Problem-1: (Background In Combinational Logic) (100 Points)
Design a digital circuit with 4 input lines (A, B, C, D) and 1 output line (Z). The output Z will be 1 if the 4-bit binary number on the input lines is a multiple of 3, 5 or 7. Assume that A is the most significant bit and D is the least significant bit. (Note: Zero is a multiple of any number)

a) Show the minimum SOP expression for Z in terms of A, B, C and D. (7 Points)
b) Show the minimum POS expression for Z in terms of A, B, C and D. (7 Points)
c) Implement the circuit using only NAND gates. (3 Points)
d) Implement the circuit using only NOR gates. (3 Points)

Problem-2: (Background In Sequential Logic) (20 Points)
Design a synchronous counter using J-K flip flops and some logic gates. The following state diagram shows the counting sequence of the counter.

Problem-3: (Background In Assembly Language Programming) (20 Points)
Write a program using any assembly language to sort an array of 128 elements in ascending order. Assume that the array is available in memory starting from location $2000$ (the dollar sign indicates that 2000 is a HEX number), and each element of the array is a byte (8 bits). Your program must be well documented. You must also let the grader know the name of the assembly language, e.g. 6800 assembly, 8085 assembly, 68000 assembly, 8086 assembly, etc.

Problem-4: (Background In High-Level Language) (20 Points)
Write a program in any high-level programming language (BASIC, FORTRAN, PASCAL, C) to read an integer number (in the range 1 through 10000) from the keyboard and then determine whether or not it is a prime number. If it is a prime number then display the message "IT'S A PRIME NUMBER", otherwise display "IT'S NOT A PRIME NUMBER". Your program must be well documented. (A prime number can be divided only by itself or 1)

Problem-5: (Background In Timing Diagram) (20 Points)
Assume that the initial states of FF-1 and FF-4 are 1 and the initial states of FF-2 and FF-3 are 0. Draw the timing diagrams of the signals A and B for 12 clock cycles.