Information Technology University, Lahore, Pakistan

BS Computer Engineering

Digital Logic Design

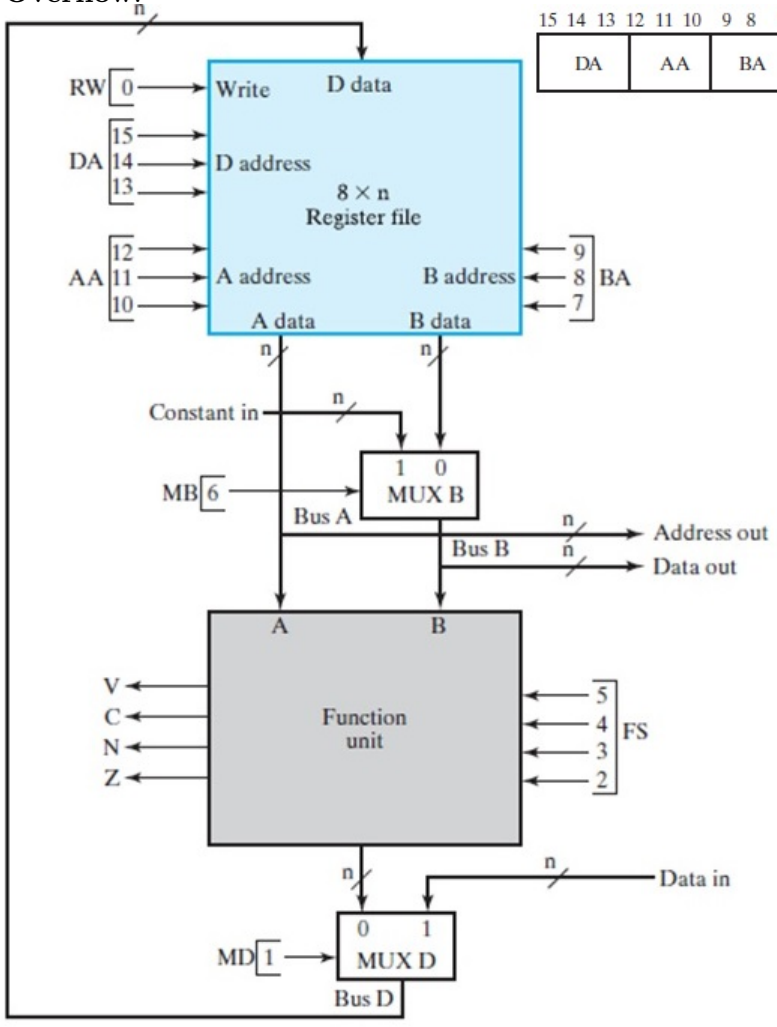
Quiz# 1, Spring 2025

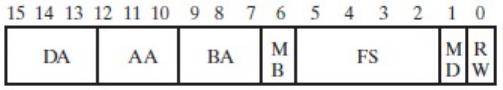
Tuesday January 28, 2025

Name: _____ Roll Number: _____

Maximum Time Allowed: 20 minutes Maximum Marks: 10

Assume that Register file (shown below) comprises of eight 4-bit registers, R0, R1, ..., R7. One of the registers is selected as the destination register based on 3-bit control input **DA** (bits 13, 14, 15). None of the registers is selected as destination if bit0 (the RW bit) is 0. Bits 10, 11, 12 are used to select first source register and bits 7, 8, 9 are used to select second source register. The control word and its complete encoding scheme is also shown. **Z, N, C** and **V** are the single bit flip-flops for **Zero, Negative, Carry** and **Overflow**.





Encoding of Control Word

DA, AA, BA		MB		FS	
Function	**Code**	**Function**	**Code**	**Function**	**Code**
$R0$	000	Register	0	$F = A$	0000
$R1$	001	Constant	1	$F = A + 1$	0001
$R2$	010			$F = A + B$	0010
$R3$	011			$F = A + B + 1$	0011
$R4$	100			$F = A + \overline{B}$	0100
$R5$	101			$F = A + \overline{B} + 1$	0101
$R6$	110			$F = A - 1$	0110
$R7$	111			$F = A$	0111
				$F = A \wedge B$	1000
				$F = A \vee B$	1001
				$F = A \oplus B$	1010
				$F = \overline{A}$	1011
				$F = B$	1100
				$F = \text{sr } B$	1101
				$F = \text{sl } B$	1110

MD	
Function	**Code**
Function	0
Data in	1

RW	
Function	**Code**
No Write	0
Write	1

Block diagram of a simple **Arithmetic and Logic Unit with Register file**.

Initial values of the registers are shown in the first row in the table below.

1. Write down the 16-bit control words (**in hexadecimal**) for the given sequence of operations in the table.
2. Write down the register values (only the updated ones).
3. Show the status of flags **Z, S, C** and **N** for each operation in the given table (show only the updated ones).

Perform the following register transfer operations and fill-in the table accordingly:

1. R3 ← R1 + R2
2. R4 ← R2 − R1
3. R5 ← R5 − 1
4. R0 ← 0
5. R6 ← R1 AND R3
6. R7 ← R1/2
7. R3 ← M[6]

Operation	**Control Word**	**R0**	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**Z**	**S**	**C**	**V**
Initially	-	10	5	2	-4	4	3	1	-8	0	0	0	0
1													
2													
3													
4													
5													
6													
7													
8													
9													