Information Technology University of the Punjab
SE201T Digital Logic Design – Fall 2024
Assignment 3 [CLO3]

Deadline: 7th December, 2024 (11:59 p.m) (Online on GCR) **Total Marks: 20**

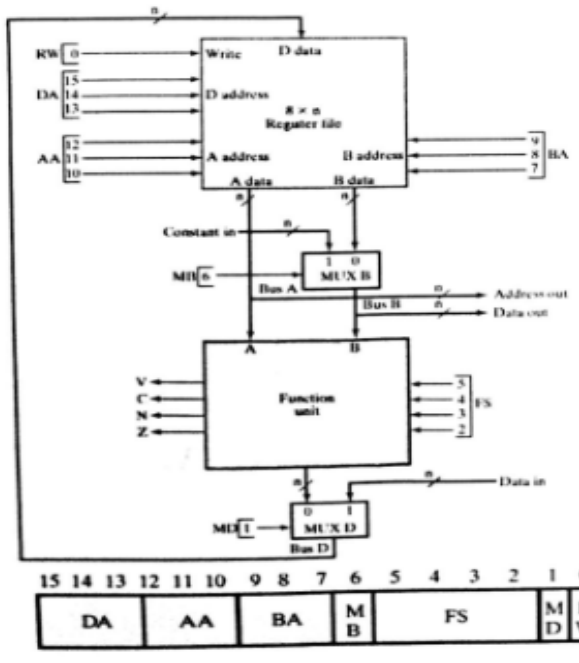
Instructions:

1. Use A4 size sheets to prepare the solution.
2. You must attempt all questions by hand. Use an ink pen or a ball point. Word processors are not advised to prepare the solution.
3. Clearly label the start of all questions and their parts. Also, make sure to highlight the final answer in each part.
4. This is an individual assignment so every student must submit their own solution.
5. You can take help from the textbook/reference books. Discussion among peers without showing the solution is acceptable, but you must attempt individually. Plagiarism, if found, will be dealt with according to the ITU anti-plagiarism policy.
6. Make sure to submit it by the deadline. Late submissions will not be accepted in any case.

Q1 [Control Word and DataPath] **[20]**

1. A block diagram of a datapath is shown below. It has a register file with eight registers, R0 through R7. The register file provides the inputs to the function unit through Bus A and Bus B. MUX B selects between constant values on Constant in and register values on B data. The ALU and zero-detection logic within the function unit generate the binary data for the four status bits: V (overflow), C (carry), N (sign), and Z (zero). MUX D selects the function unit outPut or the data on Data in as input for the register file.
There are 16 binary control inputs. Their combined values specify a control word. The 16-bit control word is also shown. It consists of seven parts called fields, each designated by a pair of letters.
The three register fields are three bits each. The remaining fields have one or four bits. The three bits of DA select one of eight destination registers for the result of the microoperation. The three bits of AA select one of eight source registers for the Bus A input to the ALU. The three bits of BA select a source register for the 0 input of the MUX B. The single MB bit determines whether Bus B carries the contents of the selected source register or a constant value. The 4-bit FS field controls the operation of the function unit. The FS field contains one of the 15 codes from Table below. The single bit of MD selects the function unit output or the data on Data in as the input to Bus D. The final field, RW, determines whether a register is written or not. When applied to the control inputs, the 16-bit control word specifies a particular microoperation.
Specify the 16-bit control word (in binary and Hexadecimal both) that must be applied to the datapath of Figure to implement each of the following microoperations:

   (a) $R4 \leftarrow R1 + R3$
   (b) $R3 \leftarrow$ Data in
   (c) $R1 \leftarrow$ sl R4
   (d) $R3 \leftarrow 0$



Encoding of Control Word for the Datapath

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
				$F =$ sr B	1101
				$F =$ sl B	1110

MD		RW	
Function	Code	Function	Code
Function	0	No Write	0
Data in	1	Write	1