GWANDA STATE UNIVERSITY

FACULTY OF COMPUTATIONAL SCIENCES

DEPARTMENTS OF MATHEMATICS AND STATISTICS

COMPUTATIONAL THINKING

CMS 1211

Examination Paper

April 2025

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **Mr. M. Mpofu**

INSTRUCTIONS

Candidates should answer question 1 and attempt **ANY OTHER THREE** questions.

ADDITIONAL REQUIREMENTS

Scientific calculator

Answer question 1 and any THREE questions.

1. (i) Define

(a) Program [2]

(b) Computational thinking [2]

(c) System software [2]

(ii) State the role of an Operating System. [4]

(iii) Distinguish between utility program and software development tools. [4]

(iv) Explain the *fetch-decode-execute cycle*. [5]

(v) Convert the following

(a) 11101010_2 to excess notation. [3]

(b) 13.375_{10} to 32 bit floating point format. [3]

2. (i) Differentiate between **top-down** and **bottom-up** approaches in computational problem-solving. [4]

(ii) Explain the four pillars of computational thinking with examples

(a) Decomposition [3]

(b) Pattern recogition [3]

(c) Abstraction [3]

(d) Algorithm design [3]

(iii) Describe the properties of an Algorithm. [4]

(iv) How does abstraction help in reducing complexity when designing an algorithm? Provide an example. [5]

3. (i) Define debugging [2]

(ii) Distinguish between a bug and error. [2]

(iii) State **TWO** advantages and **TWO** disadvantages of **Top-down**. [4]

(iv) Explain how the following measures can be used to mitigate errors:

(a) Getting defensive. [2]

(b) Reacting to problems. [2]

(v) Figure 1 and Figure 2 show an extract of a python code.

In [11]:

```
# Create variables
num_years = 4
days_per_year = 365
hours_per_day = 24
mins_per_hour = 60
secs_per_min = 60

# Calculate number of seconds in four years
total_secs = secs_per_min * mins_per_hour * hours_per_day * days_per_year * num_years
print(total_secs)
```

```
126144000
```

Figure 1:

In [13]:

```
print(hours_per_dy)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
/tmp/ipykernel_18/142450907.py in <module>
----> 1 print(hours_per_dy)

NameError: name 'hours_per_dy' is not defined
```

Figure 2:

(a) Explain each line of code in Figure 1. [5]

(b) Rewrite in the python code in Figure 1 and define a new variable **births_per_min** and set it to 250. Define a variable **births_per_day** that contains the average number of babies born each day. Mark as **In[14]**. [5]

(c) Identify the type of bug in figure 2. Rewrite the code to debug. [3]

4. (i) Distinguish between inductive argument and deductive argument. Include examples. [4]

(ii) Give an example of a real-world problem where decomposition can be applied and explain how it helps. [6]

(iii) A grocery store wants to develop a self-checkout system where customers scan items, get a bill, and make a payment. Identify how computational thinking can be applied in designing such a system. [7]

(iv) Explain how the process of abstraction can be applied to design a smart city traffic management system. [8]

5. (i) Define an Algorithm. [2]

(ii) A program is needed to calculate the roots of a quadratic equation

$$ax^2 + bx + c = 0$$

The roots of the equation are

$$x_1 = \frac{-b + d}{2a} \quad \text{and} \quad x_2 = \frac{-b - d}{2a}$$

The discriminate, $d = \sqrt{b^2 - 4ac}$

(a) Develop an algorithm to solve the above problem. [10]

(b) Produce a python program to calculate the two roots. [13]

END OF QUESTION PAPER