CSE 3203 CT 4 Assignment
Roll No: 1903099
Instruction: Covert this doc to PDF while uploading.

Assignment Problem:
Build CPU based on following requirements:

1. **Word Size of CPU = 5**
2. **ALU Operations = OR, ADD, ROL (2 bit)**
3. **Register Number = 4**
4. **Size of RAM = 7**
5. **Word size of ISA and RAM = 15 (7x15)**
6. **CPU Instructions = Register, Immediate, JMP, JNC**

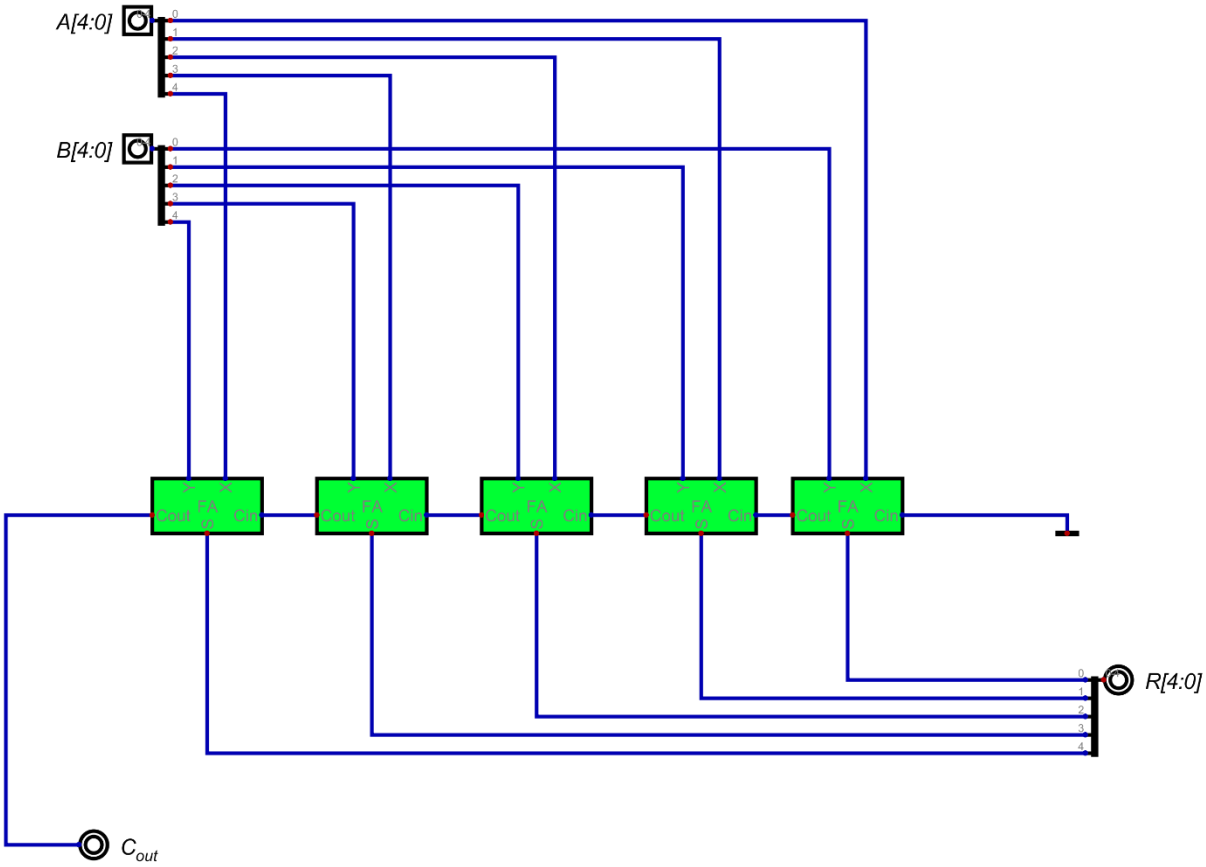
Solution:
https://youtu.be/_UUmT5XhKJ4

Simulator Design:

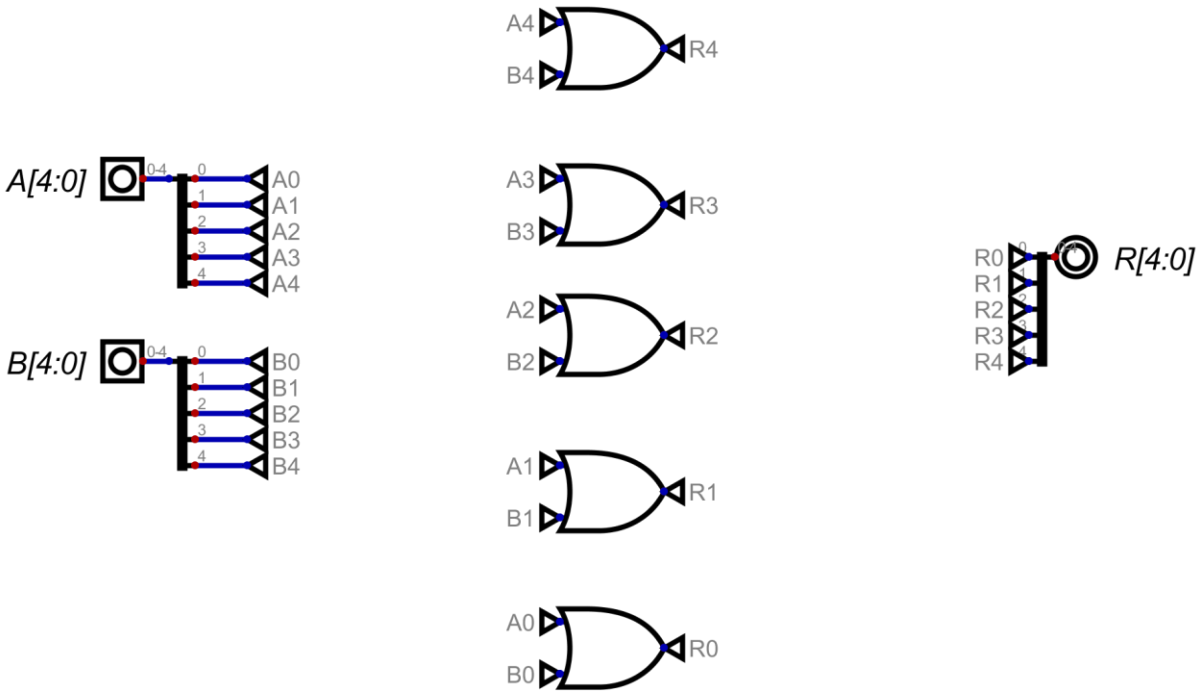
1. **ALU Circuit (Show all circuits except FA circuit)(Marks 5):**
   Check List:

Have you added all circuits of ALU from FA to ALU Operations Circuits (ADD, XOR, SHL etc.) to Top Level ALU Circuit?	YES

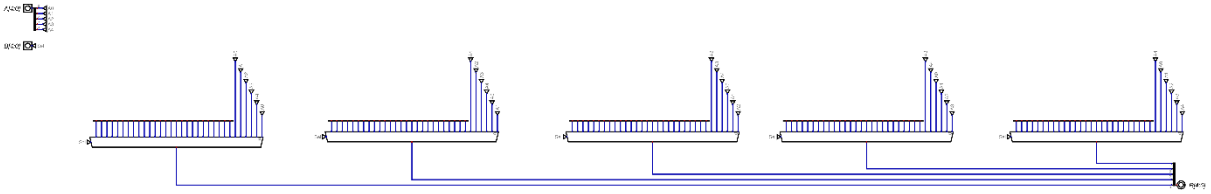
5 bit Adder:



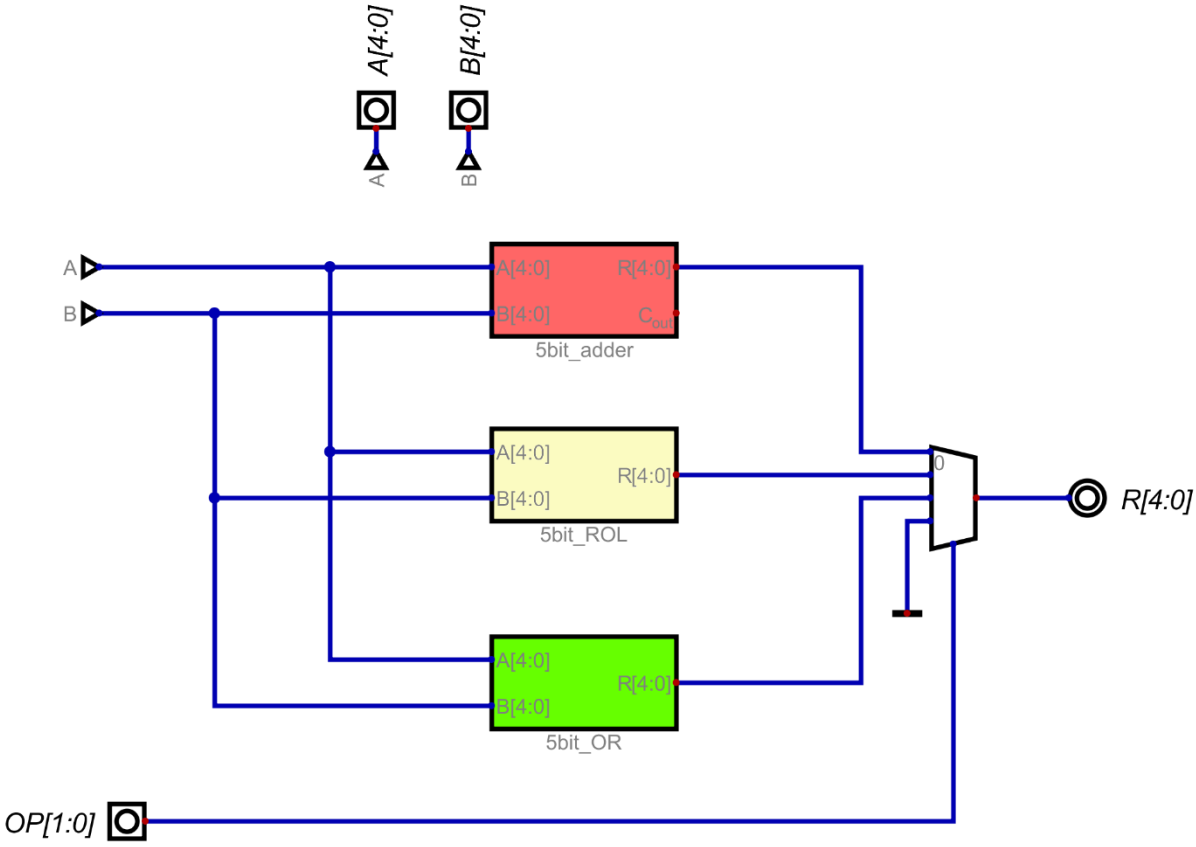
5 bit OR:



5 bit ROL:



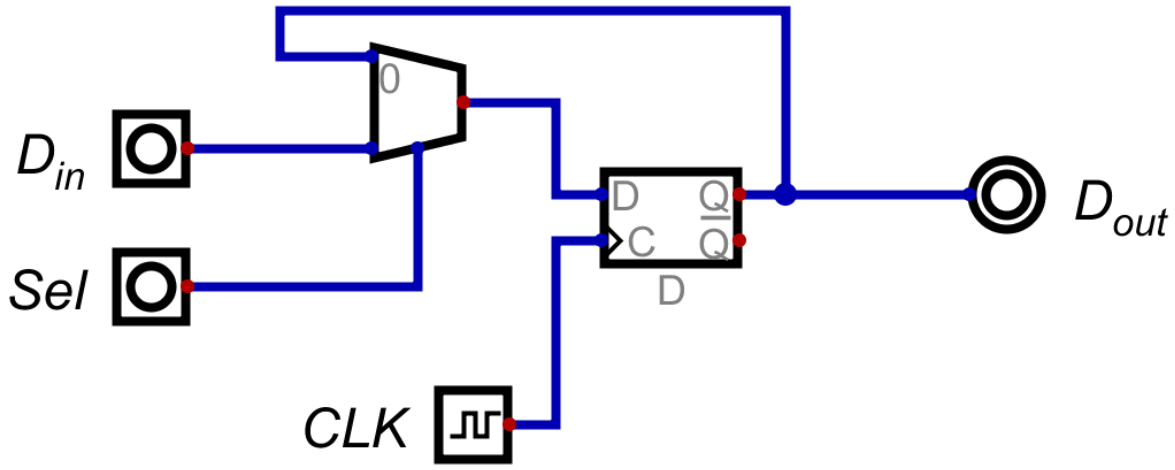
5 bit ALU:



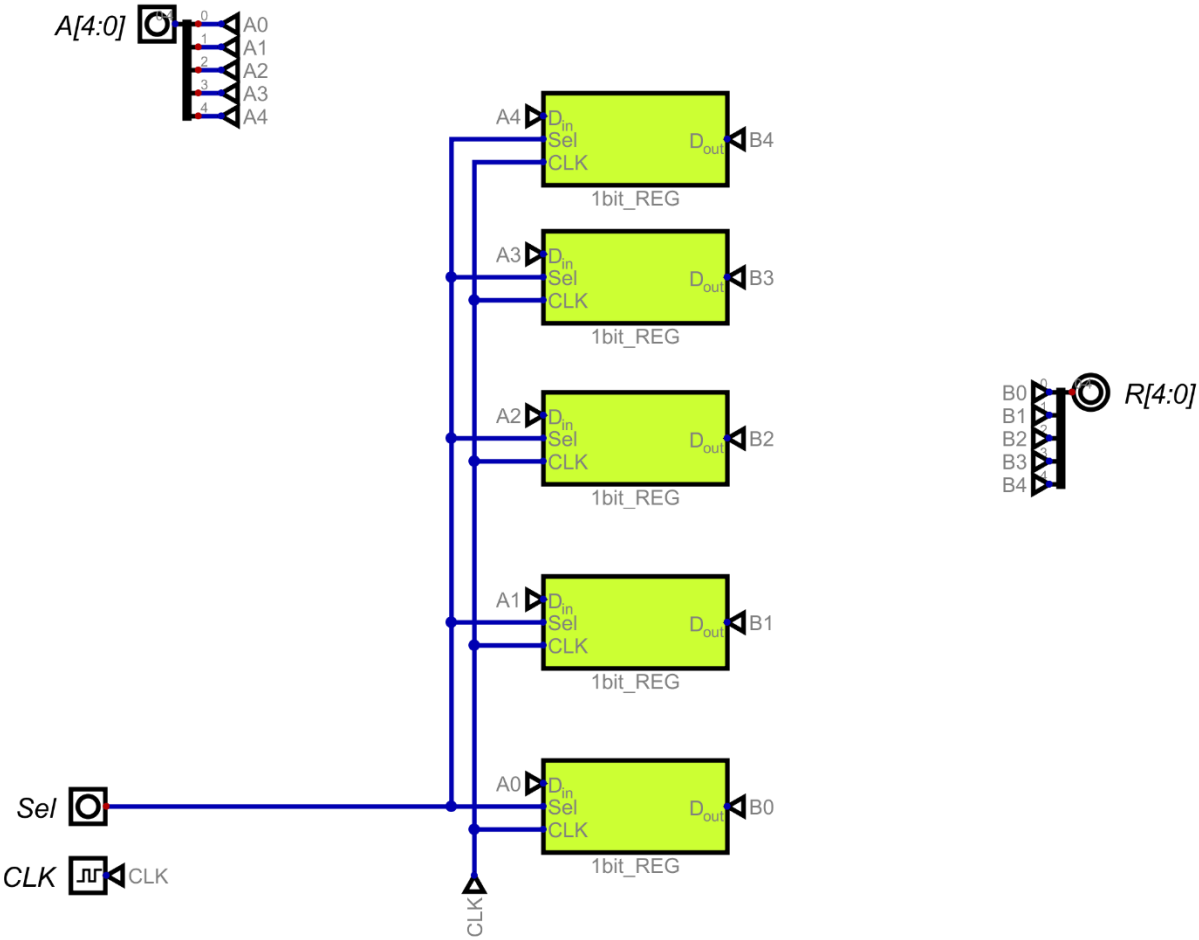
2. **Register Set Circuit (Top to Bottom all circuits)(5 Marks):**
   Check List:

Have you added all circuits of Register Set from 1 bit Register to n bit Register to Top Level Register Set Circuit.?	YES

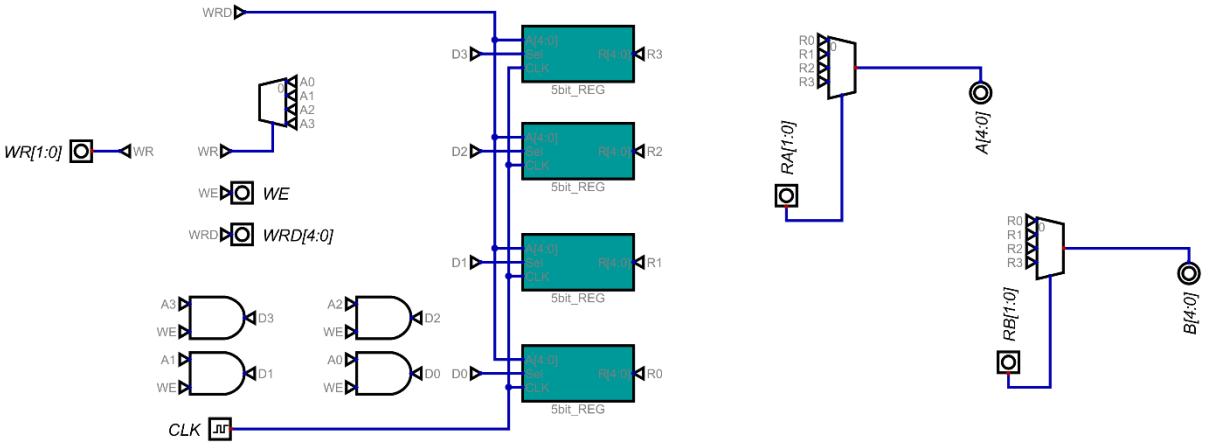
1 bit Register:



5 bit register:



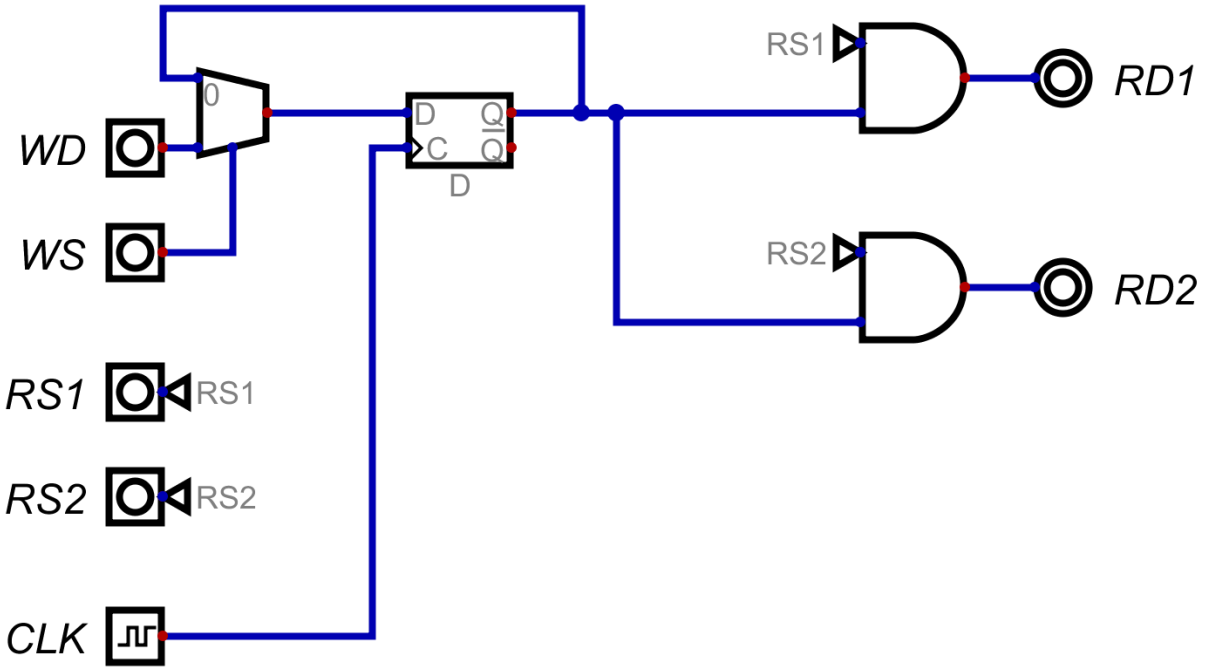
5 bit Register Set:



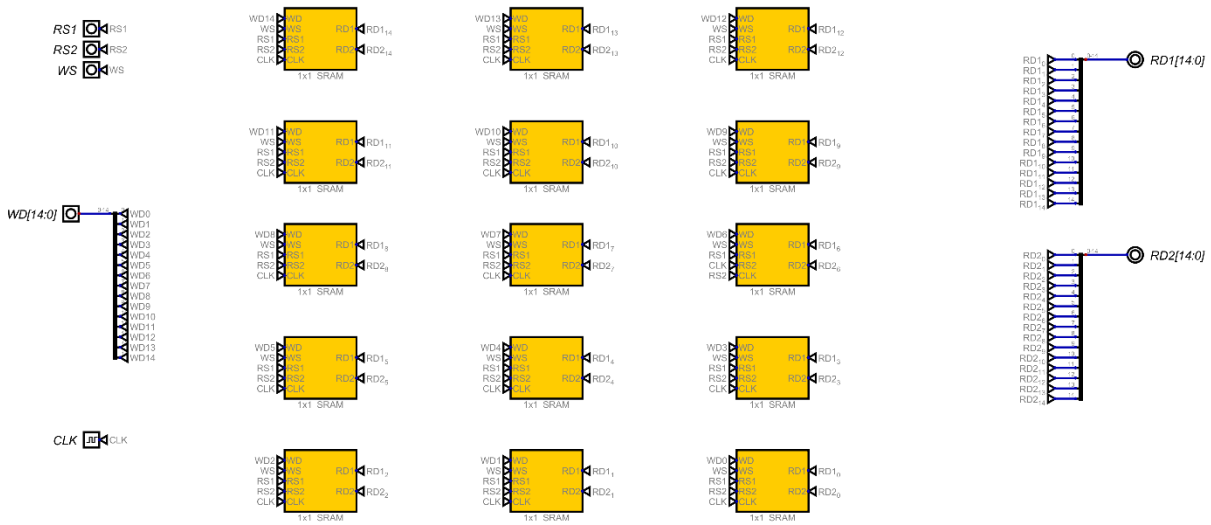
3. **RAM Circuit (Top to Bottom all circuits)(5 Marks):**
   Check List:

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

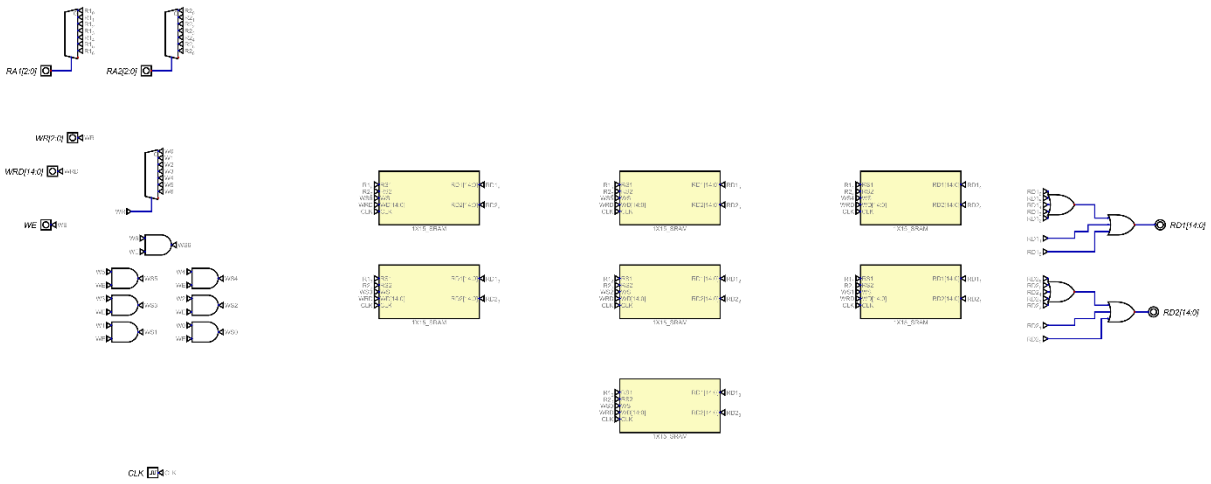
1x1 SRAM:



1x 15 SRAM:



7x15 SRAM:



4. a) ISA (2 Marks)

Check List:

Have you added all ISA of CPU along with its sample machine code to be run on CPU?	YES/

ISA (Register Mode):

Opcode (6 bit)		Register 1	Register 2	Unused
2 bits	2 bits	2 bits	2 bits	7 bit
Types of instruction	Operations (ALU selection lines)	Ra (00-11)	Rb (00-11)	X

ISA (Immidiate Mode):

Opcode (6 bit)		Register 1	value	Unused
2 bits	2 bits	2 bits	5 bit	4 bit
Types of instruction	Operations (ALU selection lines)	Ra (00-11)	Val(00000-11111)	X

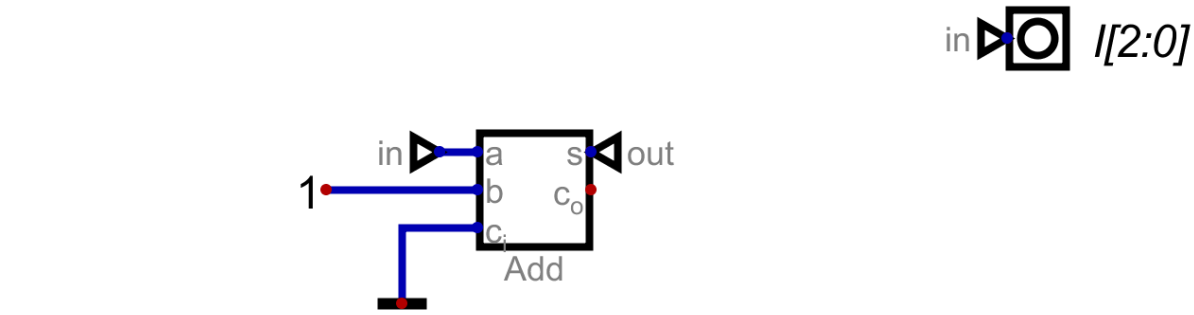
Sample Machine Code with assembly code in comments to be run on CPU (You will make a video running this machine code on CPU in order to prove that your CPU is working perfectly)

Machine Code	Assembly Code
1001000010000000 0010010100000000 0100010100101000	JE START START: OR R1,R1 JMP_TO: ADD R1,5

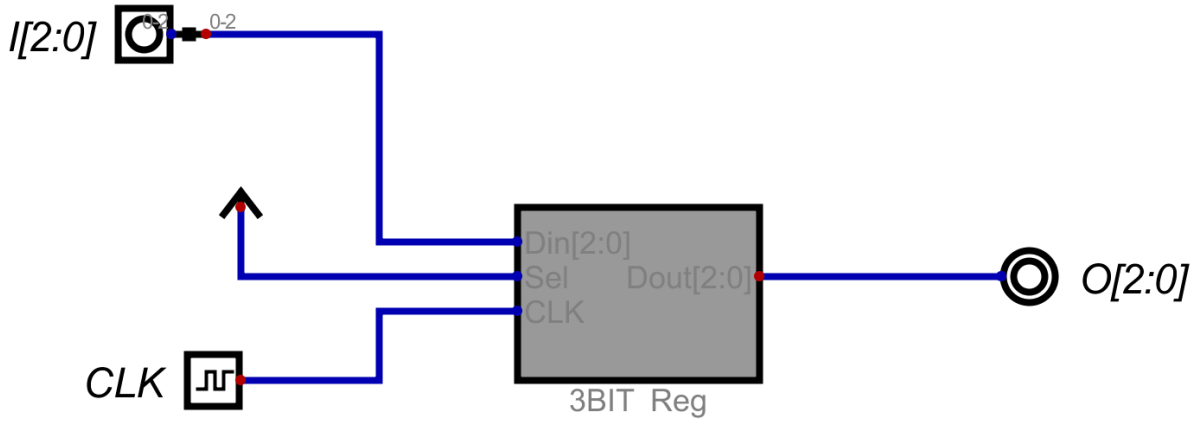
b) CPU (Top to Bottom all circuits)(3 Marks):
Check List:

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

Program Counter:



PC Adder:



5bit Control Unit:

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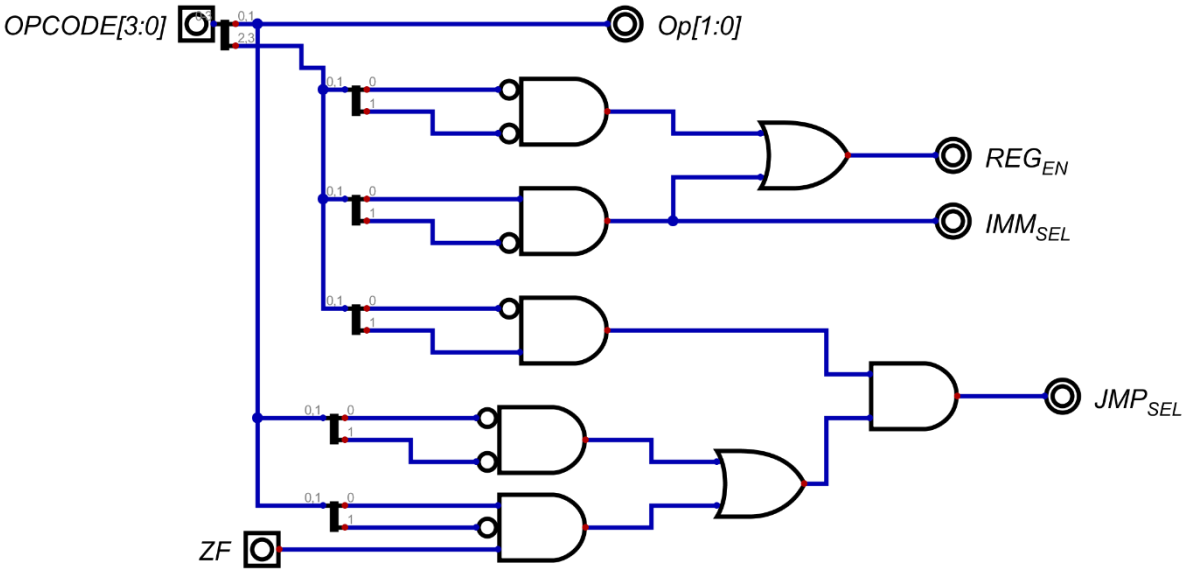

Main CPU:

Register Mode(00) = 2bit (type of operation) + 2bit(op) + 2bit(reg1) + 2bit(reg) + 7bit (don't Care)
Immediate Mode(01) = 2bit (type of operation) + 2bit(op) + 2bit(reg1) + 5bit(value) + 4 bit(don't care)
jump Mode(10) = 2bit (type of operation) + 2bit(op) + 4bit(add) + 7 bit(don't care)
JMP(OP-00), JNC(OP-01)
Op(00) = ADD
Op(01) = ROL
Op(10) = OR

JE START -> 1001000100000
START: OR R1,R1 -> 001001010000000
JMP_{TO}: ADD R1,5 -> 010001010010100
JMP JMP_{TO} -> 1000000100000