Processor Design

Q1.   The circuit below is used as a part of an ALU to perform logical and arithmetic operation on the 2-bit inputs $X=X_1X_0$ and $Y=Y_1Y_0$. The operation to be performed is determined by the function select input S_1S_0 to produce the output $F=F_1F_0$ according to the following table:

S1S0	Operations
00	F=X AND Y
01	F= X OR Y
10	F= X XOR Y
11	F=X+Y (addition)

Complete the implement of the circuit shown below according to the given requirements:

Q2. Design a 4-bit processor to implement the following arithmetic operations. The operation to be performed is determined by the following select input S_1S_0 to produce the output F according to the following table:

S_1	S_0	Operation
0	0	F=X+Y
0	1	F=X-Y
1	0	F=X+1
1	1	F=Y-1

Q3.   Two comparators for 4-bit unsigned numbers are available. Each comparator has two 4-bit inputs: $X=x_3x_2x_1x_0$ and $Y=y_3y_2y_1y_0$, and 3 logical outputs: X greater than Y ($>$), X equal to Y ($=$), and X less than Y($<$). Construct a comparator for two 8-bit unsigned numbers $A=a_7a_6a_5a_4a_3a_2a_1a_0$ and $B=b_7b_6b_5b_4b_3b_2b_1b_0$ using the two 4-bit comparators and any additional logic gates and draw the resulting circuit.

Q4.   The question deals with a 4-bit programmable processor module. The function table of the ALU, and the instruction set of the processor are given in the Appendix.

Determine the contents of the Program Counter (PC), Accumulator (ACCA), and the Carry Bit (C) after the execution of each of the following instructions using the given initial values of the Input Switches (Sw), Carry Bit (C), Program Counter (PC), Accumulator (ACCA) and content of the Memory Location 2 (M(2)).

Each of the following instructions has initial conditions as given:

ADDA

ANDA

JMP

INC

Q5. Write a program to perform X1+Y1 and set the MSB and LSB to 1.