READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE sections.

2. EACH section consists of TWO questions.

3. Answer ALL questions in the THREE sections.
SECTION A
DATA STRUCTURES
Answer BOTH questions.

1. (a) Why are stacks and queues classified as ADTs? [2 marks]

(b) Describe the main differences between stacks and queues. Support your answer by giving a real-life example to illustrate how EACH ADT can be used.

Note: An example should be given for each ADT. [6 marks]

(c) Use C code to:

(i) Write a function that adds an integer to a stack. The arguments for your function should be the stack and the number to be added. Your function should not call any other functions. [7 marks]

(ii) Write a function that adds an integer to a queue. The arguments for your function should be the queue and the number to be added. Your function should not call any other functions. [7 marks]

(d) Letters A, C, X and E have been added to a stack in the given order. Draw a diagram to illustrate how the letter C could be removed from this stack. Use the diagram to show the changing contents of the stack at EACH stage of the process. [3 marks]

Total 25 marks
2. (a) Consider the array called **data** below.

| data | 10 | 13 | 8 | 15 | 16 | 6 | 22 | 4 |

A selection sort algorithm is being used to sort the eight integers in **ascending** order (that is, smaller values must come before bigger values).

Draw the array after the first, second and third passes of selection sort (that is, 3 diagrams in all). [6 marks]

(b) A linked list contains **three** nodes with the integers 3, 4 and 5, where 3 is at the head of the list, 4 is in the middle and 5 is at the end.

(i) Draw a diagram to show the linked list. [3 marks]

(ii) Explain how to delete the integer 3 from the linked list. [4 marks]

(c) Assume that an array, **numbers**, of size 50 is already loaded with 50 integers and **sorted in ascending order**.

(i) Write code to obtain the value of an integer, **target**, from the user. [2 marks]

(ii) Using the array, **numbers**, write code to search for the value, **target**, using binary search. If target is found, print its location, otherwise print –1. [Target is the value obtained from the user in (c) (i) above.] [10 marks]

**Total 25 marks**
SECTION B
SOFTWARE ENGINEERING

Answer BOTH questions.

3. (a) Explain the rapid prototyping approach to systems development.

(b) Describe the main challenge which the rapid prototyping approach seeks to overcome.

(c) Some systems analysts believe that the entire systems development life cycle can be initiated and completed during the maintenance phase. Explain FOUR reasons why this may be true. Your answer should contain FOUR major points.

(d) New Smiles is a doctor’s office operating in the busy town of Happy Ville. Patients book appointments in advance to see Dr Sam. Typically, a patient calls into the office to request an appointment. The receptionist asks for the person’s name to check whether their patient record already exists in the patient database. If the record does not exist, a new patient record must be created in the database using the following information gathered from the patient: name, telephone number, address, and a brief medical history.

On completion of this standard procedure the receptionist books the appointment; that is, the patient submits a preferred date/time, the receptionist checks the appointment database for available dates/time and schedules a suitable appointment based on this. The scheduled appointment is returned to the patient.

Finally, every day the receptionist calls patients one day before their appointment to provide them with a reminder. A list of upcoming appointments is generated from the appointment database to facilitate this.

Draw a Level-0 diagram to represent the flow of data described in the case above.

[13 marks]

Total 25 marks
4. (a) Why are data flow diagrams developed during the analysis phase as well as the design phase of the system development life cycle? [3 marks]

(b) State THREE benefits of the object oriented approach to software design. [3 marks]

(c) Describe TWO of the major deliverables resulting from the design phase of the system development life cycle. [4 marks]

(d) In a certain company, employees are assigned to a single department. Each department is managed by a manager and a manager can be assigned to more than one department. There are a number of supervisors who work in each department and each one may supervise one or more employees. Each employee has a unique employee ID (primary key). The company keeps track of the name of each employee, his/her address, job title, next of kin and an emergency contact number.

Draw an entity-relationship model for the above scenario. Relationships should be named and the cardinality of each relationship should be clearly specified. All given attributes should be clearly noted in your model. [15 marks]

Total 25 marks
SECTION C

OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) Briefly describe TWO advantages of a client/server network over a peer to peer network. [4 marks]

(b)   (i) Explain what is meant by the term ‘firewall’. [2 marks]

      (ii) Explain why firewall software needs to be frequently updated. [2 marks]

(c) State TWO differences between FDDI and Ethernet network architectures. [2 marks]

(d) Briefly explain the role of the network and transport layers in the OSI network model. [4 marks]

(e) Outline THREE reasons why many users prefer wireless routers over wired routers. [3 marks]

(f)   (i) Explain the purpose of GPRS. [2 marks]

      (ii) Name and describe TWO applications that use GPRS. [6 marks]

Total 25 marks
6. (a) Carefully explain the role of a device driver in an operating system. [3 marks]
   
   (b) Jeff received a message on his computer: “Document is currently spooling…”

   Explain the meaning of the term ‘spooling’. [3 marks]

   (c) Outline TWO advantages of a menu interface over a command interface. [4 marks]

   (d) Briefly describe TWO components of a process control block in an operating system. [4 marks]

   (e) Besides passwords, explain TWO other ways in which files can be protected from unauthorized access. [4 marks]

   (f) Explain how processes can be scheduled in round-robin. [3 marks]

   (g) Explain how an interrupt is handled by the processor in a computer. [4 marks]

   **Total 25 marks**

**END OF TEST**

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

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