

CSE 3203 CT 4 Assignment
Roll No: 1903164

Assignment Problem:

Build CPU based on following requirements:

1. Word Size of CPU = 3 bit
2. ALU Operations = ADD, OR, ROL
3. Register Number = 5
4. Size of RAM = 9
5. Word size of ISA and RAM = 18
6. CPU Instructions = JMP & JL

Solution:

<https://www.youtube.com/watch?v=Z4pHt0uK5ME>

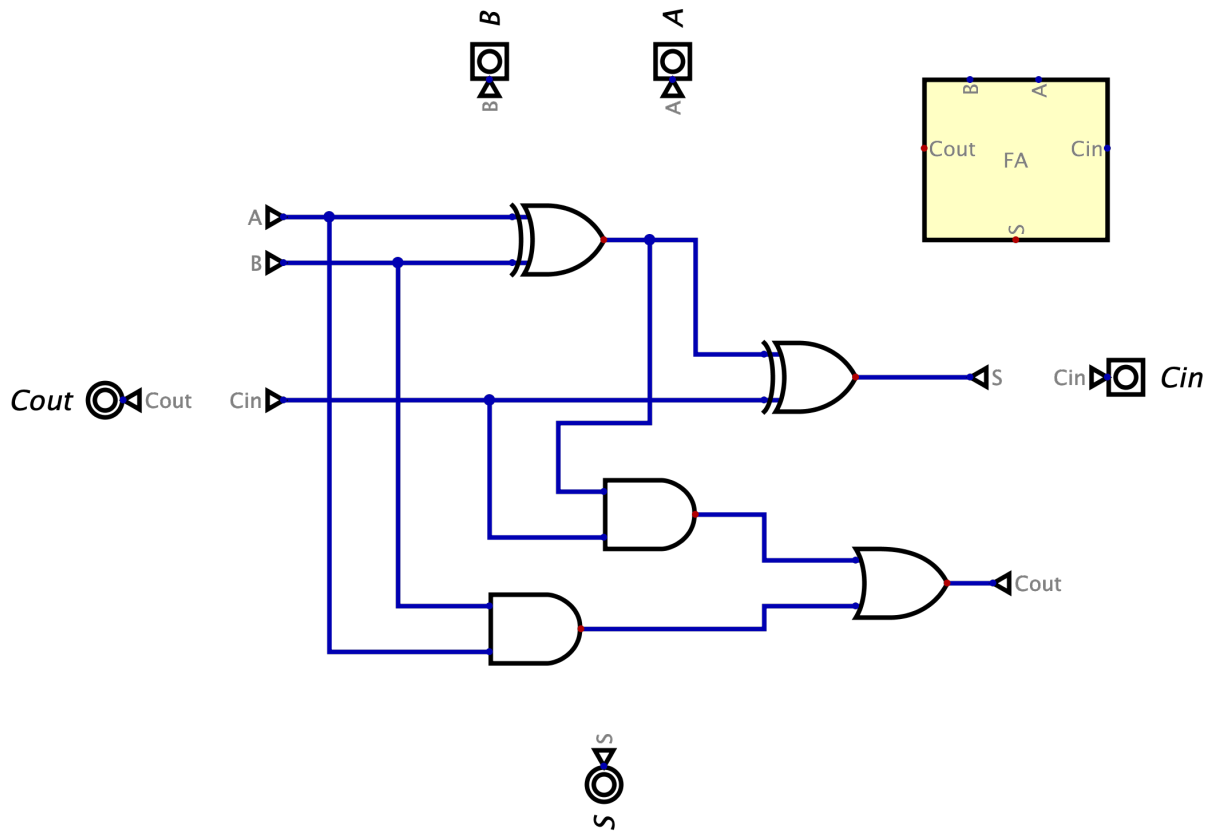
Simulator Design:

1. ALU Circuit (Show all circuits except FA circuit)(Marks 5):

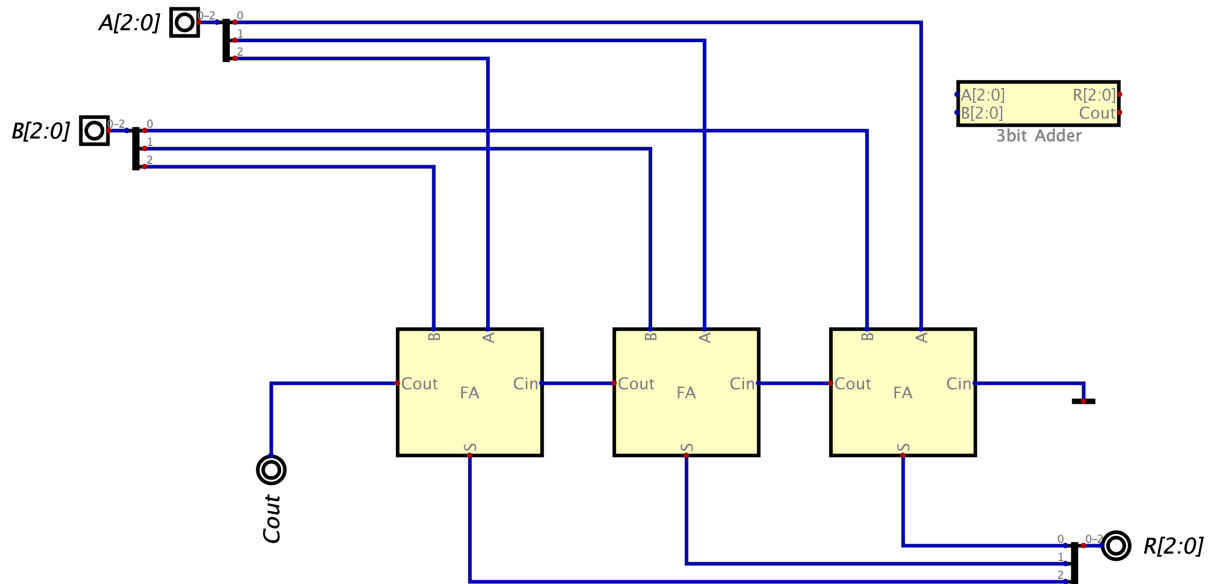
Check List:

Have you added all circuits of ALU from FA to ALU Operations Circuits (ADD, XOR, SHL etc.) to Top Level ALU Circuit?	YES
NB: Failing to add any required circuits will cause point penalty (1-2 Marks)	

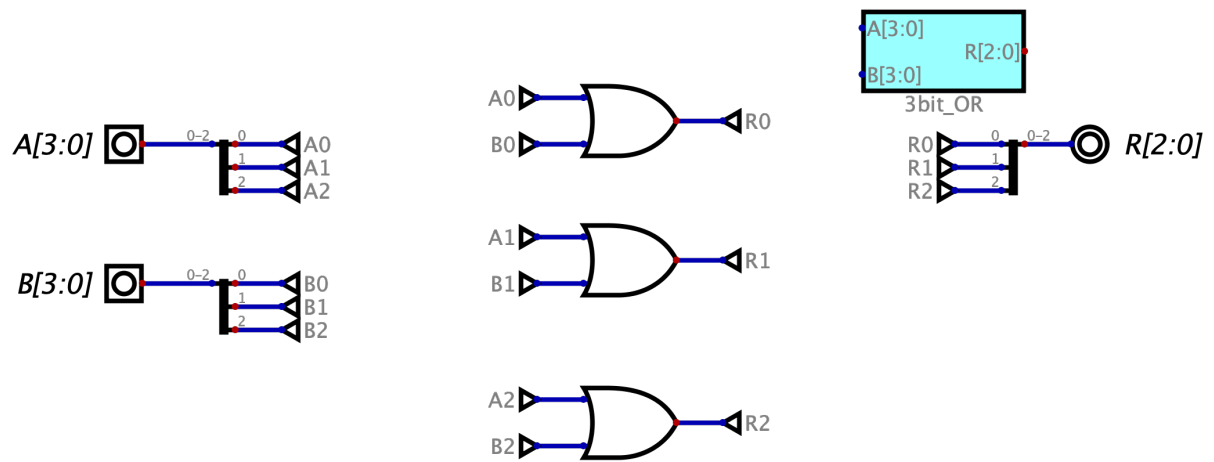
FA:



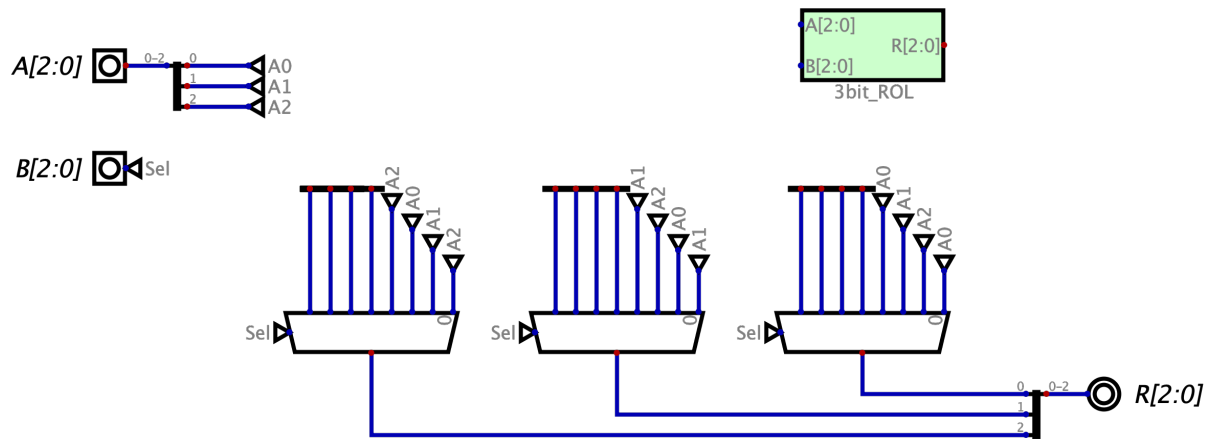
3BitAdder:



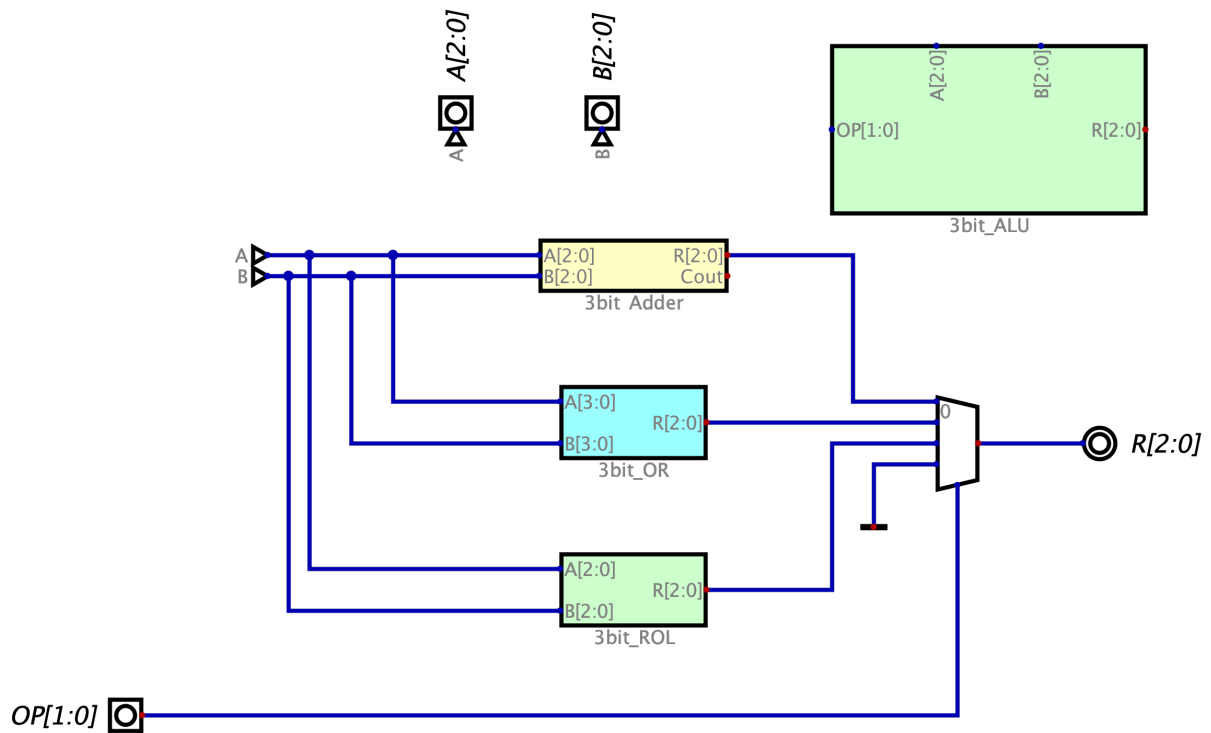
3BitOr:



3bitROL:



3BitALU:



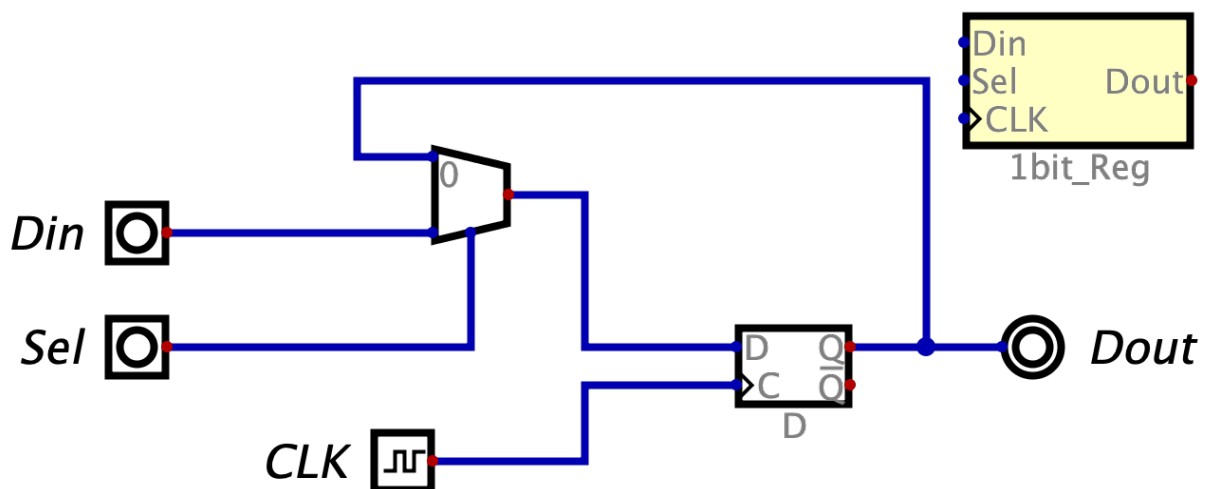
2. Register Set Circuit (Top to Bottom all circuits)(5 Marks):

Check List:

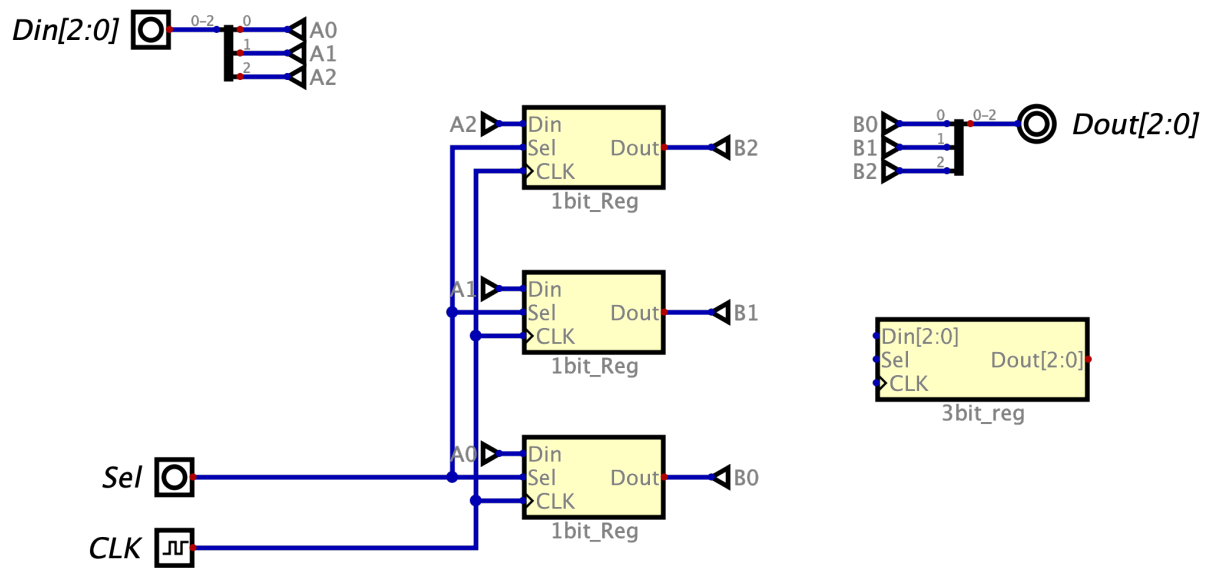
Have you added all circuits of Register Set from 1 bit Register to n bit Register to Top Level Register Set Circuit.?	YES
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NB: Failing to add any required circuits will cause point penalty (1-2 Marks)
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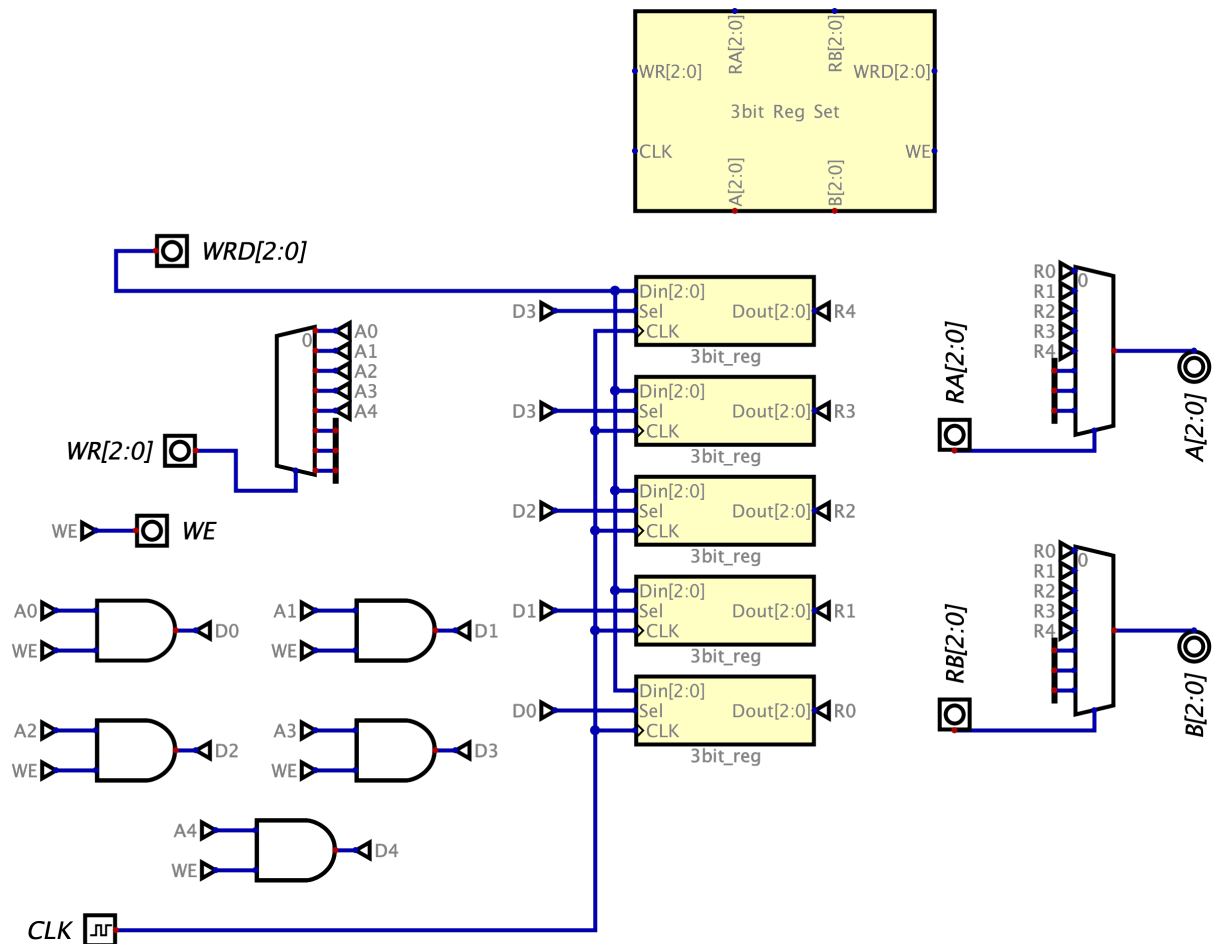
1Bit Register:



3Bit Register:



3Bit RegisterSet:



3. RAM Circuit (Top to Bottom all circuits)(5 Marks):

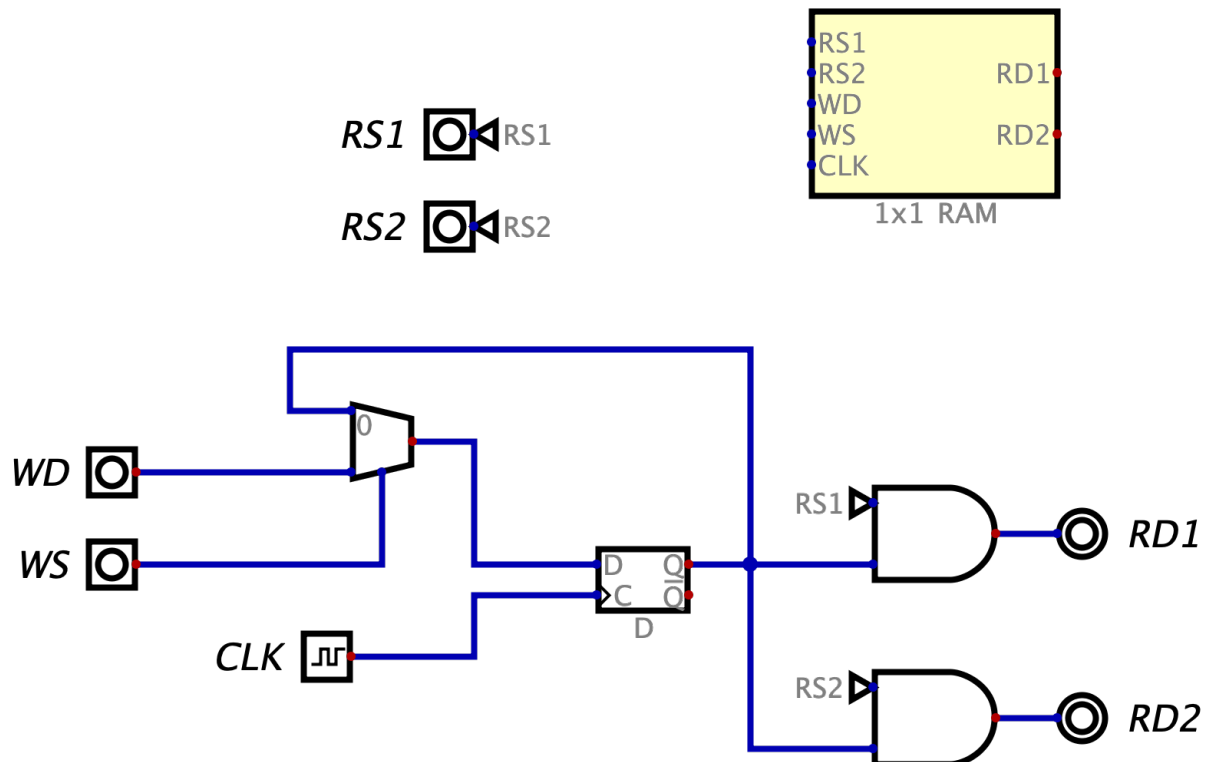
Check List:

Have you added all circuits of RAM from 1x1 RAM to 1xN RAM to MxN RAM?

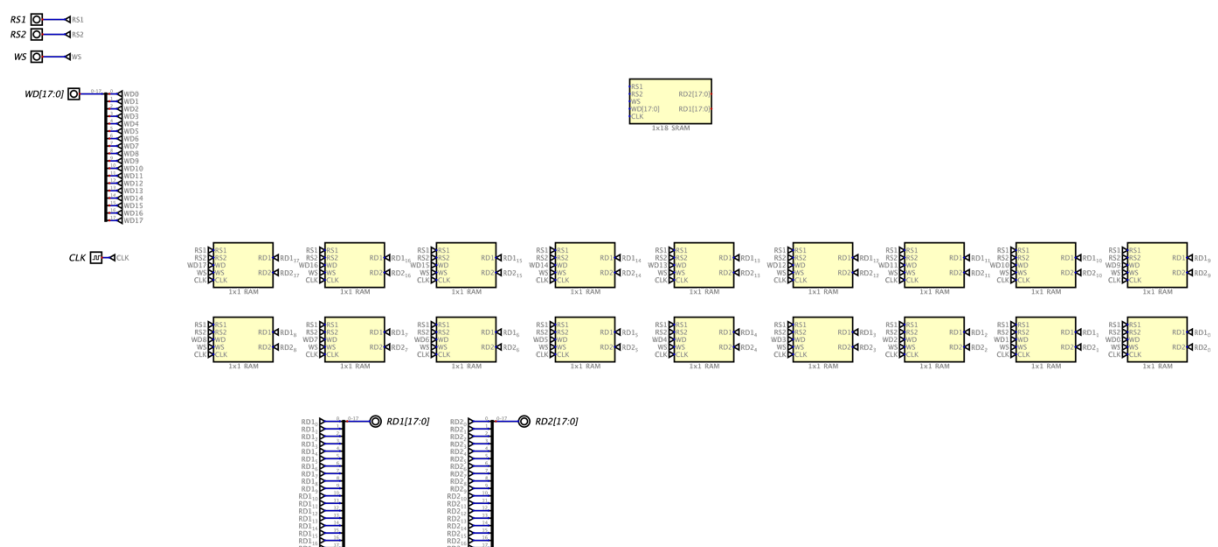
YES

NB: Failing to add any required circuits will cause point penalty (1-2 Marks)

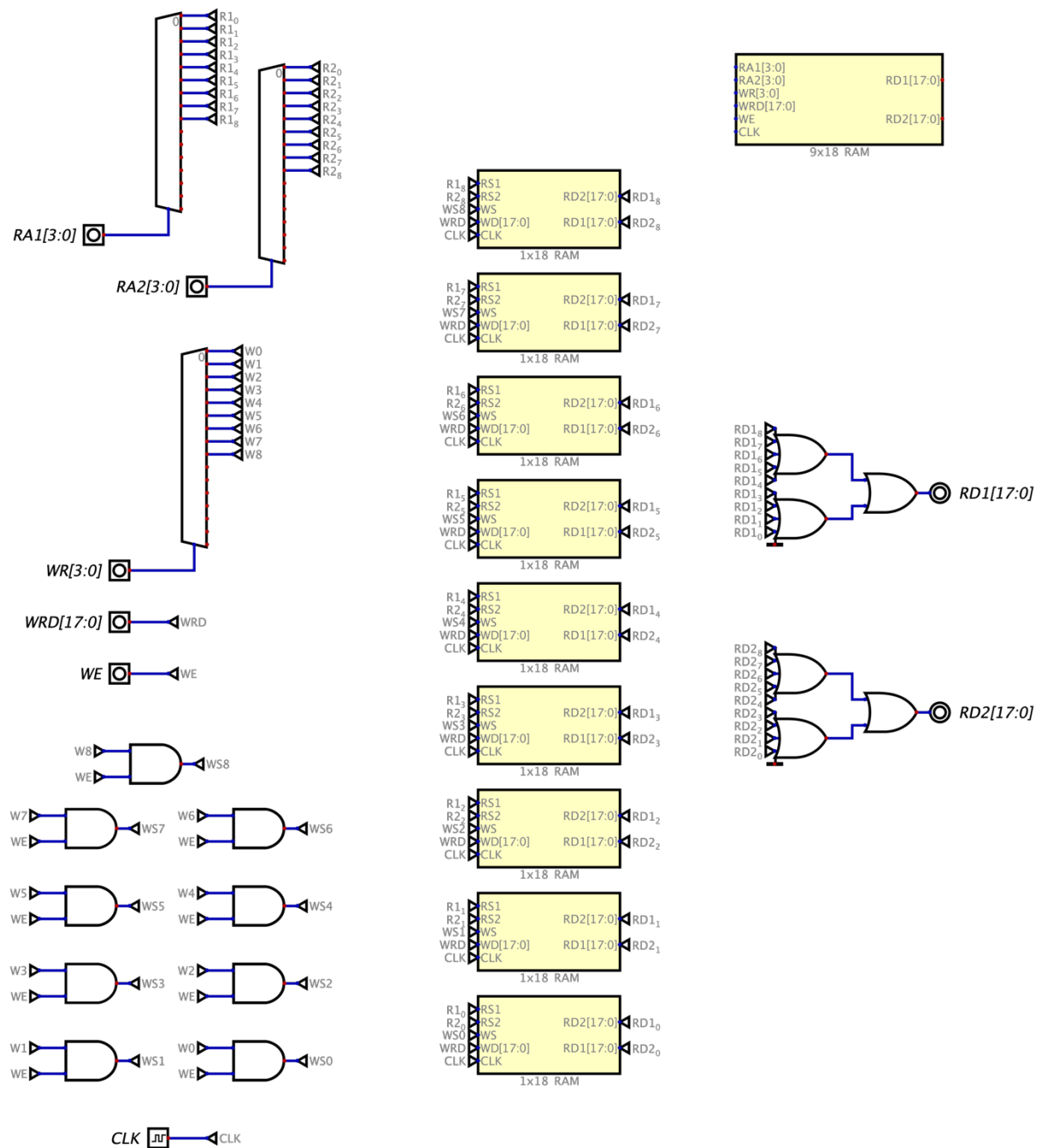
1x1 Ram:



1x18 RAM:



9x18 RAM:



Have you added all ISA of CPU along with its sample machine code to be run on CPU?	YES
NB: Failing to add any required ISA or sample code will cause point penalty (1-2 Marks)	

ISA (Register Mode):

Opcode (6 bit)		Register 1	Register 2	Unused
2 bits	2 bits	3 bits	3 bits	1 bit
Types of instruction 00	Operations (ALU selection lines) (00 – 11)	Ra (000-111)	Rb (000-111)	X

ISA (Immediate Mode):

Opcode (6 bit)		Register 1	Register 2	Unused
2 bits	2 bits	3 bits	3 bits	1 bit
Types of instruction 01	Operations (ALU selection lines) (00 – 11)	Ra (000-111)	Rb (000-111)	X

ISA (Branching Mode):

Opcode (6 bit)		Address		Unused
2 bits	2 bits	4 bits		1 bit
Types of instruction 10	Operations (ALU selection lines) 00,11,JMP & JL	Ra (0000-1111)		X

Sample Machine Code with assembly code in comments to be run on CPU (You will make a video running this machine code on CPU in order to prove that your CPU is working perfectly)

JL START ->101100010000000000

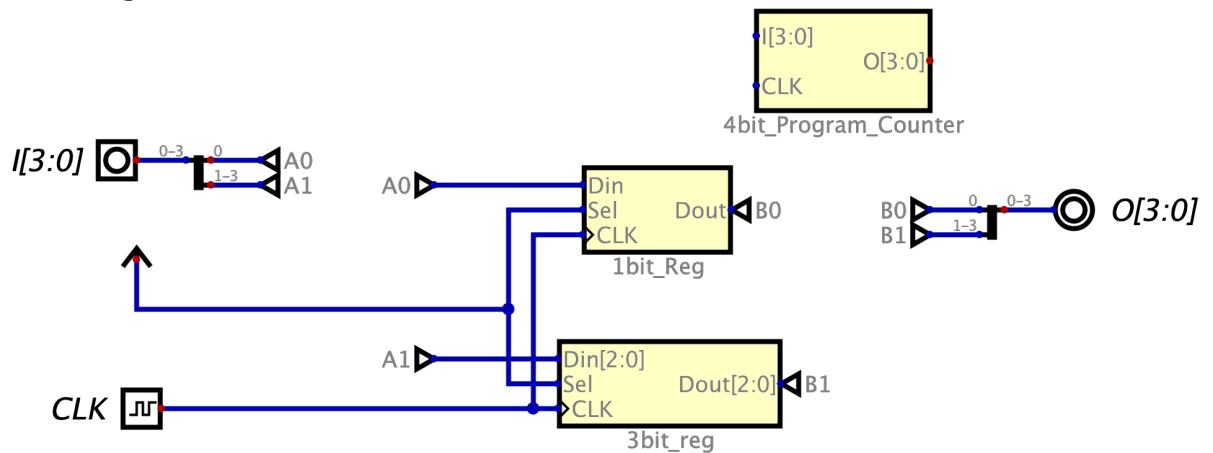
START: ROL R1,R1 ->001000100100000000
 JMP_TO: ADD R1,2 ->010000101000000000
 JMP JMP_TO ->100000100000000000

b) CPU (Top to Bottom all circuits)(3 Marks):

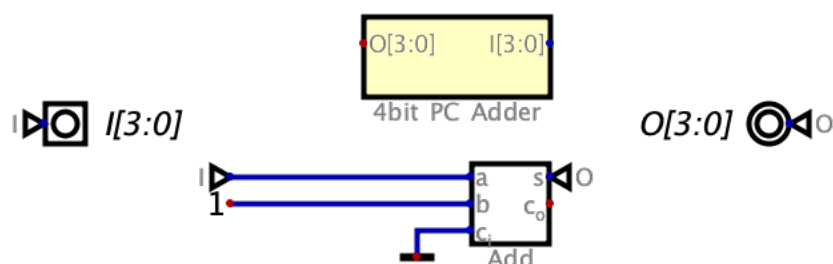
Check List:

Have you added all circuits of CPU from Program Counter to Control Unit to Top Level CPU Circuit with Output Pins showing contents of ALU, Register Set, RAM etc. (Important for CPU Verification, Check Tutorial Videos for Details)?	YES
Have you made a video running this sample machine code on the CPU (1 instruction at a time in a similar way shown in video) in order to prove that your CPU is working perfectly.	YES
NB: Failing to add any required circuits will cause point penalty (1-2 Marks) NB: Failing to add video will cause point penalty from CPU segment (3 Marks)	

4bit Program Counter



4Bit PC Adder:



3Bit CPU:

Register Mode (Type of Op = 00) = 2bit (Type of Op) + 2bit (Op) + 3bit (Reg1) + 3bit (Reg2) + 8bit (Dont Care)
 Immediate Mode (Type of Op = 01) = 2bit (Type of Op) + 2bit (Op) + 3bit (Reg1) + 3bit (Imm Value) + 8bit (Dont Care)
 Add (Op = 00), OR (Op = 01), ROL (Op = 10)
 JMP (Op = 00), JL (Op = 11)

JL START -> 101100010000000000
 START: ROL R1,R1 -> 001000100100000000
 JMP_{TO}: ADD R1,R2 -> 010000101000000000
 JMP JMP_{TO} -> 100000100000000000

