give those bytes a value.

```

                AREA  PROB_11, CODE, READONLY
                ENTRY
0               ADR    r0, x
4               ADR    r1, y
8               ADR    r2, z
12              LDR     r3, size
16              LDR     r4, i
20      loop    CMP     r4, r3
24              BGE     done
28              LDR     r5, [r0], #4
32              LDR     r6, [r1], #4
36              CMP     r5, r6
40              STRGT   r5, [r2], #4
44              STRLE   r6, [r2], #4
48              ADD     r4, r4, #1
52              B       loop
56      done    B       done
60      x       DCD     100, 3, -1, 2, 4, 4
84      y       DCD     -53, 247, 95, -7, 481, 91
108     z       SPACE   24
132     i       DCD     0
136     size    DCD     6
                END

```

r0																	
r1																	
r2																	
r3																	
r4																	
r5																	
r6																	

Results of the STR instruction.

Memory Address	Contents

