1. (20%)

(a) (5%) Describe the principle and application of even-parity code.

(b) (5%) If $A = 41_{10}$, $B = -27_{10}$, express A, B and A+B by using 8-bit 1's complement number system. The procedure of operations shall be written down.

(c) (5%) Express $A = 41_{10}$ by using Binary coded Decimal (BCD).

(d) (5%) Using switching algebra to simplify $(a+b)(\bar{a}+c)(d+b+c)$. The procedure of simplification shall be written down.

2. (30%) Briefly answer the following questions. Try to show the key points in your answer.

(a) (5%) Discuss the difference between "Batch system" and "Interactive system". Also discuss their impact on "throughput rate" and "response time" on computer systems.

(b) (5%) What is "Daisy-chain arbitration" in computer I/O system?

(c) (5%) List four frequently used *computer addressing modes*. Use graphs to illustrate their operations in computer systems.

(d) (5%) Discuss the difference between "compiler" and "interpreter".

(e) (5%) Explain "double-precision floating-point number" in computer number system.

(f) (5%) Explain "Virtual address" and "Physical address" in *Virtual memory system*.

3. (10%) The flowcharts of a main program and a subroutine are shown in Fig.1. Show the values of x and y for

(a) (5%) *Call-by-value* subroutine call.

(b) (5%) *Call-by-address* subroutine call.
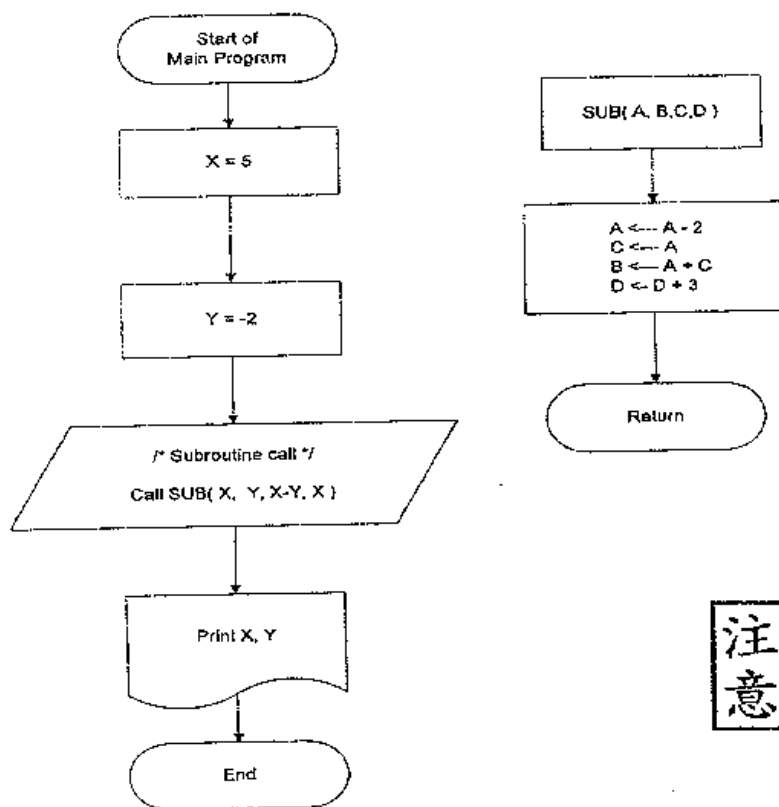
Fig. 1　Flowchart of Main program and subroutine of Problem 3.

4. (20%) *A* is a decimal number and $0 \leq A \leq 255$. *b[7:0]* is an array of size 8, and b[i] , i=0,1,...,7, can store 0 or 1.

   (a) (8%) Draw the flowchart that converts A into an 8-bit binary number. The converted binary number is stored in b[7:0], where the *most-significant-bit (MSB)* is stored in b[7], and the *least-significant-bit (LSB)* is stored in b[0].

   (b) (8%) Show how many
   - (i) Addition operations
   - (ii) Subtraction operations
   - (iii) Division operations
   - (iv) Modulo operations
   - (v) Multiplication operations
   - (vi) Branch operations

   are used in this program.

   (c) (4%) Suppose we generalize this conversion program to convert a decimal number into an *n*-bit binary number. How many addition operations will be performed if the same flowchart is used? Show your result in terms of *n* and some constants. Also show the *order* of the computational complexity for the addition operation.

5. (20%) If we want to design an *electronic chicken* (電子雞) which consists of input/output devices (such as buttons to control/choose the functions, audio sound output, and LCD display panel to display the image), and control circuits to implement the function. From computer architecture point of view, describe the required components (micro-controller, memory, I/O, *etc.*) and their relationship. Use block diagrams and some descriptions to describe your design concept.