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

DATA STRUCTURES

Answer BOTH questions.

1. (a) State whether a stack must exist for each of the following operations:
   (i) CreateStack
   (ii) DestroyStack

(b) (i) In a searching application the procedures Add or Mult cause the following to occur:
   - The stack is popped twice
   - The two popped items are added (Add) or multiplied (Mult)
   - The result is pushed back onto the stack

Use the following sequence of procedure calls to determine the contents of the stack below if \( X = 1 \), \( Y = 2 \), \( Z = 3 \), and \( W = 4 \). (Show all steps involved.)

```
Push (Stack, X)
Push (Stack, Y)
Add (Stack)
Push (Stack, Z)
Push (Stack, W)
Mult (Stack)
Add (Stack)
```

(ii) State ONE condition that must exist for the Add and Mult procedures to work effectively.

(iii) If the ADD operation is continuously used on the stack, explain what would happen to the stack.

(c) (i) Explain the purpose of Enqueue() and Dequeue() in a FIFO queue.

(ii) Using only the operations of the queue Abstract Data Type (ADT), write an algorithm CountQueue that returns an integer count of the number of elements in the queue.

Total 25 marks
2. (a) The numbers 5 and 15 are to be stored in a singly linked list. Explain how these numbers would be inserted into the list. Draw the final linked list. [10 marks]

(b) (i) Write C code to declare an array num that can store 100 integers. [2 marks]

(ii) Write code to fill num with integers entered by the user. [4 marks]

(iii) Write C code to accept an integer key from the user and search num to see if key is present. If found, print the location of key; otherwise, print "Key Not found". [9 marks]

Total 25 marks
SECTION B
SOFTWARE ENGINEERING

Answer BOTH questions.

3. (a) Explain what is meant by a 'deliverable' in the systems development life cycle. [3 marks]

(b) Describe TWO factors that can cause an information system to be replaced. For each factor describe why the development of a new information system would be necessary. [4 marks]

(c) Describe THREE main factors that must be considered during a feasibility study of the systems development life cycle. [6 marks]

(d) A popular diet drink is sold in many stores. Each store has one or more branches. A branch is supervised by a manager who hires employees to run its day-to-day business activities. Employees can be transferred to any branch. The following information is stored on a drink: Barcode Num (primary key), size, and flavour.

Draw an entity-relationship diagram for the above scenario. [12 marks]

Total 25 marks
4. Students at a university are required to register for courses using an online system. Some of the information to be entered is illustrated in the screen-based form below.

| CAPE University                               |
| Student Registration Form                     |
| Student ID:                                    |
| Date of Birth:                                 |
| Course Code and Name:                         |
| Course Code and Name:                         |
| Course Code and Name:                         |
| Course Code and Name:                         |
| Course Code and Name:                         |

(a) Answer the following questions based on the options below.

- Student ID
- Date of Birth
- Course Code and Name

For EACH option:

(i) Write TWO examples of data that may be entered in the form. [6 marks]

(ii) Explain whether a textbox, menu, command line, checkbox or other option would be suitable. [3 marks]

(iii) Describe a test that could be used to ensure that valid data is entered. [3 marks]

(b) A pharmaceutical company receives orders from pharmacies at its sales department. The sales department prepares an internal order form that is sent to the warehouse and also sends an acknowledgement to the pharmacy.

The data from the internal order form is stored in a database. The warehouse checks its stock database for the availability of the items. For items in stock, the order is prepared and shipping instructions are sent to the shipping department which sends a copy to the sales department and to the accounting department. The accounting department sends the invoice to the customer. All items not in stock are placed on backorder to be processed by the shipping department.

Draw a Level-0 data flow diagram that shows the flow of information between the pharmacy, pharmaceutical company and various departments within the company. [13 marks]

Total 25 marks
SECTION C

OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) You have been asked to set up a small home network for a friend. She needs Internet access on computers. She has purchased a switch and a router. The Internet service provider has already installed a modem which is providing Internet service to her home. She also has a large supply of twisted pair cables and connectors.

(i) Draw a diagram to show how her network would be set up. [6 marks]

(ii) State the role of the modem, switch and router in the network drawn. [3 marks]

(b) What is a hybrid network topology? [1 mark]

(c) Describe ONE advantage and ONE disadvantage of using fibre optics as a transmission medium. [4 marks]

(d) With the aid of a diagram, explain how data is communicated in an IEEE802.11b network. [6 marks]

(e) Explain why the quality of voice over IP (VOIP) communication might be different from telephone communication service as offered by the telephone company. [3 marks]

(f) What is the main purpose of general packet radio service (GPRS)? [2 marks]

Total 25 marks
6. (a) Early operating systems were 'primitive batch systems'. Currently there exists 'sophisticated multiuser systems'.

Describe EACH of the following terms:

(i) Primitive batch systems
(ii) Sophisticated multiuser systems [4 marks]

(b) An application process exists in a computer. Explain what is meant by a

(i) blocked process
(ii) running process. [4 marks]

(c) A user is playing a game that accesses a small file on a disk to get a high score. The game process reads the file, gets the value and uses it in the process itself.

Explain how interrupts are used in the above scenario. [3 marks]

(d) What is pre-emptive scheduling of processes? [2 marks]

(e) Student records at Bayshore High School are stored in a database on a computer at the school. Discuss THREE ways in which the students' records can be secured from unauthorized access. [9 marks]

(f) Explain the role of the special software used to allow the operating system to communicate with devices. [3 marks]

Total 25 marks

END OF TEST

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