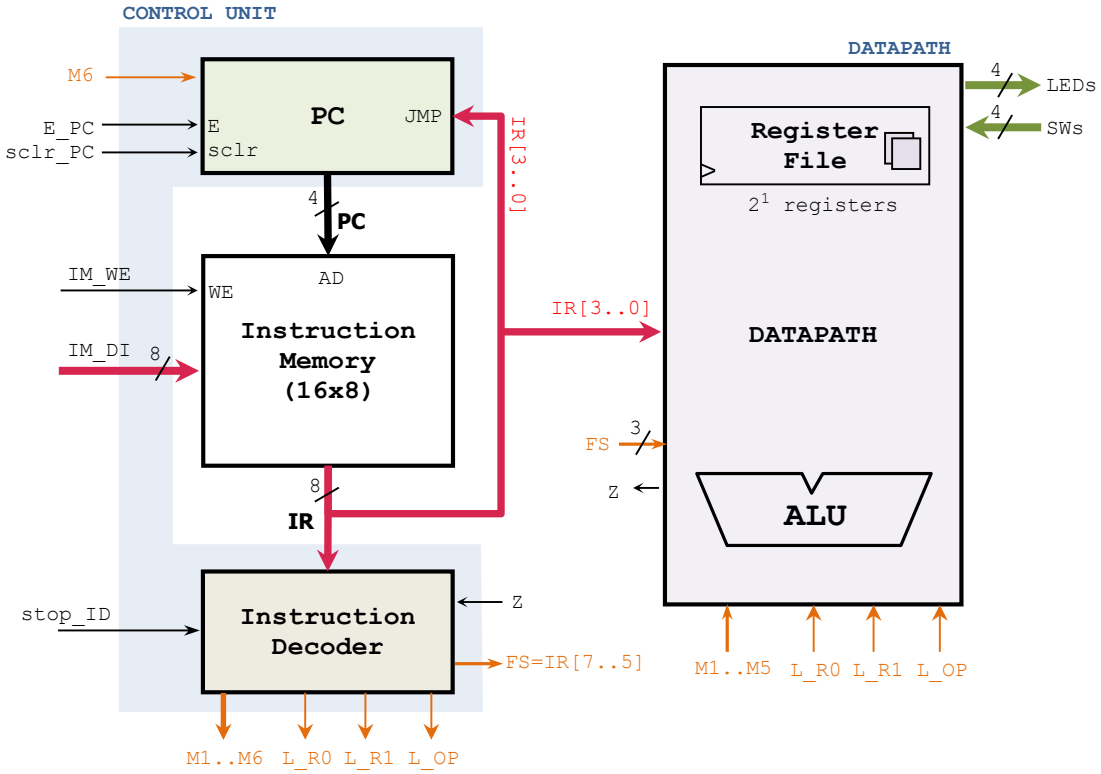
Homework 4

(Due date: April 5th @ 7:30 pm)
Presentation and clarity are very important! Show your procedure!

PROBLEM 1 (40 PTS)

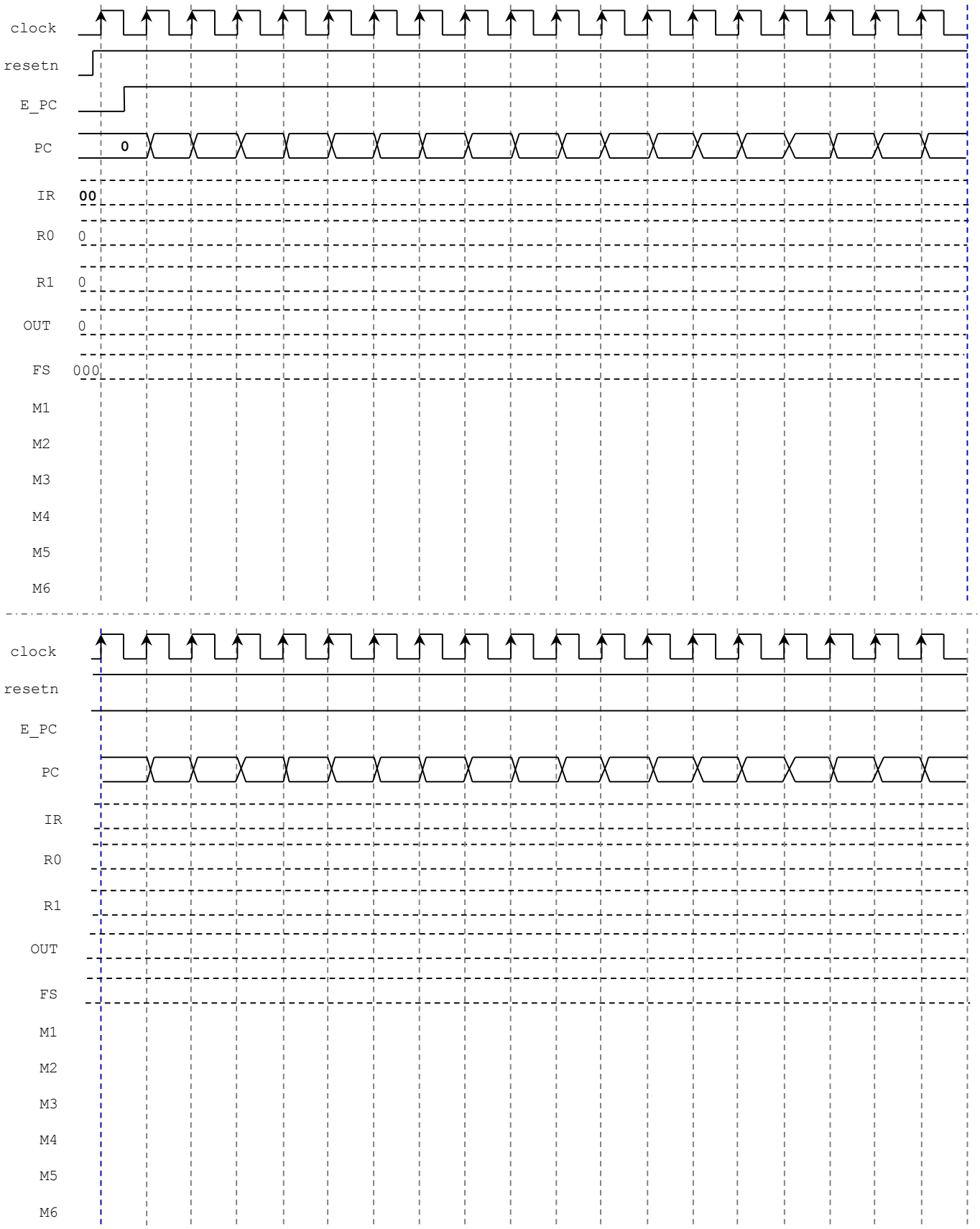
- **"VBC (Very Basic Computer)"**: 2 registers, 16-word instruction memory, 8 bits per instruction.



- ✓ Write an assembly program for a counter from 4 to 11: 4, 5, 6, …, 11, 4, 5, 6, … The count must be shown on the output register (**OUT**). Use labels to specify any address that an instruction may jump to. You can only have up to 16 instructions.
- ✓ Provide the contents of the Instruction Memory. If some instruction bits are unused, you can assign 0's.

Address	Instruction Memory	Assembly Instruction
0000		
0001		
0010		
0011		
0100		
0101		
0110		
0111		
1000		
1001		
1010		
1011		
1100		
1101		
1110		
1111		

✓ Complete the timing diagram for the execution of the previous program. Use unsigned decimal values for R0, R1, OUT, and PC. Specify IR in hexadecimal. (25 pts)
IM: Array of registers. In this case, when reading, output data appears as soon as address is ready.
Assumptions: the program is already in IM. Also: `sclr_PC=0, IM_WE=0, stop_ID=0`.



PROBLEM 2 (25 PTS)

- "**Simple Computer**": 8 registers, 64-word instruction memory, 16 bits per instruction (see Notes – Unit 6).
  - ✓ For each of the following instructions, indicate the bits for the instruction fields (if they do not apply, write 'NA'), and the instruction memory contents (if some bits are unused, you can assign 0's).

Address	Instruction	OPCODE	DR	SA	SB	OP	AD	Instruction Memory contents
0	LDI R0,3							
1	LDI R3,2							
2	LDI R4,6							
3	SUB R7,R0,R4							
4	ADI R5,R4,7							
5	ST R5, R7							
6	XOR R4,R7,R5							
7	LD R6, R5							
8	BRN R7,-5							
9	ST R7,R4							
10	JMP R3							

  - ✓ Emulate the execution of the program by completing the PC (use binary values) as well as the state of the registers (use hexadecimal values) after the instruction pointed by PC is executed. Complete it until the JMP instruction is reached (execute this instruction as well).

PC	R0	R3	R4	R5	R6	R7
000000						

PROBLEM 3 (20 PTS)

- "**Simple Computer**": 8 registers, 64-word instruction memory, 16 bits per instruction (see Notes – Unit 6)
  - ✓ Write an assembly program for a counter from 3 to 11: 3, 4, 5, 6, 7, 8, …, 11, 3, 4, … The count must appear on **R2**. Use labels to specify any address that an instruction may jump to. Note that you can only have up to 64 instructions. Note that the ALU treats data as signed numbers. Thus, data on the registers and Data Memory (16 bits) is signed.
  - ✓ Provide the contents of the Instruction Memory and its addresses.

PROBLEM 4 (15 PTS)

- Attach a printout of your Project Status Report (no more than three pages, single-spaced, 2 columns). This report should contain the current status of the project. You **MUST** use the provided template (`Final Project – Report Template.docx`).