FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	**IFM01B1 & IFM1B10** INFORMATICS 1B: *INTRODUCTION TO DATA STRUCTURES (VB)*
CAMPUS	APK
EXAMINATION	JANUARY 2020 (SSA)

DATE	2020-01-07	**TIME**	15:00–17:00
ASSESSORS		PROF WS LEUNG MR D COTTERRELL	
INTERNAL MODERATOR		MS M FOURIE	
DURATION	2 Hours	**MARKS**	100

INSTRUCTIONS

- Length of this question paper (including this cover page): 5 (five) pages.
- ALL questions are compulsory.
- Code questions may only be answered in syntactically-correct Visual Basic.
- Mark each answer correctly and answer entire questions contiguously (in ONE block) – if this is not possible, clearly indicate that your answer continues later.
- Write clearly and legibly – marks will not be awarded if the lecturer is unable to make sense of what has been written.
- Write only using a black or blue pen – work in pencil will not be marked.
- Do NOT write any answers on this question paper.
- The use of calculators is not permitted.
- Make use of the mark allocation as a guideline for how much content must be written. The recommended minimum is 1 fact for each mark.

DO NOT TURN OVER THIS QUESTION PAPER UNTIL
YOU HAVE BEEN GIVEN INSTRUCTION TO COMMENCE

QUESTION 1: General Knowledge Information Technology

1.1. Name one individual who is believed to have played a pioneering role in the creation of the Internet. (1)

1.2. Explain the difference between a compiler and an interpreter in terms of how code is executed. Why is it ambiguous to indicate that the one is faster than the other? (4)

1.3. What does IoT stand for? (1)

1.4. Name a specific type of tree data type. (1)

1.5. Name the three different classes of programming languages. (3)

[10]

QUESTION 2: Recursion

Consider the following recursive function. What does it calculate in terms of x, y, and z? (5)

```
01: Private Function Q2Recurse(ByVal x As Integer, ByVal y As Integer, _
02:                            ByVal z As Integer) As Integer
03:     If y < 0 Then        'Assume that Q2Recurse always starts with y >= 0
04:         Return 1
05:     Else
06:         Return (x * z) * Q2Recurse(x, y - 1, z)
07:     End If
08: End Function
```

Choose ONE of the following options below. You MUST show your full working out by means of a trace table.

A) $(x \times z)^{y}$

B) $(x \times z)^{(y + 1)}$

C) 1

D) $(x \times z)^{(y - 1)}$

E) None of the above.

[5]

QUESTION 3: Unified Modelling Language (UML) Notation

Consider a class called `HealthWorker` which will be used by Dr Motsepe's Local Clinic to manage the medical staff she has working there. Present a single UML class diagram in which you:

3.1. Define the `HealthWorker` class – it must have at least two attributes and one appropriate method (constructor and property methods do not count). (2)

3.2. Define two additional classes which inherit directly from `HealthWorker` – they must each have two attributes and one appropriate method each (constructor, property methods, and overridden methods do not count). (6)

3.3. Use the correct UML notation. (2)

[10]

QUESTION 4: General Programming

Consider the following classes:

- `FastFoodPlace`
- `BurgerFastFood`
- `PizzaFastFood`
- `ILicensedToServeAlcohol`
- `CashRegister`
- `frmFastFoodChain`

Using only the above-mentioned classes provided, demonstrate that you understand the following concepts by writing sufficient and appropriate Visual Basic code (i.e. the code must be relevant to the classes) to fully illustrate the programming concepts listed below. Make sure that you clearly indicate:

- The classes that your code is located in; and
- Where the concept is being demonstrated in your code.

4.1.	Make the base class abstract.	(1)
4.2.	In this base class, define an appropriate internal class composition relationship. Create a property method for this relationship, allowing external members to write to, but not read from the item.	(4)
4.3.	Define the constructor which will also instantiate the component object defined in Question 4.2	(2)
4.4.	Define a utility method in the base class that can also be used in the derived classes.	(2)
4.5.	Demonstrate the concept of shadowing. In the line below, as a comment, rectify the error created.	(3)
4.6.	Definition and use of a class-level member.	(4)
4.7.	Upcasting.	(4)
		[20]

QUESTION 5: Collision Handling

Given that you are provided with the following hash table for insertion into a random access file with 13 record positions (records are inserted into the file in the order table), illustrate the contents of the full random access file if the following collision handling methods are used:

5.1.	Linear search.	(5)
5.2.	Synonym chaining.	(5)
5.3.	Two-pass file creation.	(5)
		[15]

Entry #	Key	Position
1	Alpha	8
2	Bravo	12
3	Charlie	10
4	Delta	3
5	Echo	4
6	Foxtrot	3
7	Golf	2
8	Hotel	4
9	India	5
10	Juliet	6

QUESTION 6: Random Access Files

Consider the following which defines the structure of the 18 `Pizza` records that a Random Access File will store:

```
01: Private Structure Pizza
02:   Public ID As Integer
03:   Public Name As String
04:   Public Vegetarian As Boolean
05: End Structure
```

With the exception of Questions 6.1 and 6.2, provide syntactically correct Visual Basic code (along with any necessary declarations) in all questions in this section.

6.1. Describe two strategies for ensuring that all Pizza names are limited to 13 characters only. Which one would you use? *Your answer must be well-motivated.* (3)

6.2. What is the size of one `Pizza` record structure in bytes? Show your working out. (2)

6.3. Define `CalcHash`, a function that will return a file position in the Random Access File, given the Integer parameter `PizzaID`. (4)

6.4. Create a brand new file which must be physically stored locally as `Menu.ifm`. Use the `Pizza` variable `BlankPizza` which has already been initialised for you. The relevant resources will close and clear themselves. (6)

[15]

QUESTION 7: Sequential Files

Provide syntactically correct Visual Basic code (along with any necessary declarations) in all questions in this section.

```
01: Private FS As FileStream
02: Private BF As BinaryFormatter
03: Private Plants() as Plant
04: 'Assume that all Plant objects have been correctly instantiated
05: 'Create new file and save all Plant objects sequentially
06: 'Add up the weight (an integer attribute) of all PoisonousPlant objects
```

7.1. Add the necessary FCL reference so that `FileStream` objects can be used without its fully qualified name. (1)

7.2. Create the `FS` object for reading objects from the file. The file is physically located in the location `C:\Isley.ifm`. (2)

7.3. Read the full contents of the file. We are interested in the total weight (add up the `Weight` Integer attribute) of only the `PoisonousPlant` objects. Output this total weight to a textbox called `txtTotalPPWeight`. (5)

7.4. Provide an algorithm for merging two sequential files containing `Plant` objects. You may assume that each file contains `Plant` objects stored sequentially in the order of their `PlantIDs`. No collisions will occur. (7)

[15]

QUESTION 8: Social Aspects of IT

During one of the practicals, you were asked to work on a team project.

Discuss two different tools (or techniques) that you used in order to aid you in your collaboration with your team members. Which worked? Which did not? In future, how would you ensure a smooth collaborative effort?

[10]

The End

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