READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE sections.

2. Answer ALL questions from the THREE sections. Each section consists of TWO questions.
SECTION A

COMPUTER ARCHITECTURE AND ORGANIZATION

Answer BOTH questions.

1. (a) Draw a clearly labelled block diagram of a 2 to 1 line multiplexer. [5 marks]
(b) Explain what is meant by the term 'logic gate'. [2 marks]
(c) Write the truth table for the circuit shown in Figure 1 by listing all possible input bit patterns and their corresponding outputs.

Figure 1.

(d) State which of the following terms are associated with a single output value:

- Decoder
- Flip-flop
- Multiplexor [2 marks]
(e) A decoder is used to display the number of the teller who is available to serve the next customer in a bank. The seven-segment configuration illustrated in Figure 2 is used to form the number of the teller.

![Figure 2.]

(i) If there are three bits needed to display a digit, calculate how many digits this decoder can display. [2 marks]

(ii) List the letters of the segments that must be switched on to display the number 5. [5 marks]

(f) Find the 4-bit two's complement of −7. [2 marks]

(g) Consider the following floating point representation:

1-bit sign, 3-bit exponent, 5-bit mantissa

Calculate the decimal representation of 001110110. [3 marks]

Total 25 marks
2. (a) Describe the THREE main activities that take place in an instruction cycle, stating the correct order. [5 marks]

(b) (i) Give ONE similarity and ONE difference between RAM and hard disks as used in computer systems. [2 marks]

(ii) Give TWO reasons why registers are included in the CPU of a computer. [4 marks]

(c) Briefly describe a situation where EACH of the following can be used:

(i) Supercomputer

(ii) PDA

(iii) Mainframe [6 marks]

(d) Describe the kind of information that is typically stored in the ROM of a computer. [2 marks]

(e) Discuss TWO reasons why current computers may not be able to work efficiently with new storage devices developed ten years from now. [6 marks]

Total 25 marks
SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) Give ONE example of EACH of the following control constructs:
   (i) Sequence
   (ii) Selection
   (iii) Iteration [6 marks]

(b) A secondary school is doing a survey on students’ favourite subjects. Students are asked to vote for any of four choices: Mathematics, English, Spanish, none. If Mathematics, English or Spanish is not the favourite, students vote “none”.

Write an algorithm to find and print:
   (i) The number of students that voted for EACH of the subjects: Mathematics, English, Spanish
   (ii) The TOTAL number of students that voted for Mathematics, English or Spanish

Assume that on the day of the survey, 100 students are present. Also assume that all votes are valid. [10 marks]

(c) Write an algorithm that uses iteration to find the sum of all multiples of six and all multiples of seven between 100 and 250 exclusive. Use one variable, for example, sumMulti, to accumulate the sum of the multiples of both numbers in the given range. [9 marks]

Total 25 marks
4. (a) Construct an algorithm to solve the following problem.

Data exists for ten items. Each line of data consists of a product name, price and discount %. You are required to read the data and complete the following tasks.

(i) Print the product name, the discount for that product followed by the new price. For example, given

Shirt   120  25

The algorithm should print

Shirt   30  90

where “Shirt” is the product, $30 is the discount of 25% and $90 is the price after the discount.

(ii) Print the TOTAL amount of product discounts overall. If the total amount of discounts is greater than $500, print “Discounts exceeded.”

(b) Construct a flow chart to represent the algorithm given in 4 (a) above.

(c) Read the following algorithm and answer the questions that follow.

```
read x
sum1 = 1
while x < 10 do
    sum1 = sum1 * (x-1)
    print sum1
    read x
endwhile
print 'Sum=', sum1
```

What would the algorithm print given the line of input data below? (Clearly show how you arrived at your answer.)

5    3    2    6    12    4

Total 25 marks
SECTION C

PROGRAMMING

Answer BOTH questions.

5. (a) State the stage of the translation process that represents EACH of the following descriptions:

(i) A stream of characters making up the source program is read from left to right and grouped into tokens

(ii) A piece of code is transformed to make it more efficient without changing its output or side effects [2 marks]

(b) Explain the role of a ‘watch’ in programming. [2 marks]

(c) Write a C function which accepts an integer array and an integer variable indicating the size of the array. The function should return a count of the numbers in the array that are LESS THAN 20. [6 marks]

(d) A nonprofit organization is asking for donations for a worthy cause. They hope to raise $100,000.

All donations are stored in a file called ‘donations.txt’. The first line of the file gives the amount the organization hopes to raise. Each line thereafter contains the amount of each donation. The last line of data in the file contains −1 only.

Write a C program that determines and outputs to a file, “funds.txt”, the total funds raised and how many donations were made. (You may not use arrays in your solution.) [15 marks]

Total 25 marks
6. (a) Explain why indentation is important in programming. [2 marks]

(b) Why is it recommended that comments be used in programming code? [2 marks]

(c) What output is produced by the following C program? (For the output state the values of i and j at each stage.)

```c
#include <stdio.h>
int main ()
{
  int i, j, final = 1;
  for (j = 9; j > 0; j = j - 3) {
    i = j / 3;
    while (i < j) {
      printf("\ni is %d j is %d\n", i, j);
      j--;
      i = i + 1;
      final = final + 2*j;
    } //while
  } //for
  printf("\nFinal Output: %d\n", final);
  scanf("%c");
  return 0;
} //main
```

(d) Write a C program that accepts two values, price and tax (both of type float). The program applies tax to price and prints the old price and the new price in an appropriate message. Note that tax is given as a percentage.

For example, given 1000 10

The program prints: Old price: $1000 New Price with tax: $1100 [6 marks]

(e) Write C code to read four integers and print their average. (Do not write an entire program.) [4 marks]

Total 25 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.