THE ASSOCIATED EXAMINING BOARD

for the General Certificate of Education

June Examination, 1977 – Ordinary Level

COMPUTER STUDIES

Paper 2 095/2

Monday, 20 June, 2.00 p.m. to 4.30 p.m.

2 hours 30 minutes allowed

Answer **five** *questions.*

All questions carry equal marks.

1. (a) Draw a logic diagram showing how two half-adders may be connected, along with any other necessary logic elements, to form a full adder. (8 marks)

   (b) A bank uses a double security system based on key-operated switches. The manager, the chief cashier and his deputy each have a key. The door to the vaults can be opened by using any two of the three keys, but the door to the strongroom can only be opened if the vault door is open and all three keys are used to operate the strongroom lock. Design and sketch a logic circuit to satisfy the above conditions, using standard logic elements. Ensure that your diagram is fully annotated. (12 marks)

2. A meteorological experiment consists of measuring the amount of rainfall each month, for one year, at ten different places inside a specified area. The rainfall for the previous month is measured on the first day of each month.

   (a) Design a simple form to be used for recording the rainfall data for subsequent analysis. (6 marks)

   (b) The amount, in mm, recorded for January at each of the ten measuring stations is:-

   15, 10, 13, 9, 16, 13, 11, 15, 15, 10.

   Present this information by means of a frequency polygon. (7 marks)

   (c) The amount, in mm, recorded for station 1 for each month is:-

   15, 21, 27, 13, 15, 9, 6, 16, 3, 16, 21, 16.

   Calculate:

   (i) the mean, (3 marks)

   (ii) the standard deviation of this data. (4 marks)

3. Trace the development of data processing from 1890 to 1950, with particular reference to the part played by the punched card. Your answer should contain names of persons and companies concerned in this development and significant dates, along with brief descriptions of the various pieces of equipment used and some indication of the data processing applications in which they were used. (20 marks)

4. **(a)** Briefly define the following terms:

   (i) decoder,

   (ii) clock cycle,

   (iii) fetch phase,

   (iv) execute phase. (3 marks each)

   (b) A certain computer uses a 4-bit function code. The code for the instruction ADD is 1001. By means of a logic diagram, show how this instruction is decoded to provide an output of 1 from the decoder. (8 marks)

5. A certain computer has the following instruction code:

   An: add contents of location n to Accumulator

   Bn: copy contents of Accumulator to location n

   Cn: copy contents of location n to Accumulator

   Jn: if content of Accumulator = 0, go to location n for next instruction

   Kn: if content of Accumulator < 0, go to location n for next instruction

   Ln: increase contents of location n by +1

   Sn: subtract contents of location n from Accumulator

   Given that storage locations 100 and 101 initially contain the first two terms of the Fibonnacci series, that the first computer instruction is to be stored in location 1000, and that all other store locations will initially contain zero, draw a flowchart and write machine code instructions to leave the sum of the first 20 numbers in the Fibonnacci series in location 102.

   (Flowchart 8 marks; Program 12 marks)

   (The Fibonnacci series is a series of numbers where the next number in the series is found by adding together the previous two numbers, viz: 1, 1, 2, 3, 5, 8, 13, ...)

6. The following algorithm can be used to convert an integer expressed in binary to its denary equivalent:-

   1) multiply the most significant bit of the binary integer by 2 and call the result 'TOTAL';

   2) add the next bit to TOTAL;

   3) if this was the last bit, then TOTAL gives the required answer;

   4) if there are further bits, multiply TOTAL by 2 then return to step 2.

   (a) Draw a flowchart from this algorithm. (11 marks)

   (b) Dry run the flowchart using 101110_2 as input, showing all working. (6 marks)

   (c) How can the flowchart be modified to convert a number in some other base, n, (where $n<10$), to base 10? (3 marks)

7. Explain the meaning of the following terms:

(i) data bank,

(ii) process control,

(iii) parity,

(iv) micro-program,

(v) double-length working. (4 marks each)

8. $$A = \begin{pmatrix} 0 & 2 & -1 \\ -3 & 1 & -2 \end{pmatrix}; \quad B = \begin{pmatrix} -2 & -2 & 1 \\ 0 & -1 & 3 \end{pmatrix}; \quad C = \begin{pmatrix} 2 & -3 \\ -1 & 4 \\ 0 & -1 \end{pmatrix}; \quad D = \begin{pmatrix} 0 & -1 \\ 4 & 0 \end{pmatrix}$$

Find:

(a) (i) $A - B$ (3 marks)

(ii) BC (4 marks)

(iii) $(D)^{-1}$ (5 marks)

(b) (i) Why is matrix manipulation so much used in programming? (4 marks)

(ii) Give **two** examples of the use of matrix manipulation to facilitate problem solving. (4 marks)

9. An invoice is to be prepared by a builder for sending to a client. The builder has used his own labour and that of a number of sub-contractors, e.g. for plumbing and electrical wiring. Each sub-contractor and the builder has incurred costs for labour and materials.

(a) (i) Prepare an invoice, using your own figures, under the heading of 'A. Bloggs & Co.' in a typical invoice format, including all the items detailed above. (Marks will not be awarded or deducted for the correctness of prices of materials or costs of labour.) (10 marks)

(ii) State clearly how each item is dealt with by hand in the course of preparation of the invoice. (5 marks)

(b) If this invoice was to be prepared by a computer, what differences would be necessary in the handling of the data items used in part (a)? (5 marks)