

University of KwaZulu-Natal
School of Engineering
Electrical, Electronic, and Computer Engineering Discipline
Howard College Campus
Main examination:
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ENEL2CM: Applied Computer Methods

Duration: Two hours

Marks: 100

Examiner

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Moderator

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Instruction:

- Answer all five questions; each question has a subsection (A, B, C, and D)
- Start each question on the new page and number the answers.
- Calculators (Scientific) may be used.
- This paper must be kept in the exam hall.

Question 1: Fundamentals of Python Programming

[10 marks]

(A) Which of the following statements correctly assigns the floating-point value 36.5 to a variable named temp in Python? [2 marks]

- a) temp = "36.5"
- b) 36.5 = temp
- c) temp = 36.5
- d) temp == 36.5

Select the correct option and briefly justify your answer.

(B) Consider the following Python statement: [2 marks]

```
speed = '120'
```

- Identify the data type of the variable speed.
- Explain why it is of that type, referring to how Python interprets values.

(C) Write a Python code snippet that: [3 marks]

- Prompts the user to enter a floating-point number,
- Converts this value into an integer,
- Then displays the converted value.

Your answer must include input, conversion, and output.

(D) You are required to store a list of students along with their corresponding marks. [3 marks]

- Suggest the most appropriate data structure in Python to store this data.
- Justify your choice by explaining:
 - How the data will be organized,
 - Why this structure is suitable compared to at least one other option (e.g., list or tuple).

Question 2: Arrays and Iteration in Python

[15 marks]

(A) Consider the following Python code:

[4 marks]

```
import numpy as np
arr = np.zeros((2, 2))
for i in range(2):
    for j in range(2):
        arr[ i ][ j ] = i + j
print(arr)
```

- Predict the final output of the array.
- Show the intermediate values assigned to each position to justify your answer.

(B) Write a Python program using the NumPy library that:

[4 marks]

- Creates an array containing integers from 1 to 20,
- Squares each element in the array,
- Displays the updated array.

Ensure your solution is efficient and uses NumPy operations where possible.

(C) Using the array created in Question 2(B):

[3 marks]

- Write Python code to compute the average (mean) of all elements,
- Display the result.

(D) Write a Python program that:

[4 marks]

- Prints all numbers between 1 and 50,
- Displays only the multiples of 3,
- Clearly formats the output.

Your solution must use a loop and conditional statement.

Question 3: Symbolic Computation using SymPy

[20 marks]

(A) Write a Python program using the SymPy library to solve the following equation:
[6 marks]

$$x^2 + 4x + 4 = 0$$

- Define the symbolic variable,
- Solve the equation,
- Display the solution(s).

Your answer must include all necessary steps in SymPy.

(B) Consider the function:

[5 marks]

$$f(x) = x^2 * \sin(x)$$

Write a Python program using SymPy to:

- Compute the first derivative of the function,
- Display the result in simplified form.

(C) Write a Python program using SymPy to solve the following system of equations:
[5 marks]

$$x + y = 5$$

$$x - y = 1$$

- Define both variables symbolically,
- Solve the system simultaneously,
- Display the values of x and y.

(D) Study the code below and predict the output:

[4 marks]

```
import sympy as sp

x = sp.symbols('x')
expr1 = x**2 + 2*x + 1
print(sp.factor(expr1))
expr2 = (x + 1)**2
print(sp.expand(expr2))
```

- Write down the exact output produced,
- Briefly explain the difference between the factor() and expand() functions.

Question 4: File Handling and Data Analysis using Pandas**[30 marks]**

A CSV file named `students_marks.csv` contains the following information about students:

StudentID	Name	Test1	Test2	Exam
101	Andile	65	70	68
102	Thabo	58	62	60
103	Lerato	75	80	78
104	Amina	69	72	74
105	Sizwe	55	60	59

Write a complete Python application using the Pandas library to manage and analyse the student marks stored in the file.

Your program must perform the following tasks:

- Import the required library.
- Use a try-except block to load the file `students_marks.csv`.
- Display a suitable error message if the file is not found.
- Display a general error message for any other unexpected error.
- If the file is loaded successfully, display all student records.
- Check whether the dataset contains any missing values.
- Display the number of missing values in each column.
- Calculate and display the class average for the Exam column.
- Identify and display the student with the highest Exam mark.
- Create and add the following new student record to the dataset:

StudentID	Name	Test1	Test2	Exam
106	Naledi	72	76	79

- Display the updated dataset after adding the new student.
- Save the updated dataset back to `students_marks.csv`.

Your solution should demonstrate:

- Correct use of Pandas,
- Proper file handling,
- Clear output formatting,
- Logical program flow,
- Meaningful error messages.

Question 5: Applied Python Programming and System Efficiency Analysis
[25 marks]

A small engineering system is being monitored to determine whether it is operating efficiently. The system receives an input power and produces an output power. The efficiency of the system is calculated as:

$$Efficiency = \frac{Output\ Power}{Input\ Power} \times 100$$

The system is considered:

- Efficient if efficiency is 80% or above
- Moderately efficient if efficiency is from 60% to below 80%
- Inefficient if efficiency is below 60%

(A) Input validation loop **[11 marks]**

Write Python code that prompts the user to enter:

- Input power in watts
- Output power in watts

Your program must repeatedly ask the user to re-enter values until valid inputs are provided.

The program must display appropriate error messages in the following cases:

- The input power is less than or equal to zero
- The output power is negative
- The output power is greater than the input power

For example:

```
Input power must be greater than zero.  
Output power cannot be greater than input power.
```

(B) Analysis function **[7 marks]**

Create a function called `analyse_efficiency(input_power, output_power)`.

The function must:

- Calculate the efficiency percentage
- Determine whether the system is efficient, moderately efficient, or inefficient
- Return both the efficiency value and the system status

(C) Compute and display results

[7 marks]

After valid values have been entered, your program must:

- Call the `analyse_efficiency()` function
- Display the input power
- Display the output power
- Display the efficiency percentage rounded to two decimal places
- Display the system status