AI Assisted Coding

ASSIGNMENT 3.3

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Batch: 31

Lab 3: Application for TGNPDCL - Electricity Bill Generation Using Python & AI Tools

Lab Objectives
• To design a real-world electricity billing application using Python
• To use AI-assisted coding tools for logic generation and optimization
• To understand conditional logic and arithmetic operations
• To generate structured billing output similar to utility bills

Question 1:

Task 1: AI-Generated Logic for Reading Consumer Details

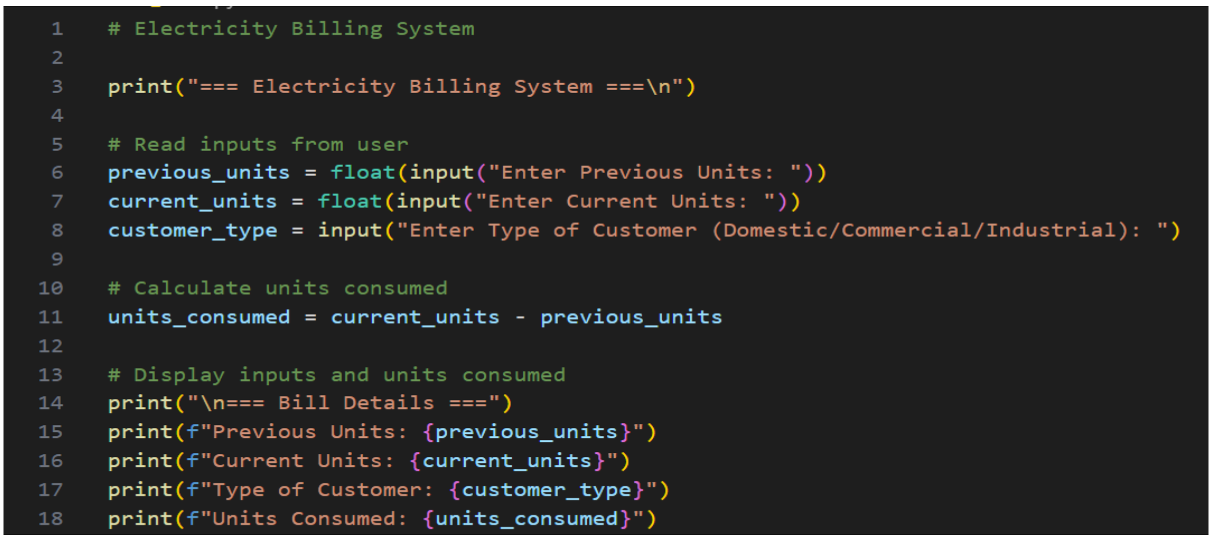
Scenario:
An electricity billing system must collect accurate consumer data.
Task Description:
Use an AI tool (GitHub Copilot / Gemini) to generate a Python program that:
• Reads:
Previous Units (PU)
Current Units (CU)
Type of Customer
• Calculates units consumed
• Implements logic directly in the main program (no functions)

Expected Output:
• Correct input reading
• Units consumed calculation
• Screenshot showing AI-generated code
• Sample input and output

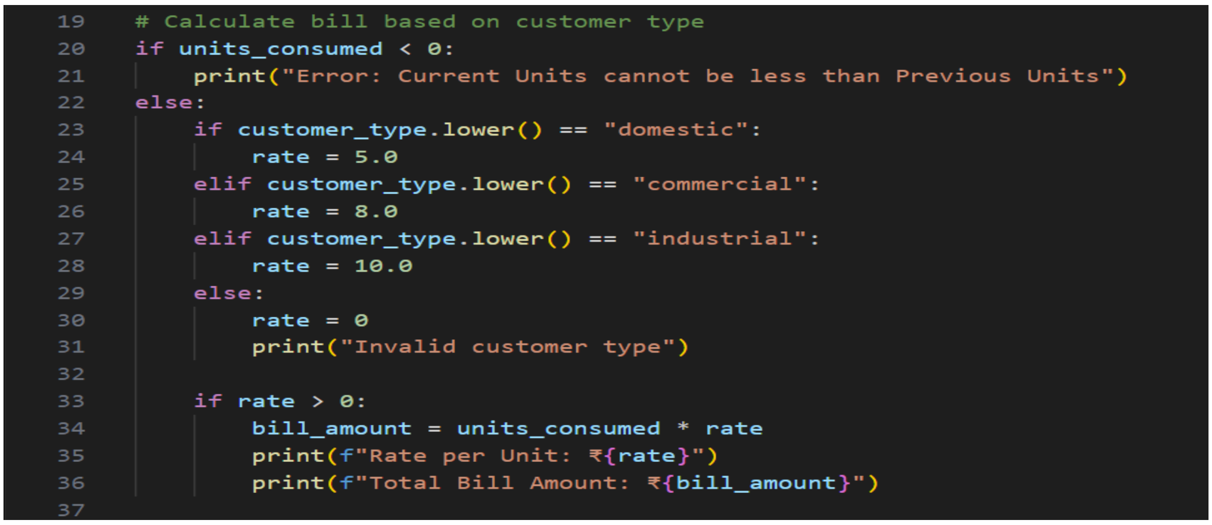
Prompt:

Write a Python program that reads Previous Units, Current Units, and Customer Type, calculates units consumed (CU − PU), implements all logic in the main program without functions, and prints the inputs and units consumed.

Code:

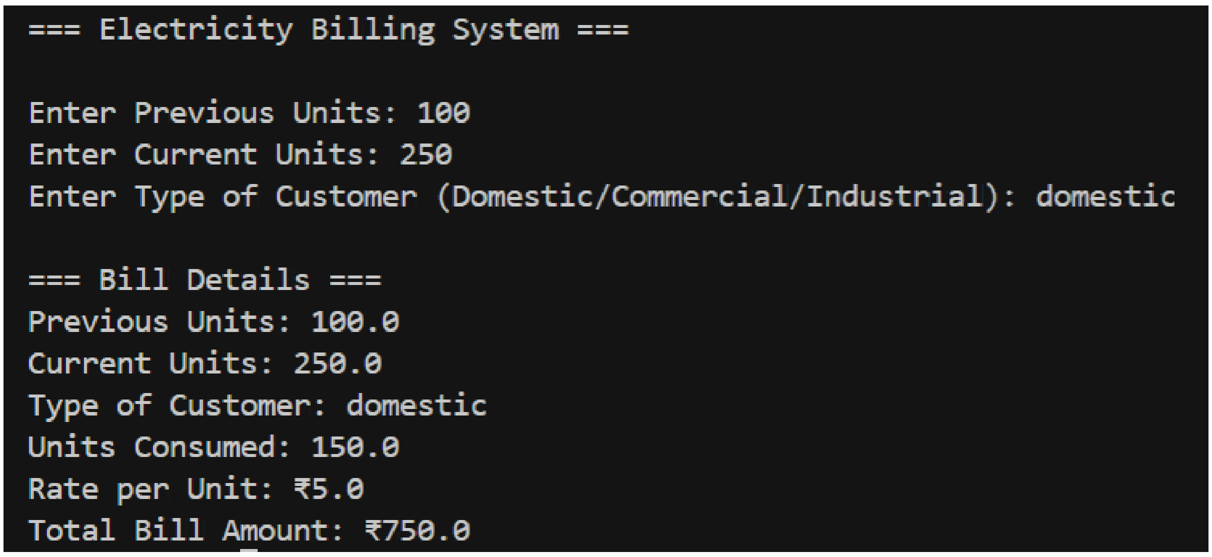


```python
# Electricity Billing System

print("=== Electricity Billing System ===\n")

# Read inputs from user
previous_units = float(input("Enter Previous Units: "))
current_units = float(input("Enter Current Units: "))
customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ")

# Calculate units consumed
units_consumed = current_units - previous_units

# Display inputs and units consumed
print("\n=== Bill Details ===")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Type of Customer: {customer_type}")
print(f"Units Consumed: {units_consumed}")
```

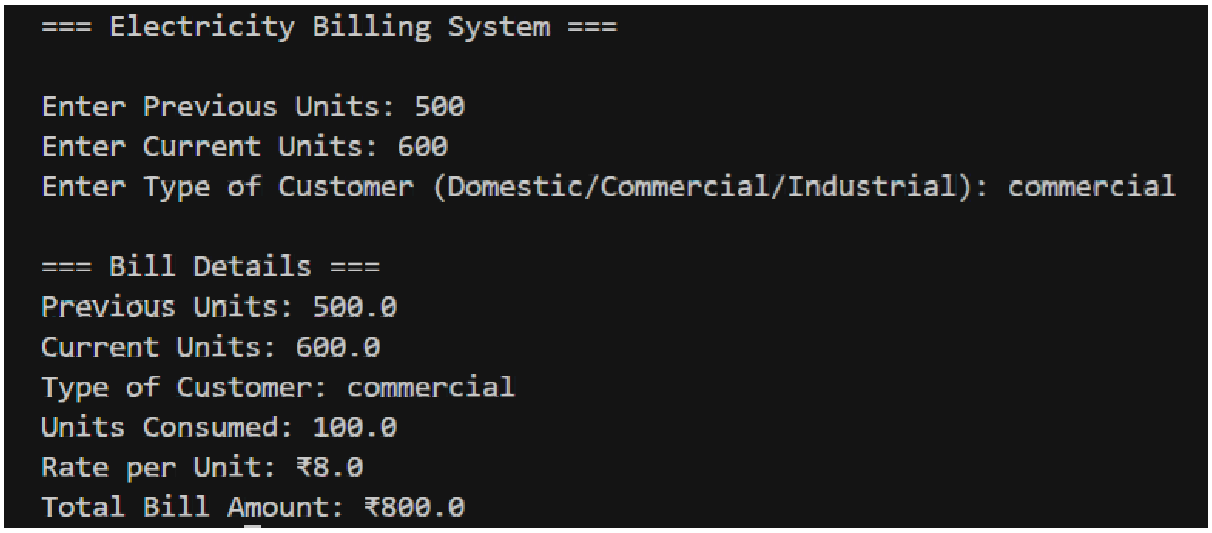


```python
# Calculate bill based on customer type
if units_consumed < 0:
    print("Error: Current Units cannot be less than Previous Units")
else:
    if customer_type.lower() == "domestic":
        rate = 5.0
    elif customer_type.lower() == "commercial":
        rate = 8.0
    elif customer_type.lower() == "industrial":
        rate = 10.0
    else:
        rate = 0
        print("Invalid customer type")

    if rate > 0:
        bill_amount = units_consumed * rate
        print(f"Rate per Unit: ₹{rate}")
        print(f"Total Bill Amount: ₹{bill_amount}")
```

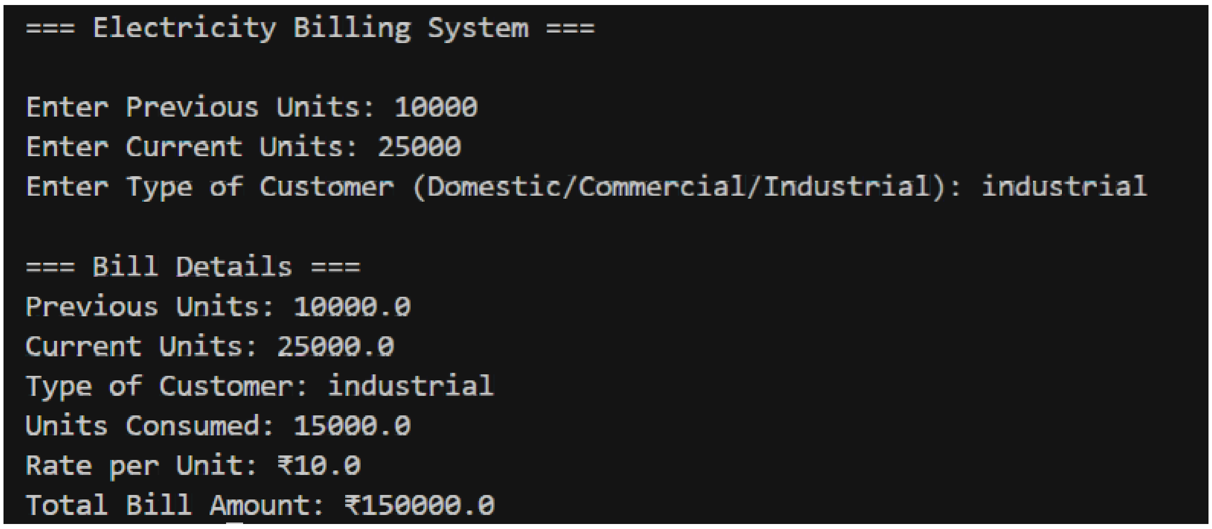
Output(O/P)



```
=== Electricity Billing System ===

Enter Previous Units: 100
Enter Current Units: 250
Enter Type of Customer (Domestic/Commercial/Industrial): domestic

=== Bill Details ===
Previous Units: 100.0
Current Units: 250.0
Type of Customer: domestic
Units Consumed: 150.0
Rate per Unit: ₹5.0
Total Bill Amount: ₹750.0
```



```
=== Electricity Billing System ===

Enter Previous Units: 500
Enter Current Units: 600
Enter Type of Customer (Domestic/Commercial/Industrial): commercial

=== Bill Details ===
Previous Units: 500.0
Current Units: 600.0
Type of Customer: commercial
Units Consumed: 100.0
Rate per Unit: ₹8.0
Total Bill Amount: ₹800.0
```



```
=== Electricity Billing System ===

Enter Previous Units: 10000
Enter Current Units: 25000
Enter Type of Customer (Domestic/Commercial/Industrial): industrial

=== Bill Details ===
Previous Units: 10000.0
Current Units: 25000.0
Type of Customer: industrial
Units Consumed: 15000.0
Rate per Unit: ₹10.0
Total Bill Amount: ₹150000.0
```

Explanation:

- The program reads user inputs for previous units, current units, and customer type.
- It calculates units consumed directly in the main program.
- No functions are used, keeping the logic simple and straightforward.
- The program displays all inputs and the calculated units, ensuring clarity for the user.

Question 2:

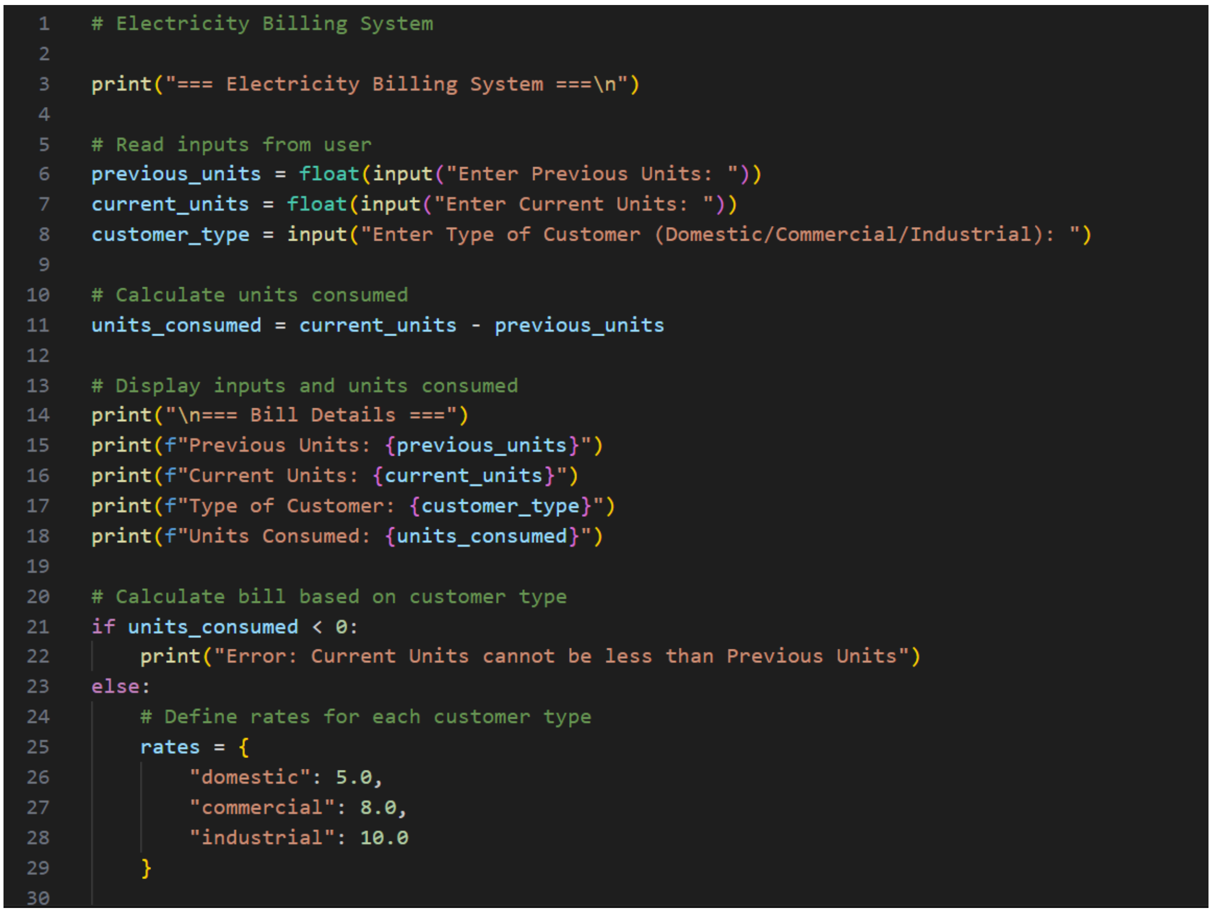
Task 2: Energy Charges Calculation Based on Units Consumed

Scenario:
Energy charges depend on the number of units consumed and customer type.
Task Description:
Review the AI-generated code from Task 1 and extend it to:
• Calculate Energy Charges (EC)
• Use conditional statements based on:
Domestic
Commercial
Industrial consumers
• Improve readability using AI prompts such as:
“Simplify energy charge calculation logic”
“Optimize conditional statements”
Expected Output
• Correct EC calculation
• Clear conditional logic
• Original and improved versions (optional)
• Sample execution results

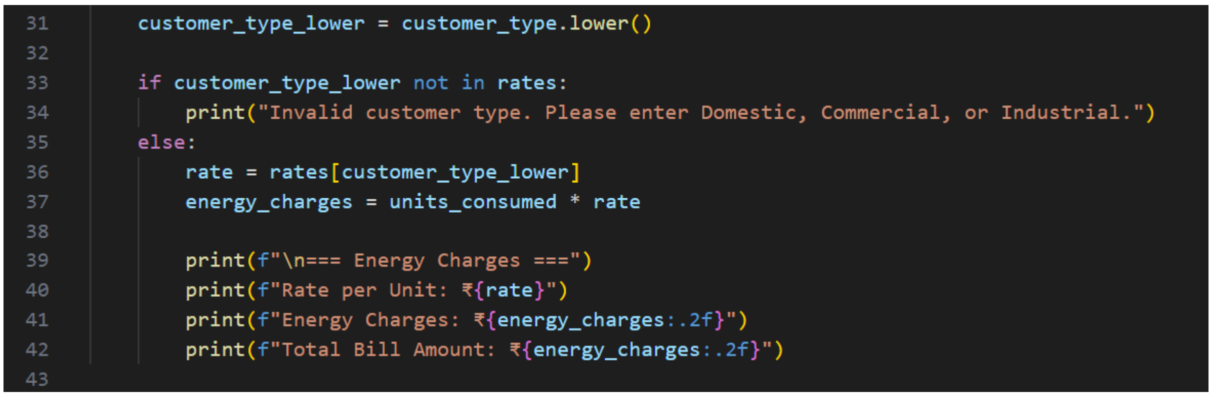
Prompt:

Extend the Python billing program to calculate Energy Charges (EC) based on units consumed and customer type (Domestic, Commercial, Industrial). Use clear conditional statements and optimize the logic for readability, then display the inputs, units consumed, and calculated charges.

Code:

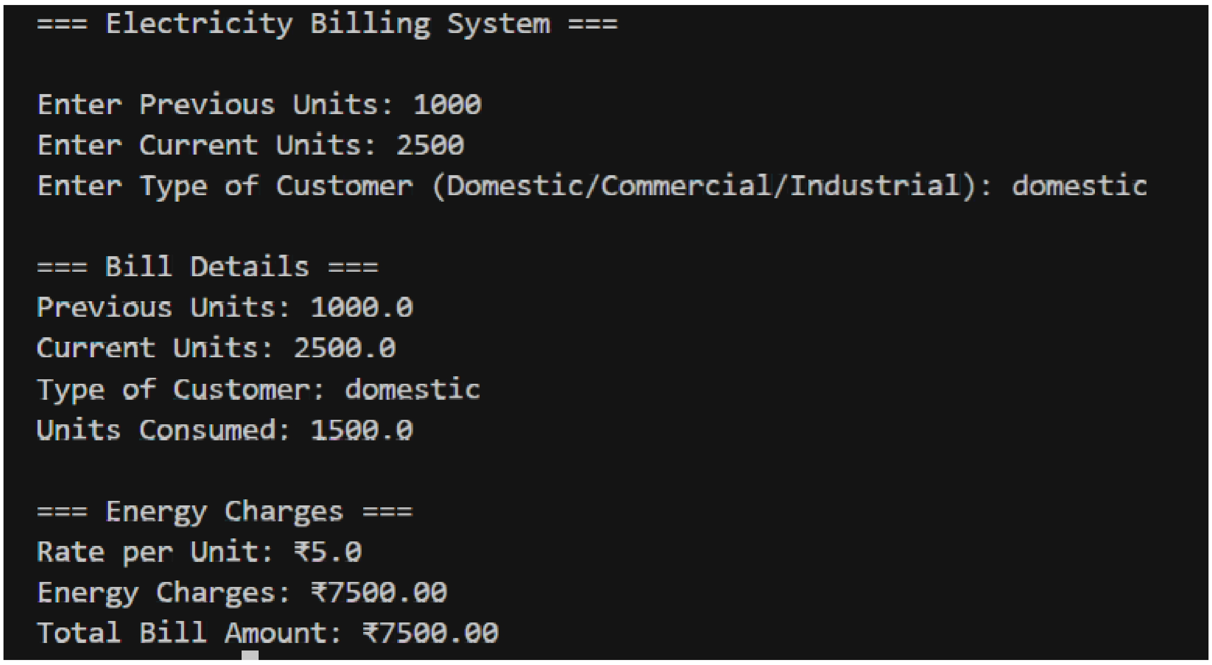


```python
# Electricity Billing System

print("=== Electricity Billing System ===\n")

# Read inputs from user
previous_units = float(input("Enter Previous Units: "))
current_units = float(input("Enter Current Units: "))
customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ")

# Calculate units consumed
units_consumed = current_units - previous_units

# Display inputs and units consumed
print("\n=== Bill Details ===")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Type of Customer: {customer_type}")
print(f"Units Consumed: {units_consumed}")

# Calculate bill based on customer type
if units_consumed < 0:
    print("Error: Current Units cannot be less than Previous Units")
else:
    # Define rates for each customer type
    rates = {
        "domestic": 5.0,
        "commercial": 8.0,
        "industrial": 10.0
    }

```



```python
    customer_type_lower = customer_type.lower()

    if customer_type_lower not in rates:
        print("Invalid customer type. Please enter Domestic, Commercial, or Industrial.")
    else:
        rate = rates[customer_type_lower]
        energy_charges = units_consumed * rate

        print(f"\n=== Energy Charges ===")
        print(f"Rate per Unit: ₹{rate}")
        print(f"Energy Charges: ₹{energy_charges:.2f}")
        print(f"Total Bill Amount: ₹{energy_charges:.2f}")

```

Output:



```
=== Electricity Billing System ===

Enter Previous Units: 1000
Enter Current Units: 2500
Enter Type of Customer (Domestic/Commercial/Industrial): domestic

=== Bill Details ===
Previous Units: 1000.0
Current Units: 2500.0
Type of Customer: domestic
Units Consumed: 1500.0

=== Energy Charges ===
Rate per Unit: ₹5.0
Energy Charges: ₹7500.00
Total Bill Amount: ₹7500.00
```

Explanation:

- The task builds on the previous billing program.
- Adds energy charge calculation using conditionals for customer types.
- Emphasizes code readability and optimization.
- Expected output includes correct charges and clear, understandable logic.
- Sample execution demonstrates how charges vary by units and customer type.

Question 3:

Task 3: Modular Design Using AI Assistance (Using Functions)

Scenario:

Billing logic must be reusable for multiple consumers.

Task Description:

Use AI assistance to generate a Python program that:

• Uses user-defined functions to:

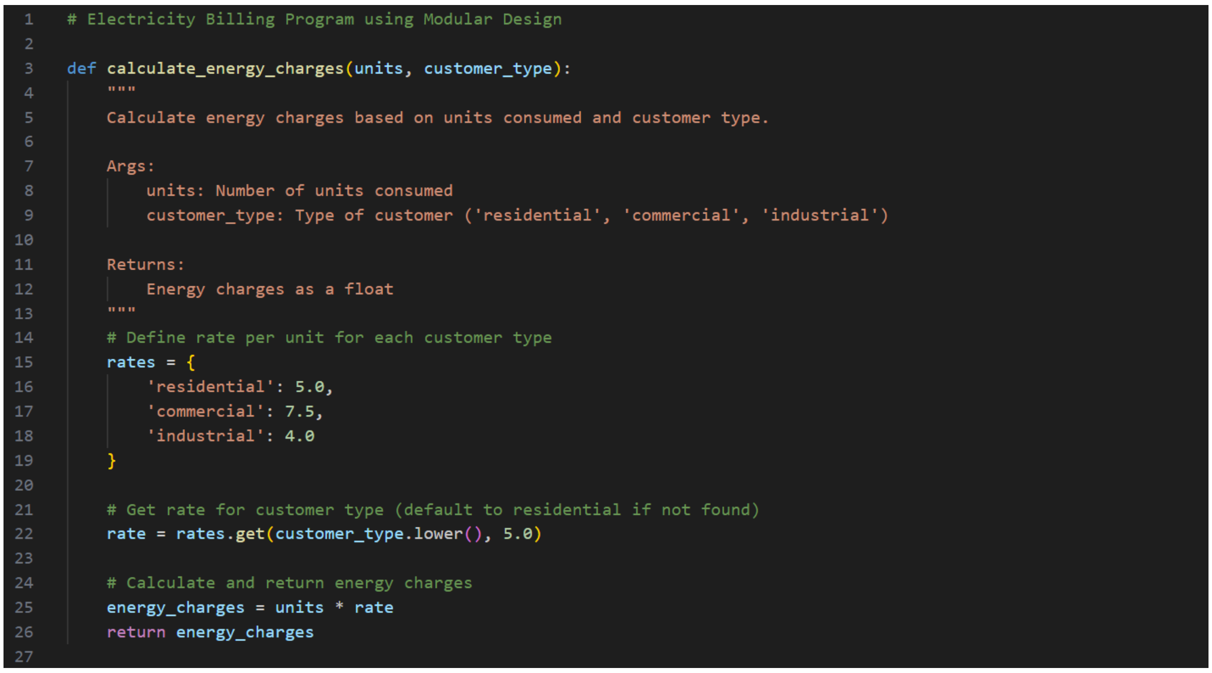
Calculate Energy Charges

Calculate Fixed Charges
• Returns calculated values
• Includes meaningful comments
Expected Output:
• Function-based Python program
• Correct EC and FC values
• Screenshots of AI-assisted function generation
• Test cases with outputs

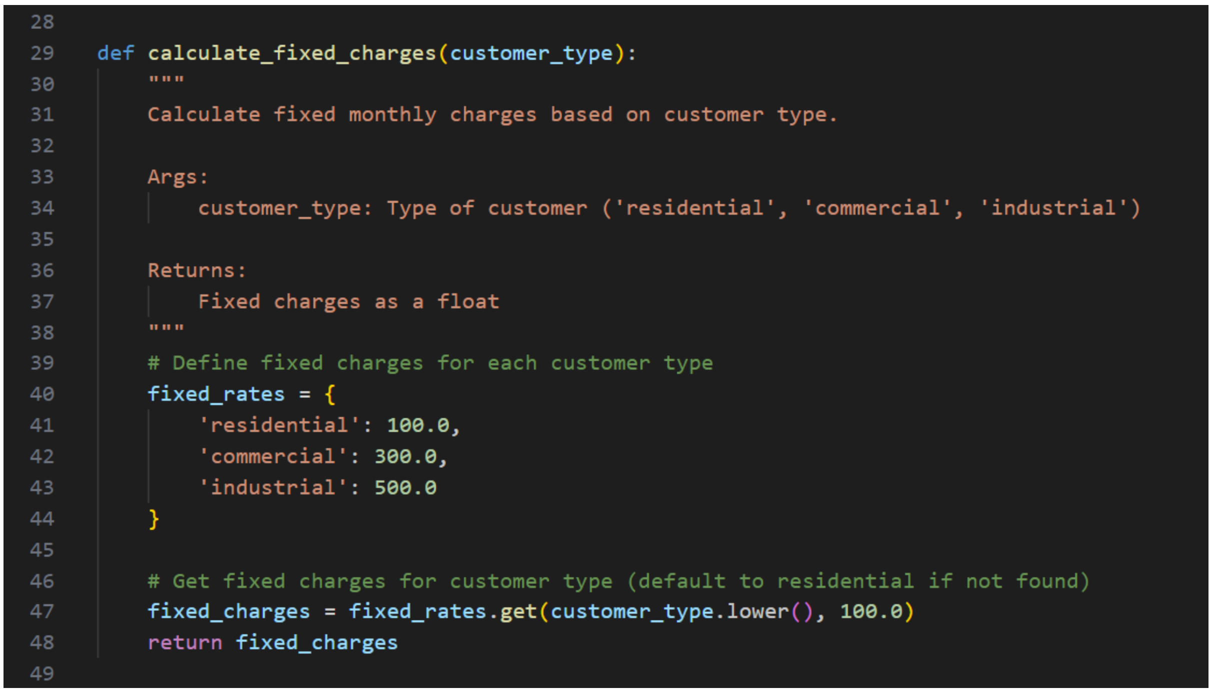
Prompt:

Create a Python program with a modular design for the billing system. Define functions to calculate Energy Charges and Fixed Charges return the calculated values, and include meaningful comments. The program should handle multiple consumers and display inputs along with the computed Energy Charges and Fixed Charges.

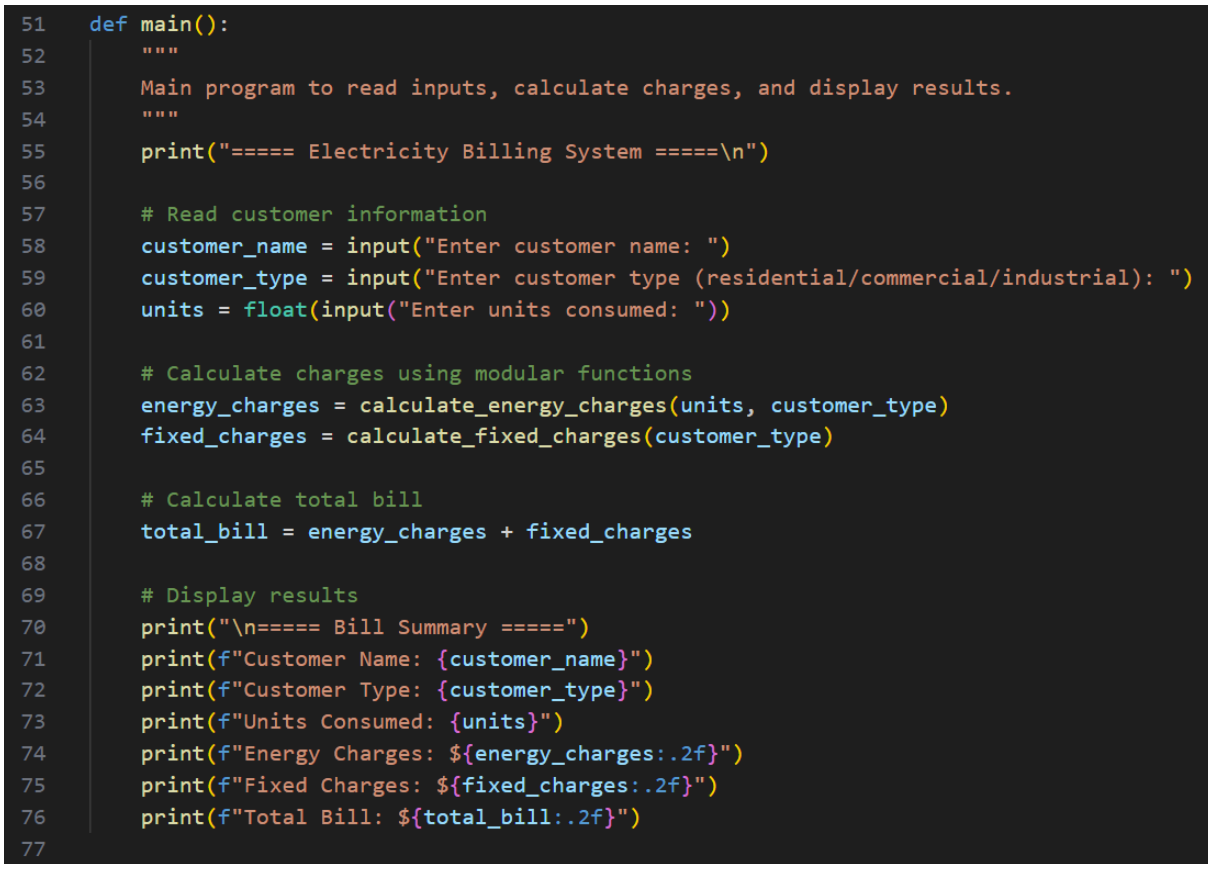
Code:



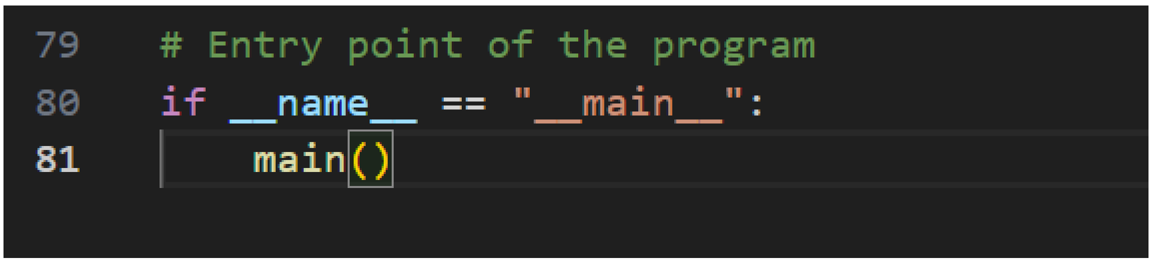
```python
# Electricity Billing Program using Modular Design

def calculate_energy_charges(units, customer_type):
    """
    Calculate energy charges based on units consumed and customer type.

    Args:
        units: Number of units consumed
        customer_type: Type of customer ('residential', 'commercial', 'industrial')

    Returns:
        Energy charges as a float
    """
    # Define rate per unit for each customer type
    rates = {
        'residential': 5.0,
        'commercial': 7.5,
        'industrial': 4.0
    }

    # Get rate for customer type (default to residential if not found)
    rate = rates.get(customer_type.lower(), 5.0)

    # Calculate and return energy charges
    energy_charges = units * rate
    return energy_charges

```



```python

def calculate_fixed_charges(customer_type):
    """
    Calculate fixed monthly charges based on customer type.

    Args:
        customer_type: Type of customer ('residential', 'commercial', 'industrial')

    Returns:
        Fixed charges as a float
    """
    # Define fixed charges for each customer type
    fixed_rates = {
        'residential': 100.0,
        'commercial': 300.0,
        'industrial': 500.0
    }

    # Get fixed charges for customer type (default to residential if not found)
    fixed_charges = fixed_rates.get(customer_type.lower(), 100.0)
    return fixed_charges

```

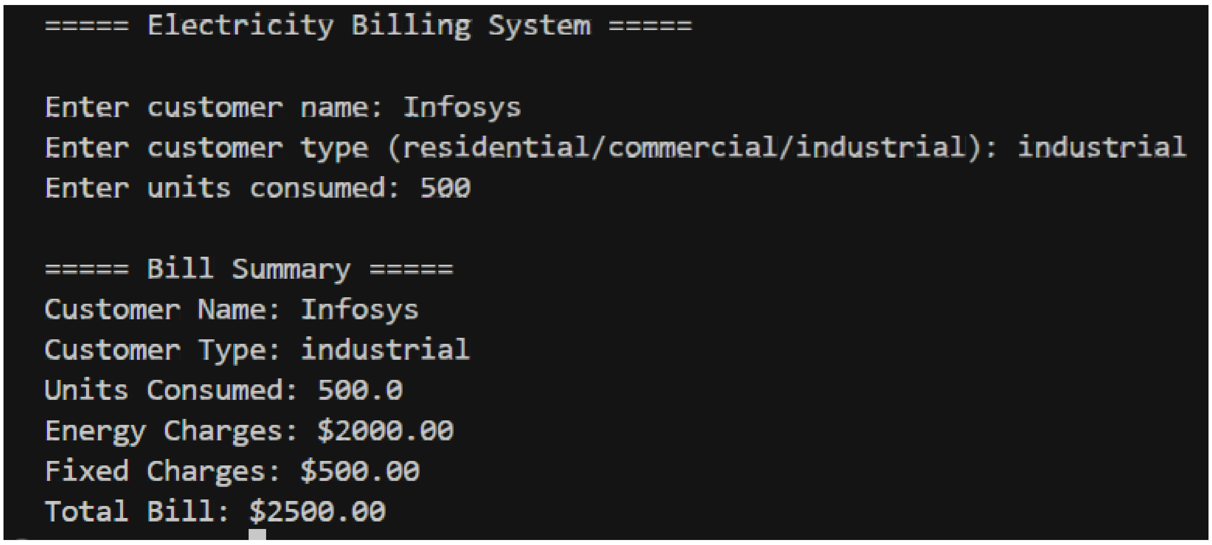


```python
def main():
    """
    Main program to read inputs, calculate charges, and display results.
    """
    print("===== Electricity Billing System =====\n")

    # Read customer information
    customer_name = input("Enter customer name: ")
    customer_type = input("Enter customer type (residential/commercial/industrial): ")
    units = float(input("Enter units consumed: "))

    # Calculate charges using modular functions
    energy_charges = calculate_energy_charges(units, customer_type)
    fixed_charges = calculate_fixed_charges(customer_type)

    # Calculate total bill
    total_bill = energy_charges + fixed_charges

    # Display results
    print("\n===== Bill Summary =====")
    print(f"Customer Name: {customer_name}")
    print(f"Customer Type: {customer_type}")
    print(f"Units Consumed: {units}")
    print(f"Energy Charges: ${energy_charges:.2f}")
    print(f"Fixed Charges: ${fixed_charges:.2f}")
    print(f"Total Bill: ${total_bill:.2f}")

```



```python
# Entry point of the program
if __name__ == "__main__":
    main()
```

Output:



```
===== Electricity Billing System =====

Enter customer name: Infosys
Enter customer type (residential/commercial/industrial): industrial
Enter units consumed: 500

===== Bill Summary =====
Customer Name: Infosys
Customer Type: industrial
Units Consumed: 500.0
Energy Charges: $2000.00
Fixed Charges: $500.00
Total Bill: $2500.00
```

Explanation:

- Introduces functions for reusable billing logic.
- Ensures correct calculation of energy and fixed charges.
- AI assistance helps generate readable, commented, and structured code.
- Enables testing for multiple consumers with consistent outputs.

Question 4:

Task 4: Calculation of Additional Charges

Scenario:

Electricity bills include multiple additional charges.

Task Description:

Extend the program to calculate:

• FC – Fixed Charges

• CC – Customer Charges

• ED – Electricity Duty (percentage of EC)

Use AI prompts like:

• “Add electricity duty calculation”

• “Improve billing accuracy”

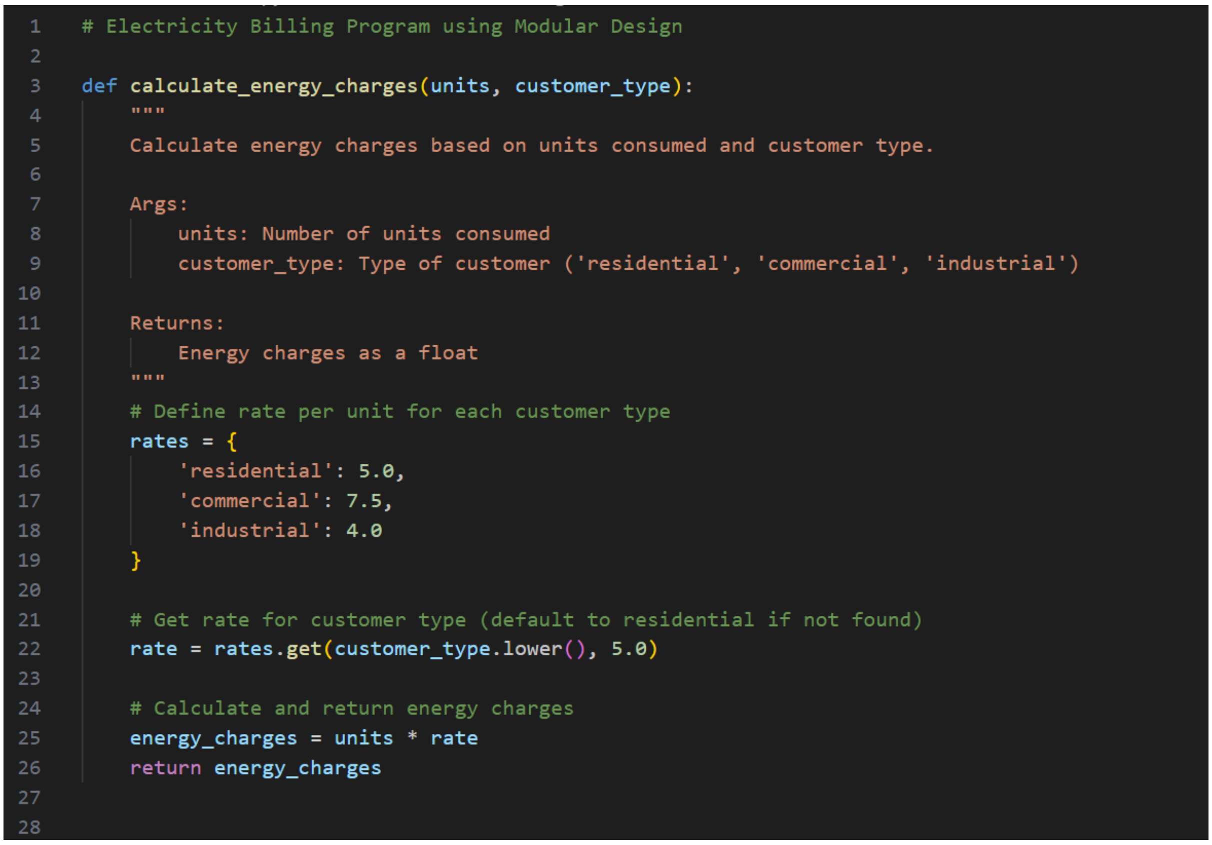
Expected Output

• Individual charge values printed
• Correct duty calculation
• Well-structured output
• Verified intermediate results

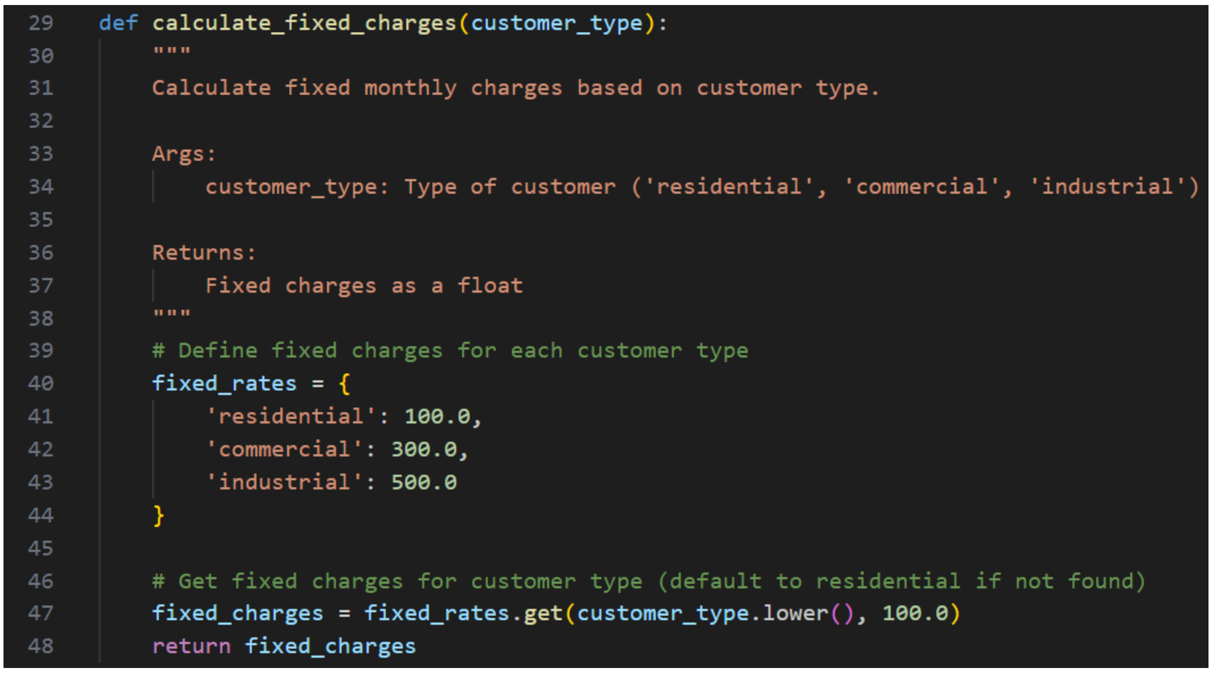
Prompt:

Enhance the existing Python electricity billing program to compute additional charges, including Fixed Charges (FC), Customer Charges (CC), and Electricity Duty (ED as a percentage of Energy Charges). Display each charge individually along with intermediate calculation steps, ensuring precise duty computation, improved billing accuracy, and a clear, well-organized output.

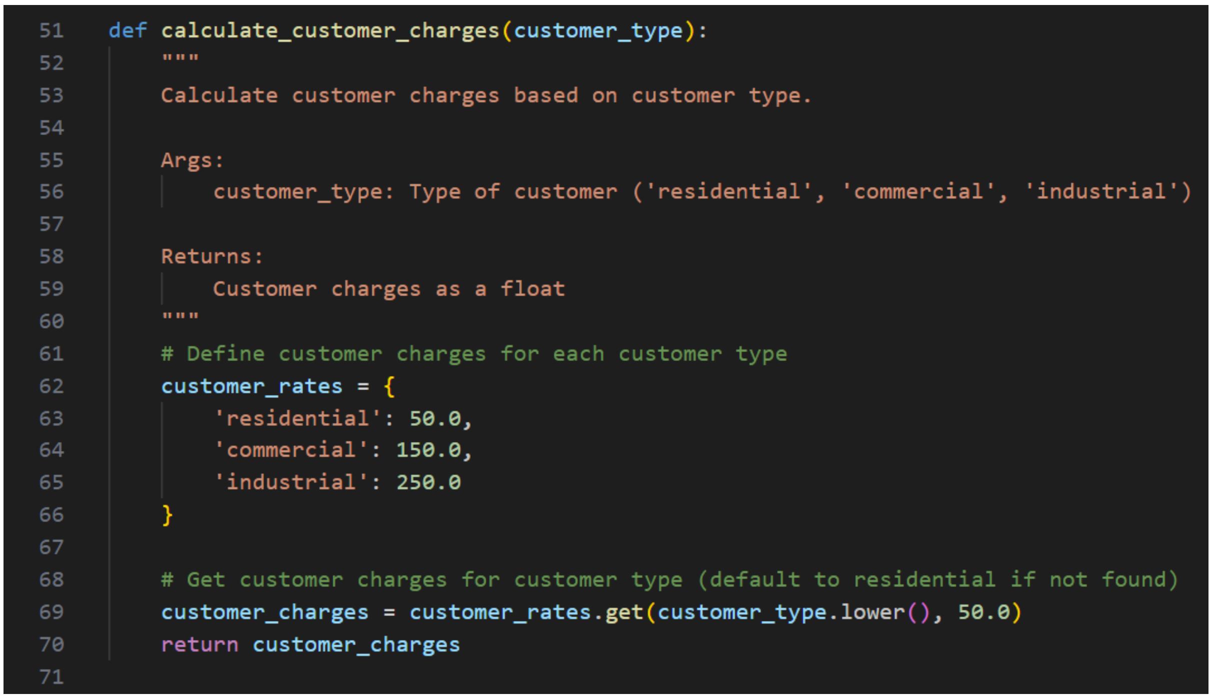
Code:



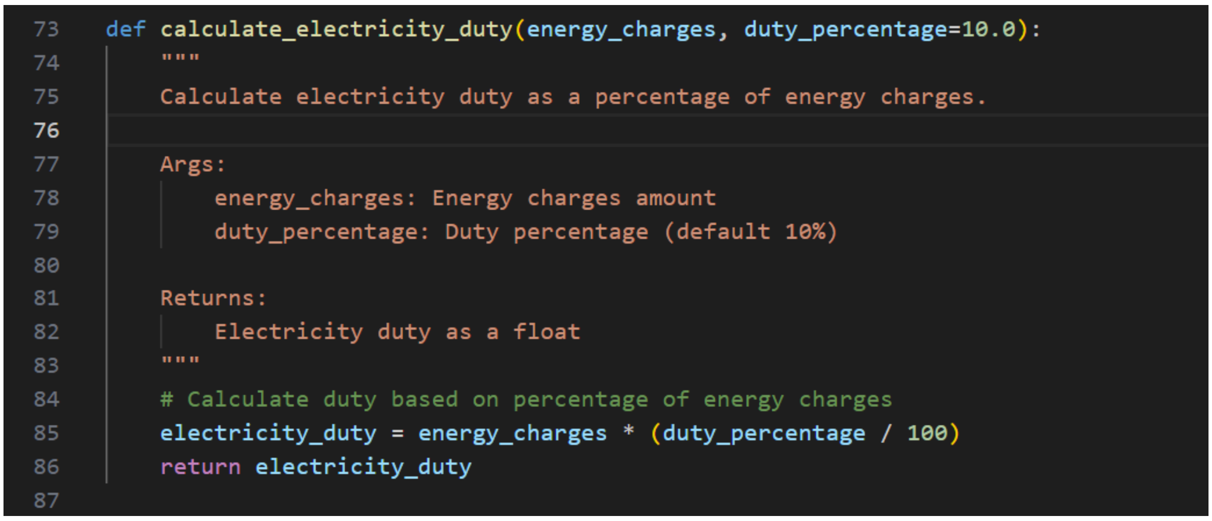
```python
# Electricity Billing Program using Modular Design

def calculate_energy_charges(units, customer_type):
    """
    Calculate energy charges based on units consumed and customer type.

    Args:
        units: Number of units consumed
        customer_type: Type of customer ('residential', 'commercial', 'industrial')

    Returns:
        Energy charges as a float
    """
    # Define rate per unit for each customer type
    rates = {
        'residential': 5.0,
        'commercial': 7.5,
        'industrial': 4.0
    }

    # Get rate for customer type (default to residential if not found)
    rate = rates.get(customer_type.lower(), 5.0)

    # Calculate and return energy charges
    energy_charges = units * rate
    return energy_charges


```



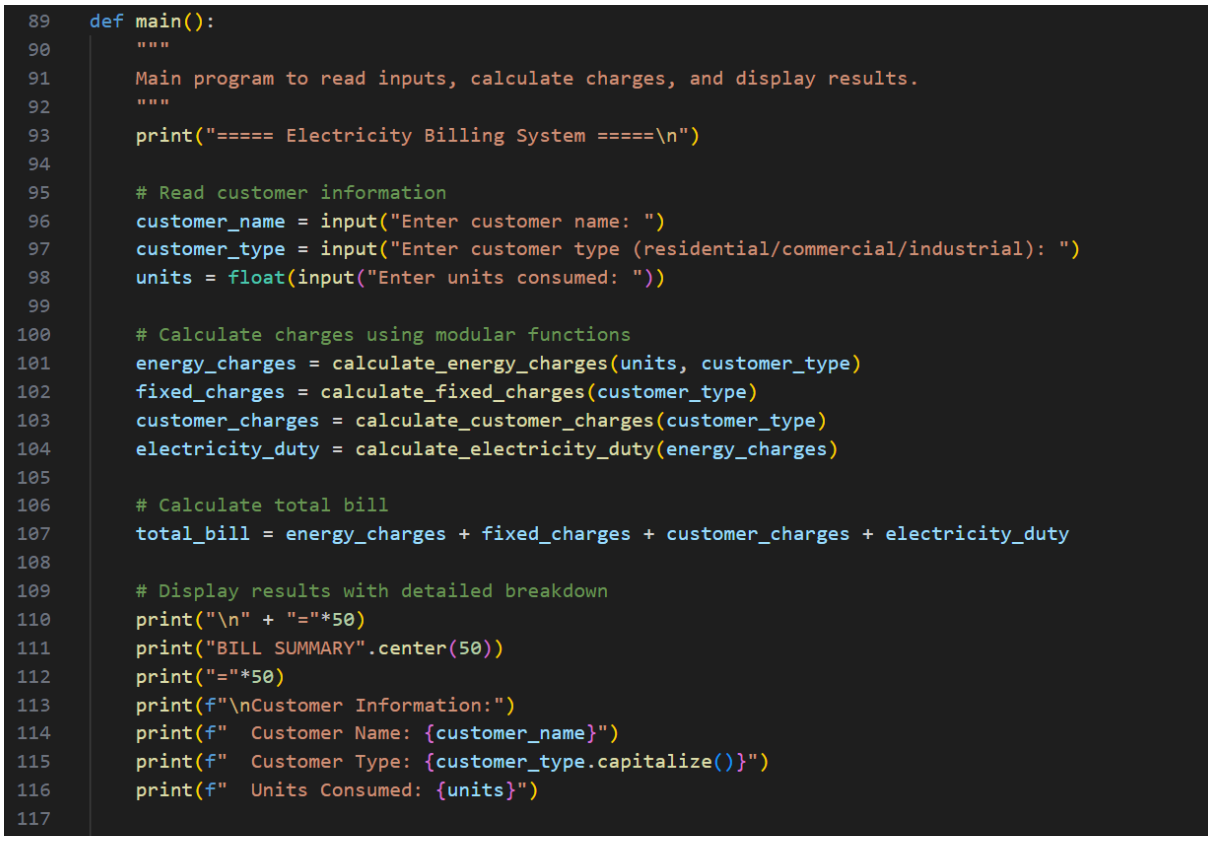
```python
def calculate_fixed_charges(customer_type):
    """
    Calculate fixed monthly charges based on customer type.

    Args:
        customer_type: Type of customer ('residential', 'commercial', 'industrial')

    Returns:
        Fixed charges as a float
    """
    # Define fixed charges for each customer type
    fixed_rates = {
        'residential': 100.0,
        'commercial': 300.0,
        'industrial': 500.0
    }

    # Get fixed charges for customer type (default to residential if not found)
    fixed_charges = fixed_rates.get(customer_type.lower(), 100.0)
    return fixed_charges
```



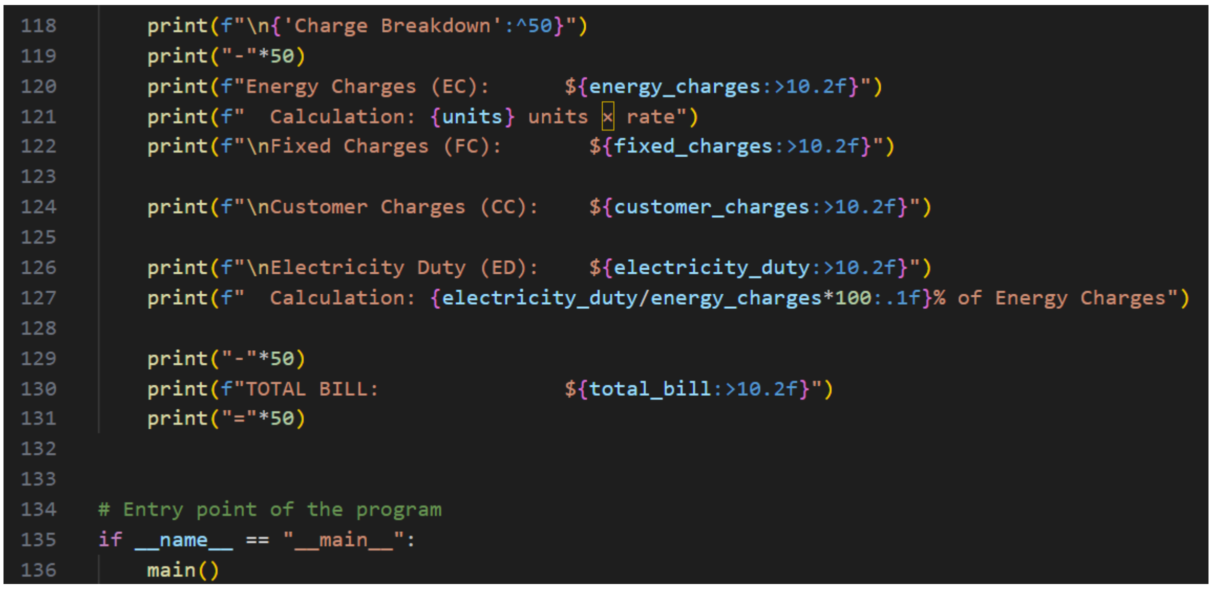
```python
def calculate_customer_charges(customer_type):
    """
    Calculate customer charges based on customer type.

    Args:
        customer_type: Type of customer ('residential', 'commercial', 'industrial')

    Returns:
        Customer charges as a float
    """
    # Define customer charges for each customer type
    customer_rates = {
        'residential': 50.0,
        'commercial': 150.0,
        'industrial': 250.0
    }

    # Get customer charges for customer type (default to residential if not found)
    customer_charges = customer_rates.get(customer_type.lower(), 50.0)
    return customer_charges

```



```python
def calculate_electricity_duty(energy_charges, duty_percentage=10.0):
    """
    Calculate electricity duty as a percentage of energy charges.

    Args:
        energy_charges: Energy charges amount
        duty_percentage: Duty percentage (default 10%)

    Returns:
        Electricity duty as a float
    """
    # Calculate duty based on percentage of energy charges
    electricity_duty = energy_charges * (duty_percentage / 100)
    return electricity_duty

```

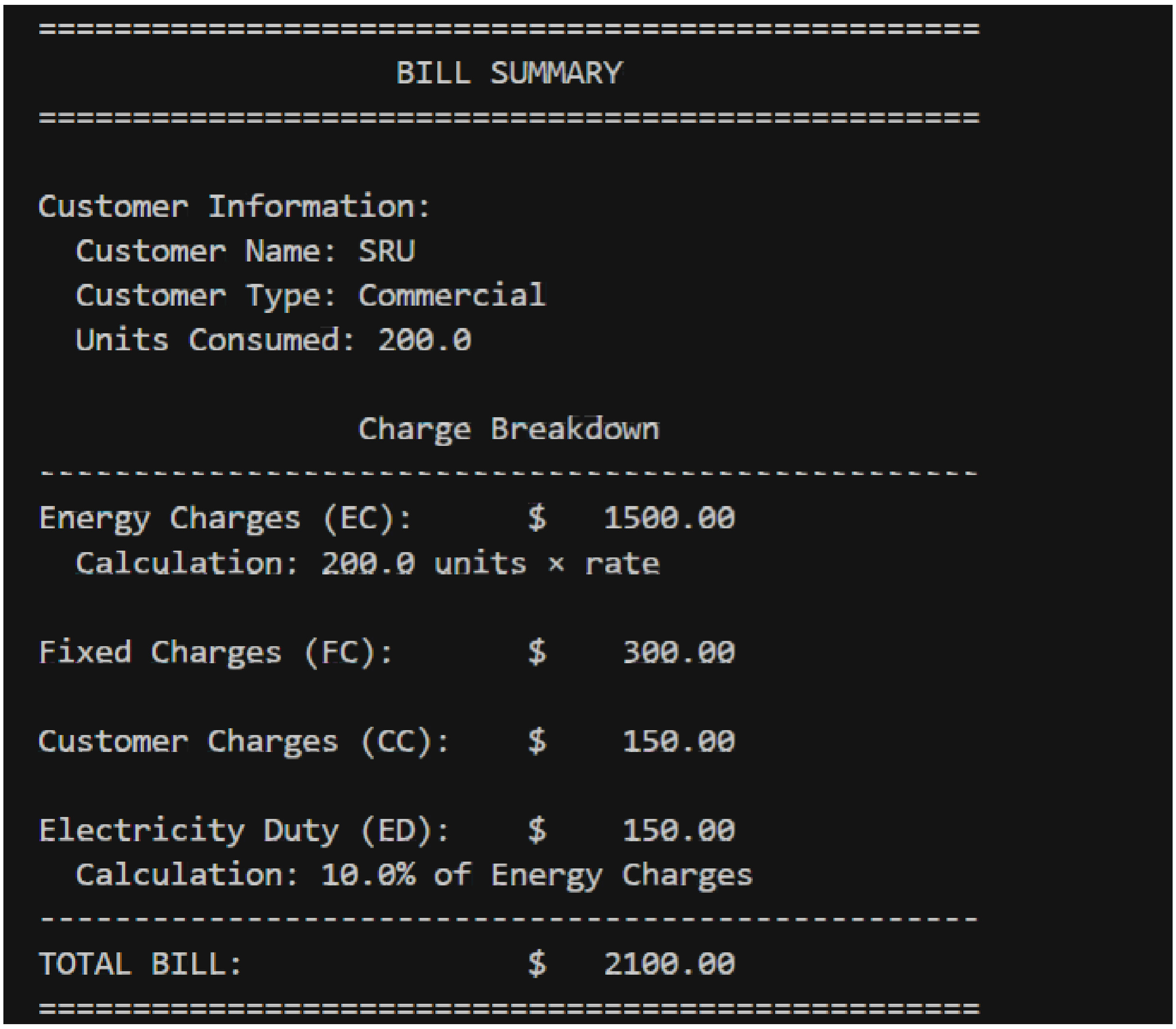


```python
def main():
    """
    Main program to read inputs, calculate charges, and display results.
    """
    print("===== Electricity Billing System =====\n")

    # Read customer information
    customer_name = input("Enter customer name: ")
    customer_type = input("Enter customer type (residential/commercial/industrial): ")
    units = float(input("Enter units consumed: "))

    # Calculate charges using modular functions
    energy_charges = calculate_energy_charges(units, customer_type)
    fixed_charges = calculate_fixed_charges(customer_type)
    customer_charges = calculate_customer_charges(customer_type)
    electricity_duty = calculate_electricity_duty(energy_charges)

    # Calculate total bill
    total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

    # Display results with detailed breakdown
    print("\n" + "="*50)
    print("BILL SUMMARY".center(50))
    print("="*50)
    print(f"\nCustomer Information:")
    print(f"  Customer Name: {customer_name}")
    print(f"  Customer Type: {customer_type.capitalize()}")
    print(f"  Units Consumed: {units}")

```



```python
    print(f"\n{'Charge Breakdown':^50}")
    print("-"*50)
    print(f"Energy Charges (EC):      ${energy_charges:>10.2f}")
    print(f"  Calculation: {units} units × rate")
    print(f"\nFixed Charges (FC):       ${fixed_charges:>10.2f}")

    print(f"\nCustomer Charges (CC):    ${customer_charges:>10.2f}")

    print(f"\nElectricity Duty (ED):    ${electricity_duty:>10.2f}")
    print(f"  Calculation: {electricity_duty/energy_charges*100:.1f}% of Energy Charges")

    print("-"*50)
    print(f"TOTAL BILL:               ${total_bill:>10.2f}")
    print("="*50)


# Entry point of the program
if __name__ == "__main__":
    main()
```

Output:



```
==================================================
                   BILL SUMMARY
==================================================


Customer Information:
  Customer Name: SRU
  Customer Type: Commercial
  Units Consumed: 200.0

                 Charge Breakdown
--------------------------------------------------
Energy Charges (EC):      $   1500.00
  Calculation: 200.0 units × rate

Fixed Charges (FC):       $    300.00

Customer Charges (CC):    $    150.00

Electricity Duty (ED):    $    150.00
  Calculation: 10.0% of Energy Charges
--------------------------------------------------
TOTAL BILL:               $   2100.00
==================================================
```

Explanation:

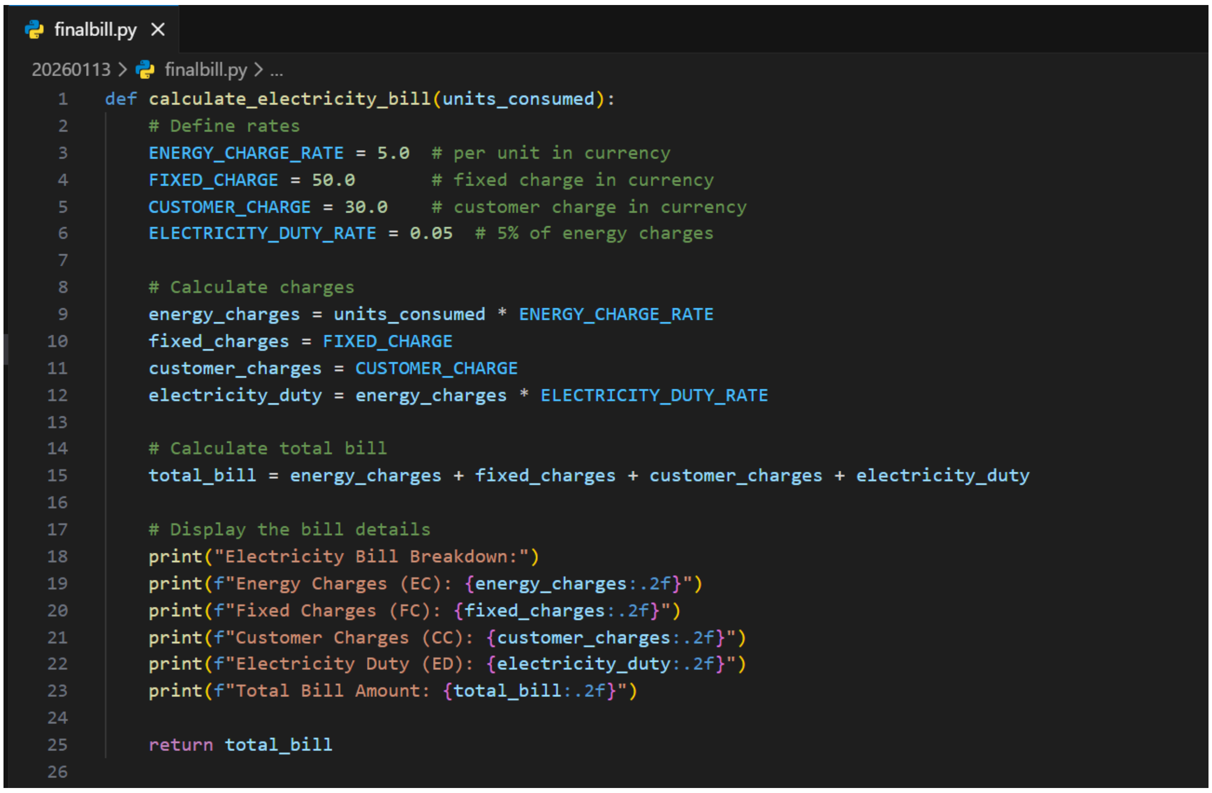
- The program is enhanced to calculate extra charges: Fixed Charges (FC), Customer Charges (CC), and Electricity Duty (ED).
- Each charge is printed separately, along with intermediate steps, for clarity.
- Ensures accurate computation, especially for Electricity Duty as a percentage of Energy Charges.
- Output is well-structured and readable, making the billing process clear and easy to verify.

Question 5:

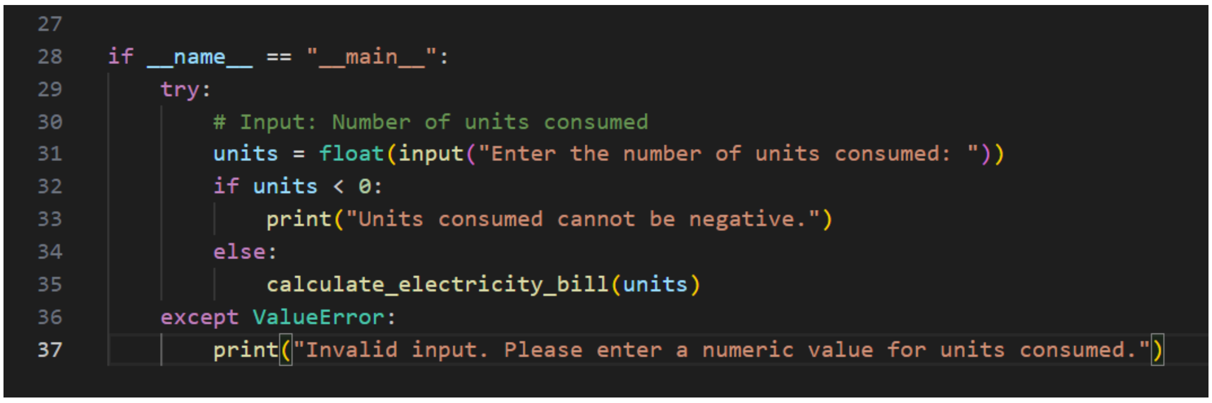
Task 5: Final Bill Generation and Output Analysis
Scenario:
The final electricity bill must present all values clearly.
Task Description:
Develop the final Python application to:
• Calculate total bill:
• Total Bill = EC + FC + CC + ED
• Display:
Energy Charges (EC)
Fixed Charges (FC)
Customer Charges (CC)
Electricity Duty (ED)
Total Bill Amount
• Analyze the program based on:
Accuracy
Readability
Real-world applicability
Expected Output

• Complete electricity bill output
• Neatly formatted display
• Sample input/output
• Short analysis paragraph

Prompt:
Create the final Python electricity billing program to calculate the total bill (EC + FC + CC + ED). Display each charge and the Total Bill Amount clearly in a neat format, include sample input/output, and ensure accuracy and readability.
Code:

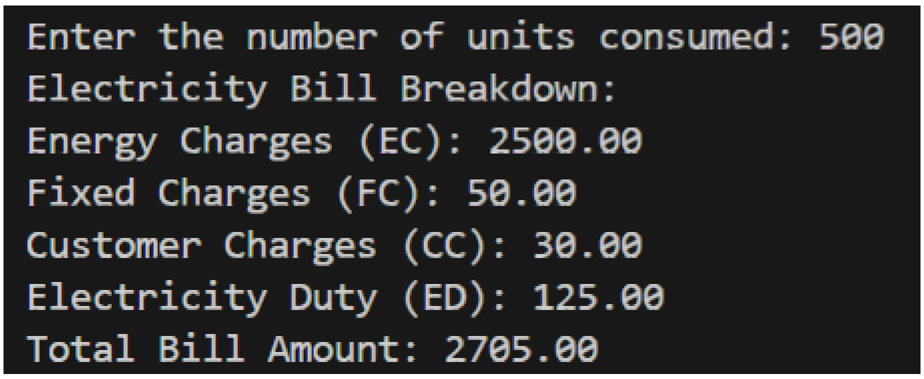


```python
def calculate_electricity_bill(units_consumed):
    # Define rates
    ENERGY_CHARGE_RATE = 5.0  # per unit in currency
    FIXED_CHARGE = 50.0       # fixed charge in currency
    CUSTOMER_CHARGE = 30.0    # customer charge in currency
    ELECTRICITY_DUTY_RATE = 0.05  # 5% of energy charges

    # Calculate charges
    energy_charges = units_consumed * ENERGY_CHARGE_RATE
    fixed_charges = FIXED_CHARGE
    customer_charges = CUSTOMER_CHARGE
    electricity_duty = energy_charges * ELECTRICITY_DUTY_RATE

    # Calculate total bill
    total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

    # Display the bill details
    print("Electricity Bill Breakdown:")
    print(f"Energy Charges (EC): {energy_charges:.2f}")
    print(f"Fixed Charges (FC): {fixed_charges:.2f}")
    print(f"Customer Charges (CC): {customer_charges:.2f}")
    print(f"Electricity Duty (ED): {electricity_duty:.2f}")
    print(f"Total Bill Amount: {total_bill:.2f}")

    return total_bill

```



```python

if __name__ == "__main__":
    try:
        # Input: Number of units consumed
        units = float(input("Enter the number of units consumed: "))
        if units < 0:
            print("Units consumed cannot be negative.")
        else:
            calculate_electricity_bill(units)
    except ValueError:
        print("Invalid input. Please enter a numeric value for units consumed.")
```

Output:


```
Enter the number of units consumed: 500
Electricity Bill Breakdown:
Energy Charges (EC): 2500.00
Fixed Charges (FC): 50.00
Customer Charges (CC): 30.00
Electricity Duty (ED): 125.00
Total Bill Amount: 2705.00
```

Explanation:

- The program generates the final electricity bill with all charges and the total clearly shown.
- Each component is displayed separately for clarity and verification.
- Emphasizes accuracy, readability, and practical applicability.
- The output is neatly formatted, making it user-friendly.
- A short analysis paragraph evaluates the program’s correctness and clarity.