CSE 3203 CT 4 Assignment
Roll No: 1803051

Assignment Problem:
Build CPU based on following requirements:

1. **Word Size of CPU = 5**
2. **ALU Operations = ADD ,ROR,OR**
3. **Register Number = 3**
4. **Size of RAM = 10**
5. **Word size of ISA and RAM = 15**
6. **CPU Instructions = JMP,JNE**

Solution:
Simulator Design:

1. **ALU Circuit (Top to Bottom all circuits):**

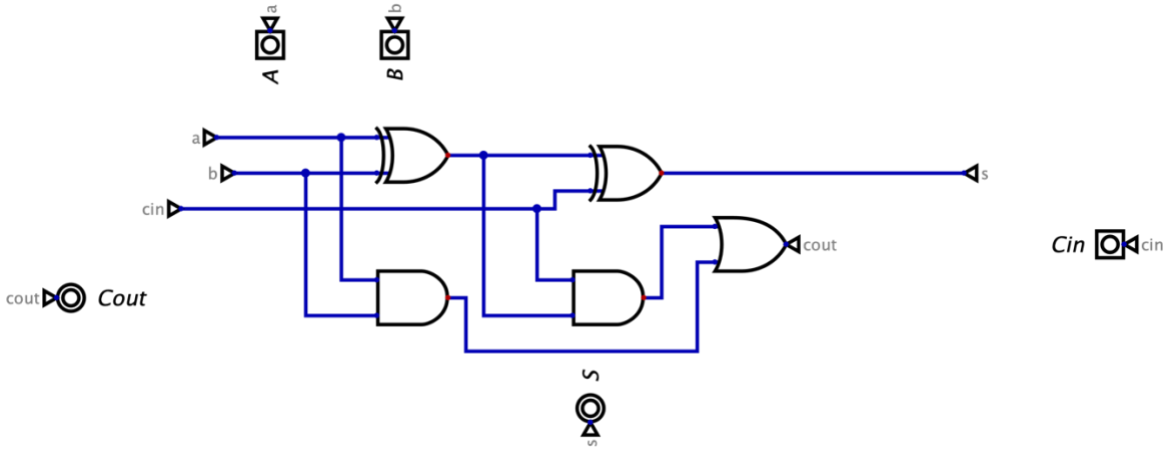

Fig: FA

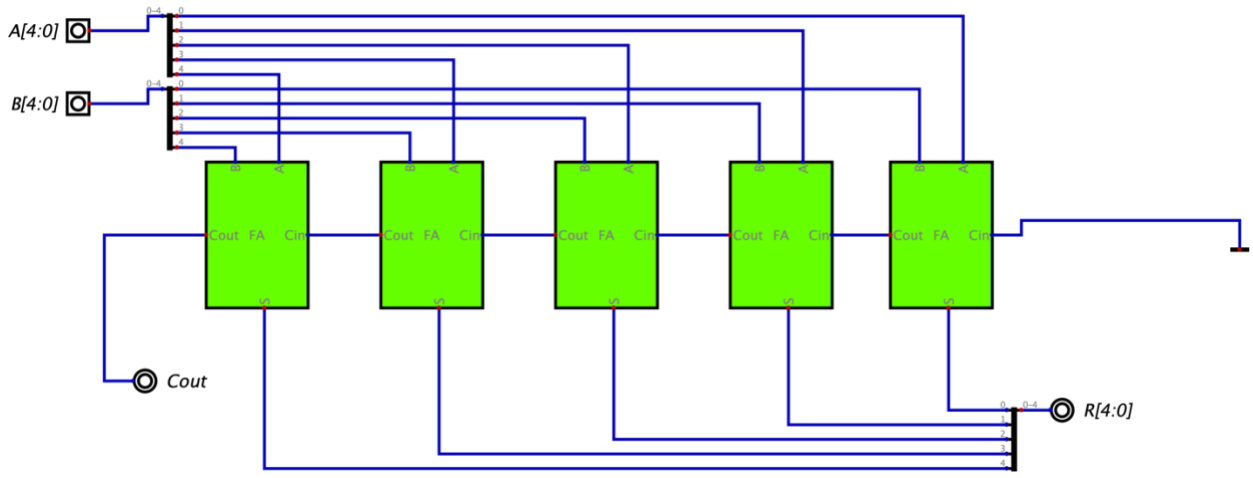

Fig: 5-bit FA

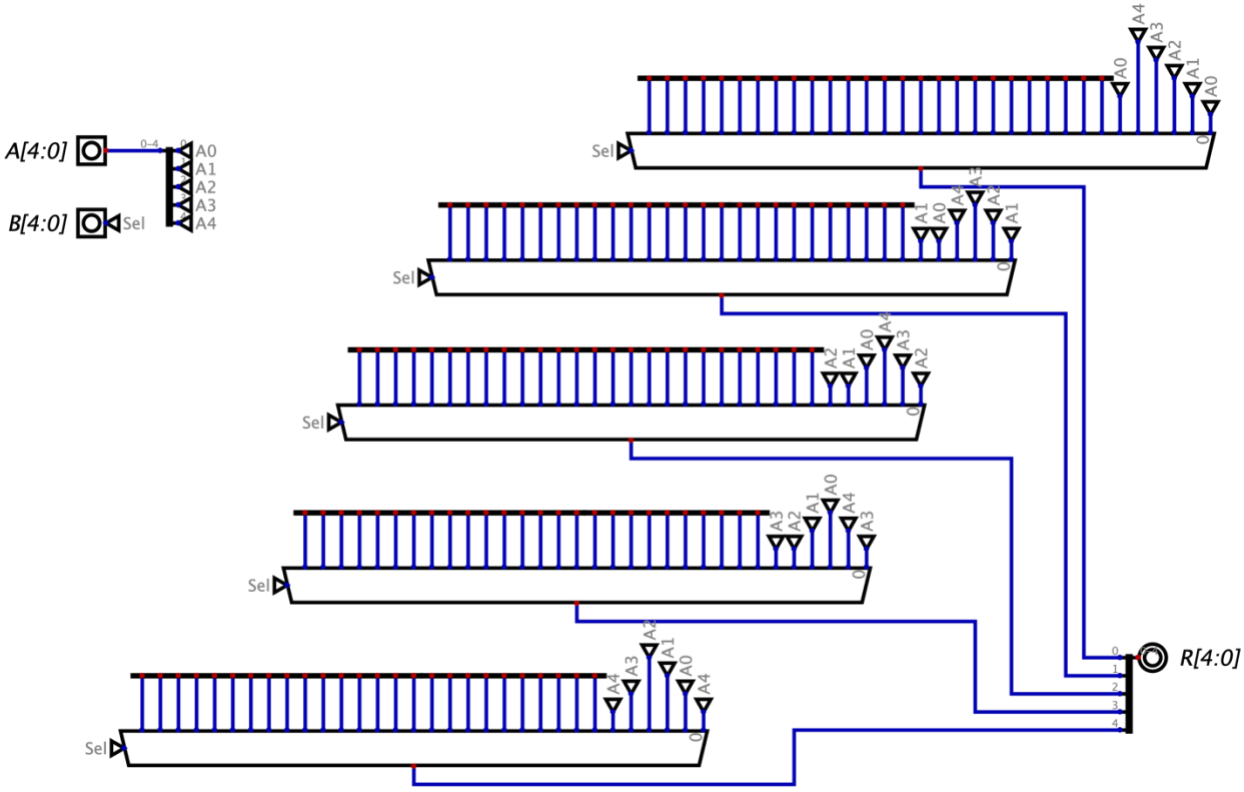

Fig: ROR

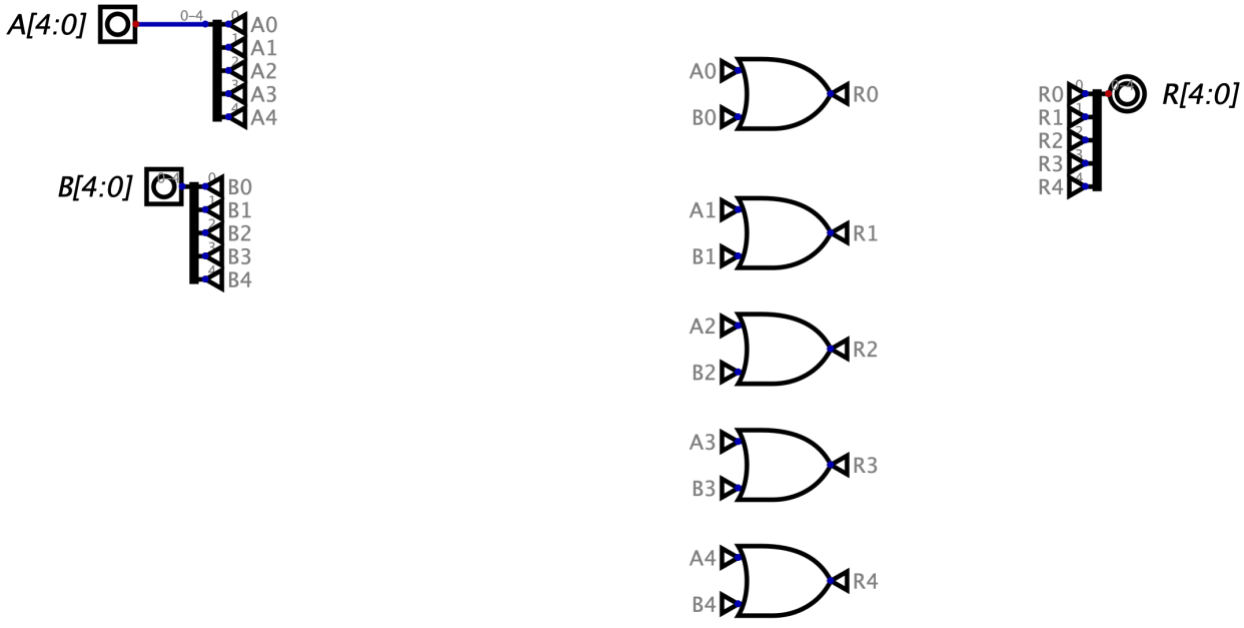

Fig: OR

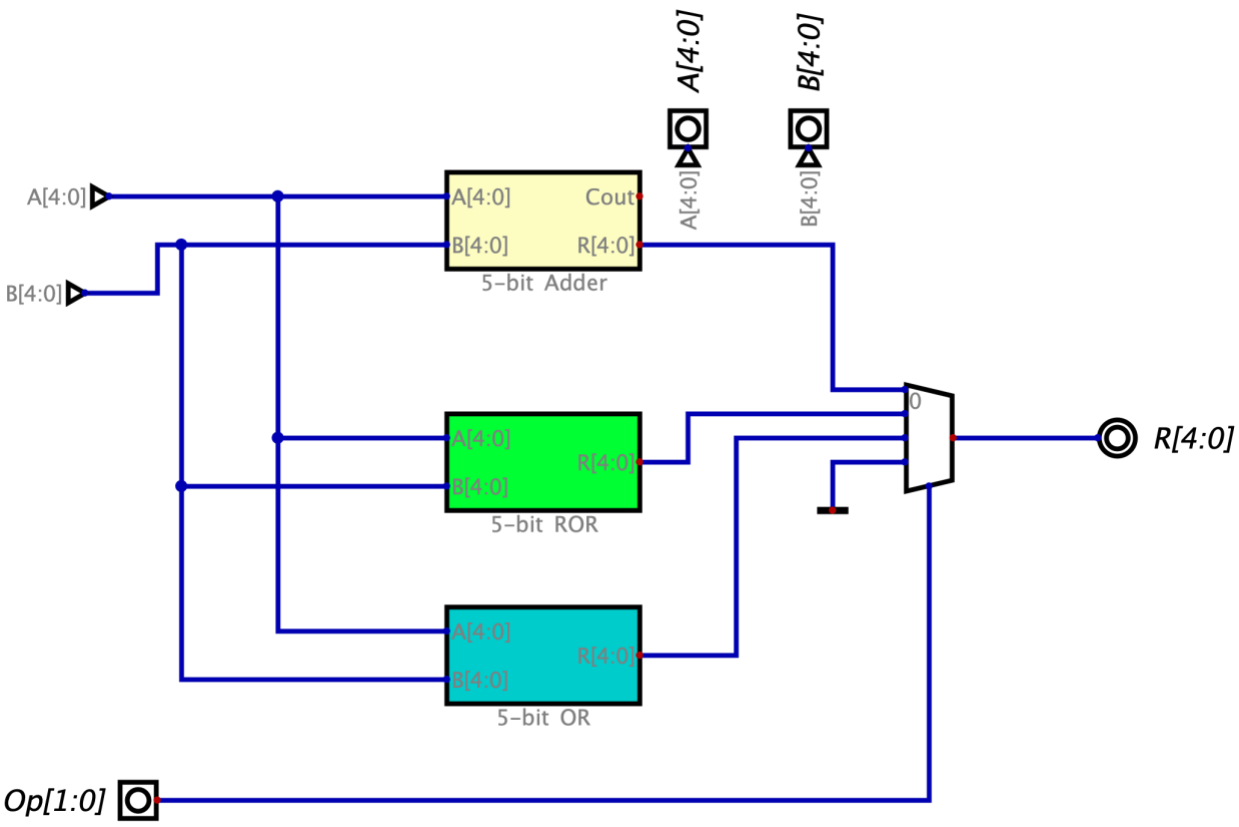

Fig: ALU

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

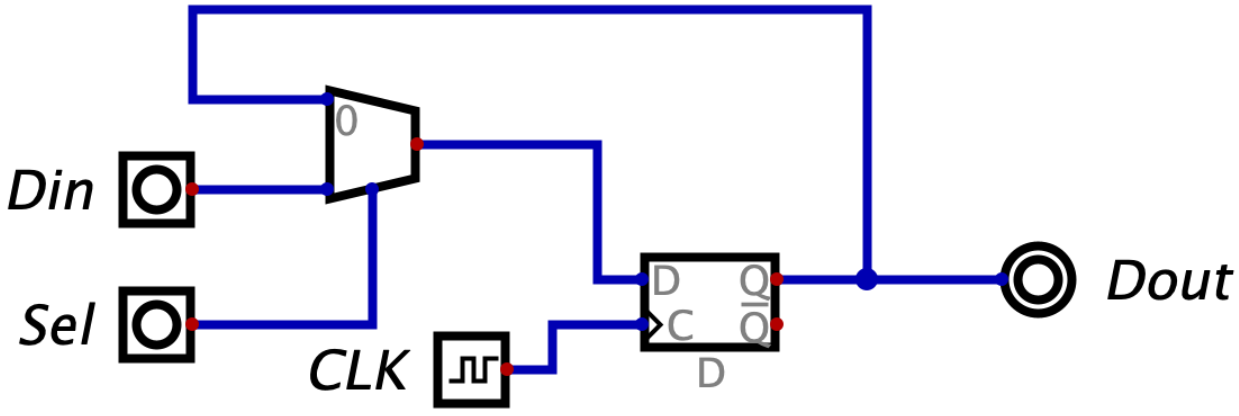

Fig: 1bit register

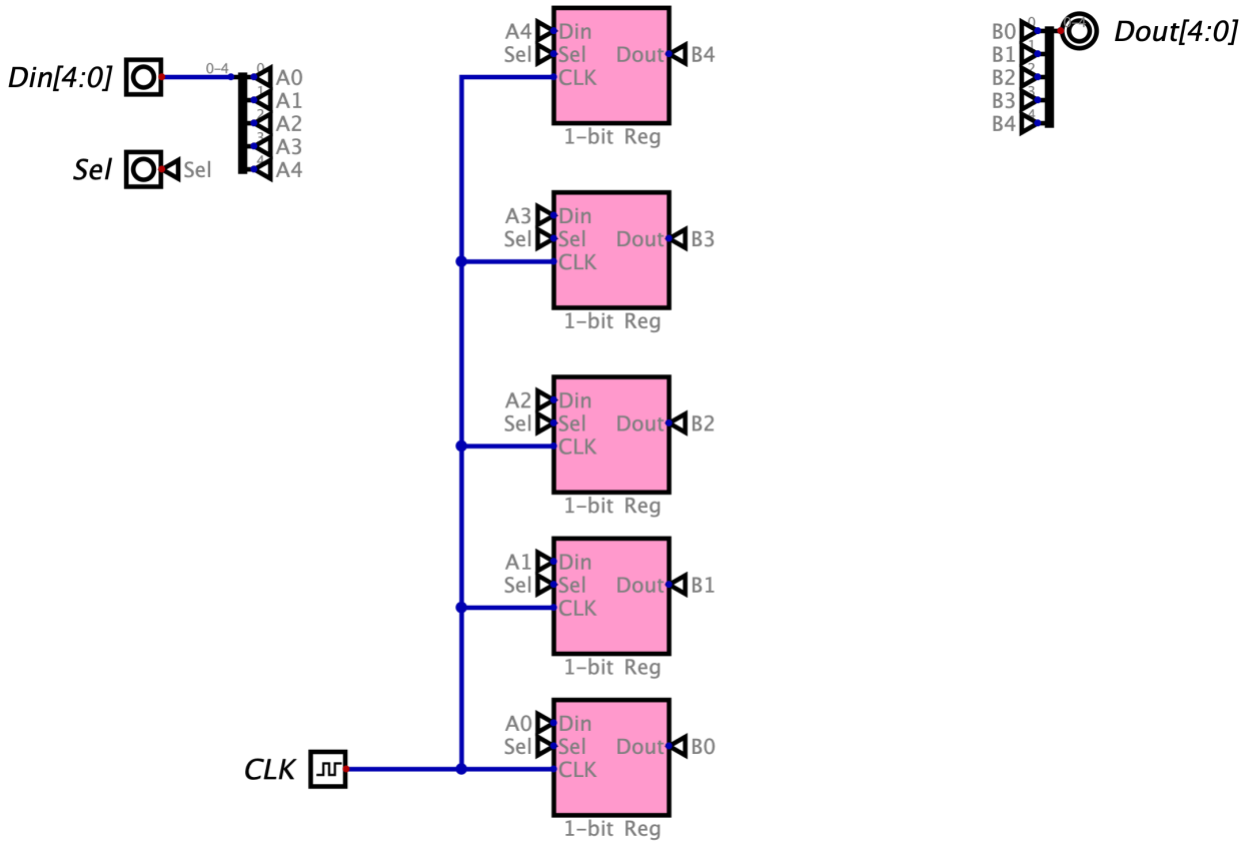

Fig: 5bit register

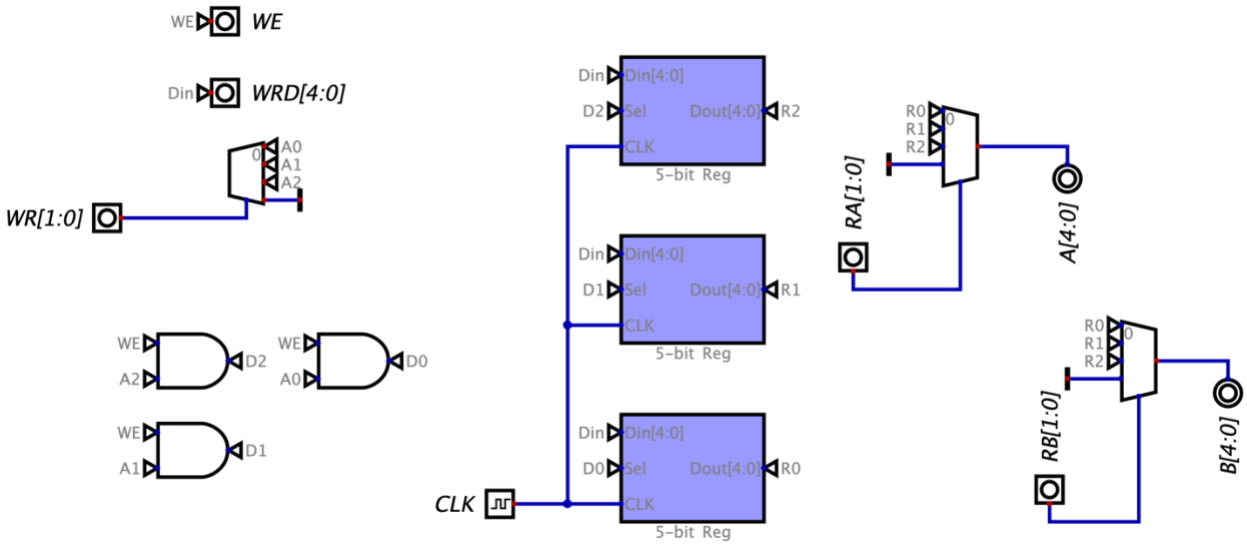

Fig: Register set

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

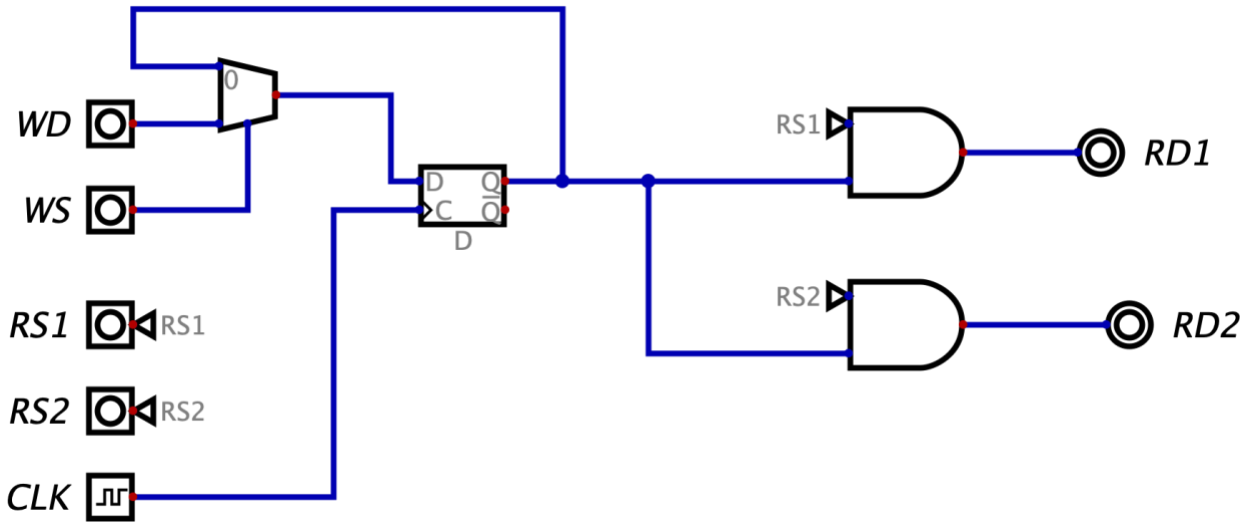

Fig: 1x1 SRAM

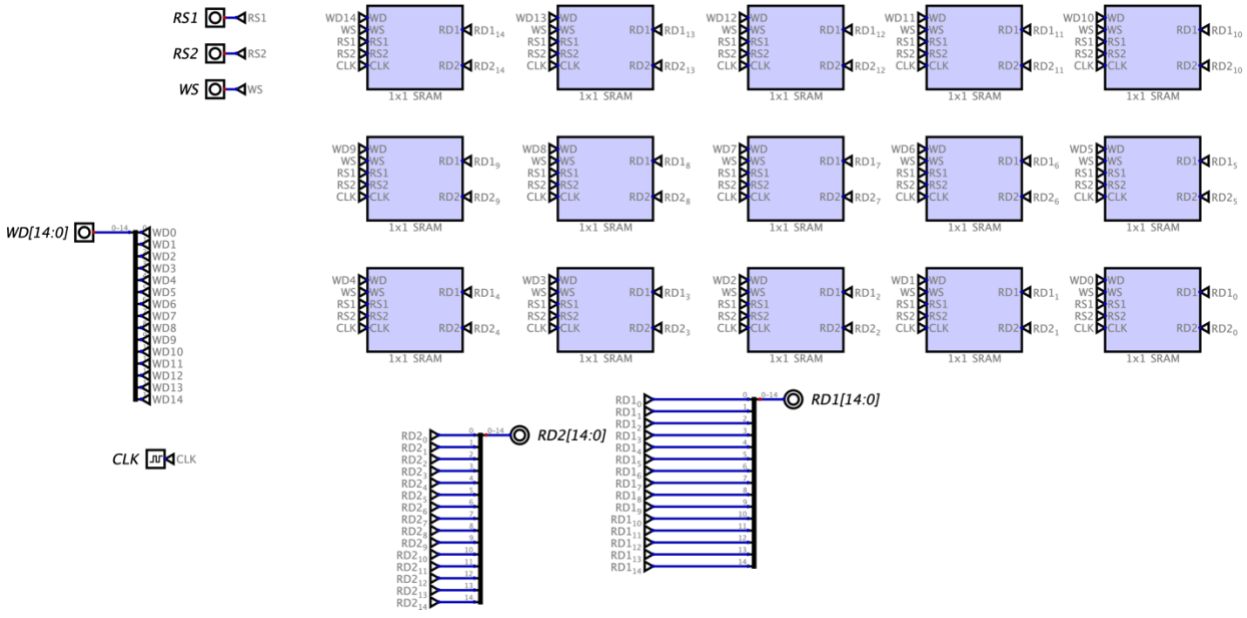

Fig:1x15 SRAM

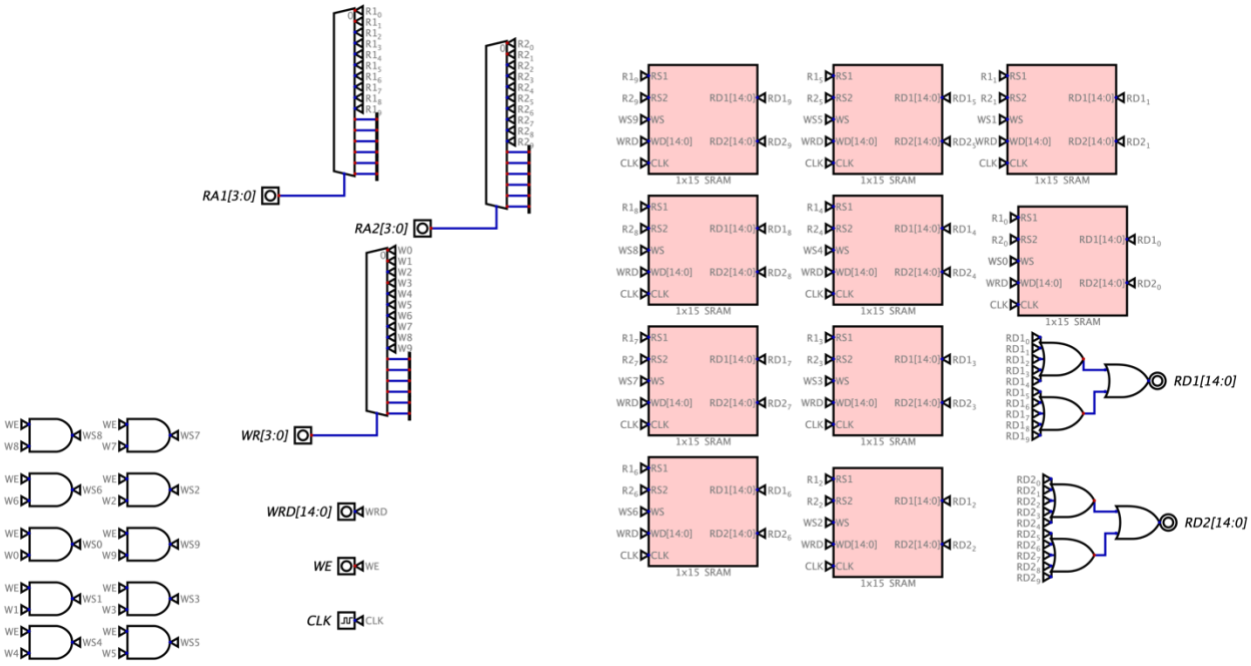

Fig:10x15 SRAM

4. ISA

ISA of Arithmetic & Logic Instruction (Register Mode)

Type of Op ->00

ADD (Op -> 00)
ROR (Op-> 01)
OR (Op->10)

Opcode (4 bit)		Register 1	Register 2	Unused
2 bit	2 bit	2bit	2bit	7bit
Types of Instruction	**Operations (ALU selection lines)**	00-10 Ra	00-10 Rb	xxxxxxx

Example: Add R1,R1 ->000001010000000

ISA of Arithmetic & Logic Instruction (Immediate Mode) :

Type of Op ->01

Opcode (4 bit)		Register 1	Constant	Unused
2 bit	2 bit	2 bit	5 bit	4 bit
Types of Instruction	**Operations (ALU selection lines)**	00-10 Ra	Value(00000-11111)	xxxx

Example: Add R1,2 ->010001000100000

ISA of Branching :

Type of Op ->10

JMP (Op -> 00)

JNE (Op -> 01)

Opcode (4 bit)		Address		Unused
2 bit	2 bit	4 bit		7 bit
Types of Instruction	**Operations**	0000-1001		xxxxxxx

Example: JNE 2(label) (100100100000000)

5. CPU (Top to Bottom all circuits):

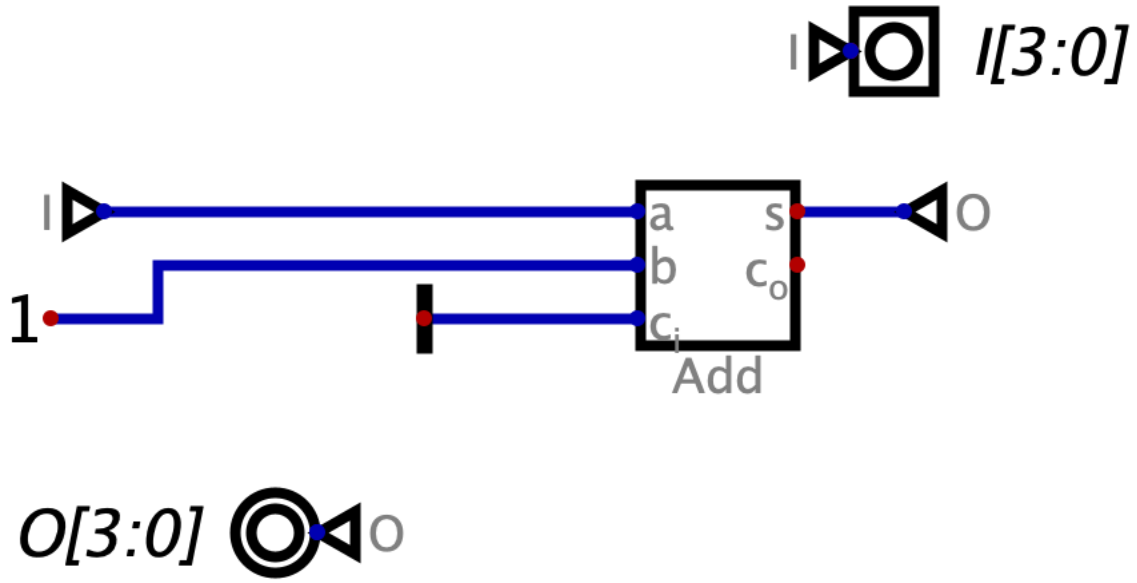

Fig: 4-bit PC Adder

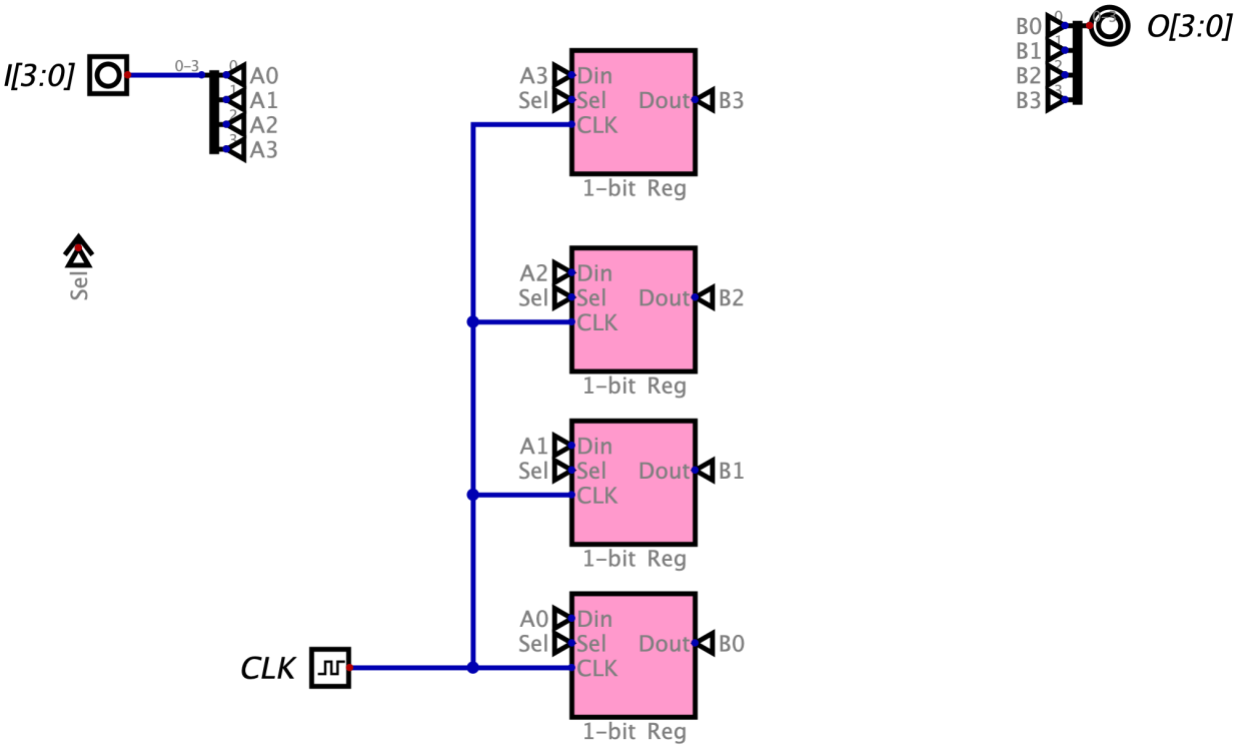

Fig: 4-bit PC register

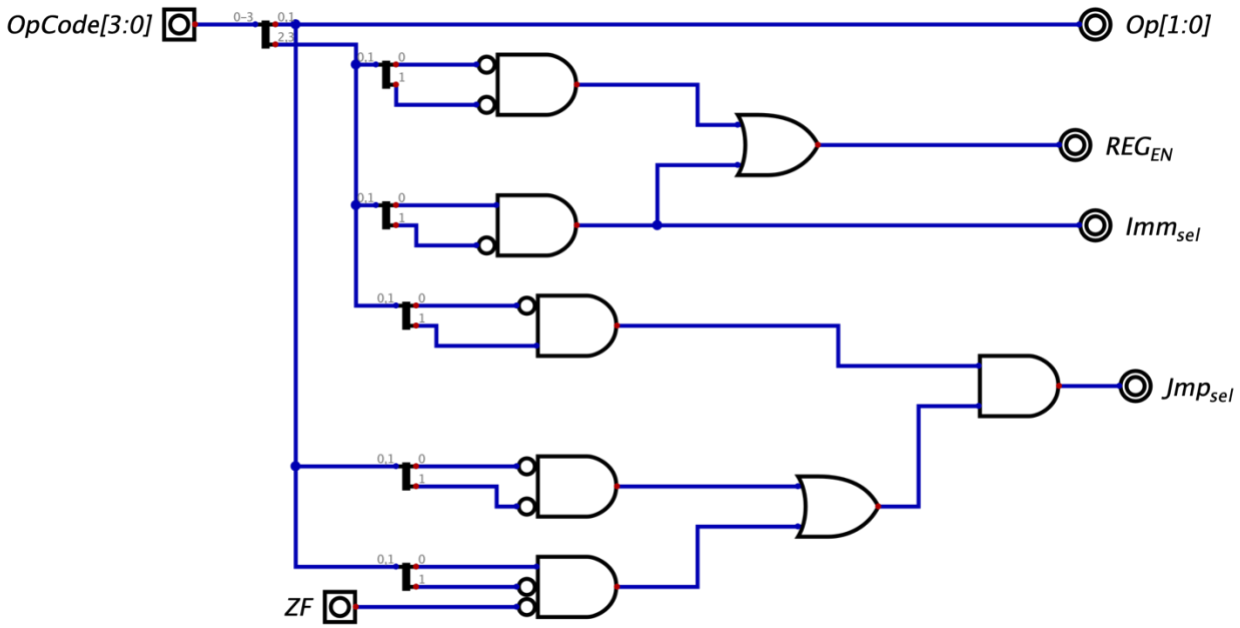

Fig: Control unit

Register Mode(type Of Op==00)2bit(Type of op)+2bit(op)+2bit(Reg1)+ 2bit(Reg2)+7 bit don't care
Imm Mode(type Of Op==01)2bit(Type of op)+2bit(op)+2bit(Reg 1)+ 5bit(Imm value)+4bit don't care
Jump Mode(type Of Op==10)2bit(Type of op)+2bit(op)+4bit(Addr)+ 7bit don't care
Add(op=00),ROR(op=01),OR(op=10)
JMP(Op=00),JNE(Op=01)
JNE START ->100100010000000
START: OR R1, R1 ->001001010000000
JMPTO:ADD R1,5 ->010001001010000
JMP JMPTO -> 100000010000000

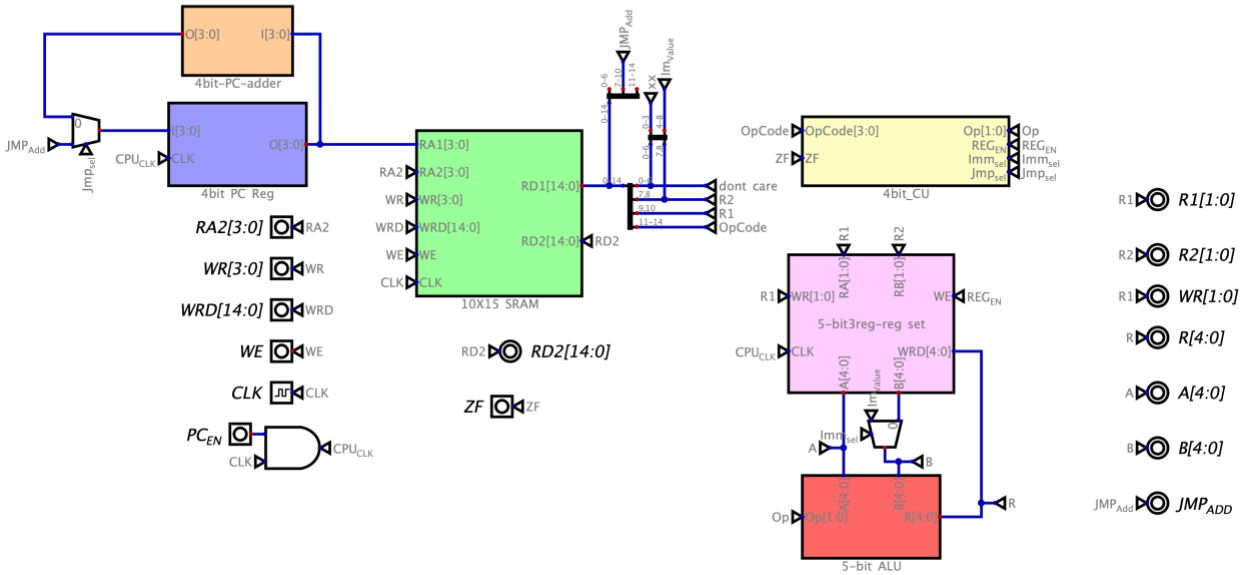

Fig: 5 bit CPU