

## **AI ASSISTANT CODING LAB-3**

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### **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:**
  - o **Previous Units (PU)**
  - o **Current Units (CU)**
  - o **Type of Customer**
- **Calculates units consumed**
- **Implements logic directly in the main program (no functions)**

#### **PROMPT:**

**Generate a Python program (without using functions) to read:**

- **Previous Units (PU)**
- **Current Units (CU)**
- **Type of customer (Domestic / Commercial / Industrial)**

**Validate inputs and calculate units consumed as:**

**`units_consumed = CU - PU`**

**Print all inputs and the calculated units consumed with clear labels.**

**Add comments explaining each step.**

#### **GENERATED CODE:**

```
1.py 3.py 4.py 9+ 5.py X 2.py
5.py > ...
1 # Utility Consumption Calculator
2 # This program calculates the units consumed based on previous and current meter readings
3
4 # Input section with validation
5 print("=" * 50)
6 print("UTILITY CONSUMPTION CALCULATOR")
7 print("=" * 50)
8 print()
9
10 # Read Previous Units (PU) with validation
11 while True:
12     try:
13         pu_input = input("Enter Previous Units (PU): ")
14         pu = float(pu_input)
15         if pu < 0:
16             print("Error: Previous Units cannot be negative. Please try again.")
17             continue
18         break
19     except ValueError:
20         print("Error: Invalid input. Please enter a valid number.")
21
22 # Read Current Units (CU) with validation
23 while True:
24     try:
25         cu_input = input("Enter Current Units (CU): ")
26         cu = float(cu_input)
27         if cu < 0:
28             print("Error: Current Units cannot be negative. Please try again.")
```

```
29         continue
30     except ValueError:
31         print("Error: Invalid input. Please enter a valid number.")
32
33 # Validate that Current Units is greater than or equal to Previous Units
34 while cu < pu:
35     print("Error: Current Units cannot be less than Previous Units.")
36     try:
37         cu_input = input("Enter Current Units (CU) again: ")
38         cu = float(cu_input)
39         if cu < 0:
40             print("Error: Current Units cannot be negative.")
41             cu = -1 # Set to invalid value to continue loop
42     except ValueError:
43         print("Error: Invalid input. Please enter a valid number.")
44         cu = -1 # Set to invalid value to continue loop
45
46 # Read Customer Type with validation
47 valid_customer_types = ["Domestic", "Commercial", "Industrial"]
48 while True:
49     customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ").strip()
50     if customer_type in valid_customer_types:
51         break
52     else:
53         print(f"Error: Invalid customer type. Please enter one of: {'', ' '}")
54
55
```

```

while True:
    customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ").strip()
    if customer_type in valid_customer_types:
        break
    else:
        print(f"Error: Invalid customer type. Please enter one of: {' '.join(valid_customer_types)}")

# Calculate units consumed
units_consumed = cu - pu

# Display results with clear labels and formatting
print()
print("=" * 50)
print("CONSUMPTION DETAILS")
print("=" * 50)
print(f"Previous Units (PU)          : {pu}")
print(f"Current Units (CU)            : {cu}")
print(f"Customer Type                  : {customer_type}")
print(f"Units Consumed (CU - PU)      : {units_consumed}")
print("=" * 50)

```

## OUTPUT:

```

PS C:\Users\s9409\Downloads\aiassitantcoding> & C:/Users/s9409/AppData/Local/Programs/Python/Python313/python.exe c:/Users/s9409/Downloads/aiassitantcoding/5.py
=====
UTILITY CONSUMPTION CALCULATOR
=====

Enter Previous Units (PU): 234
Enter Current Units (CU): 345
Enter Type of Customer (Domestic/Commercial/Industrial): Domestic

=====
CONSUMPTION DETAILS
=====
Previous Units (PU)          : 234.0
Current Units (CU)            : 345.0
Customer Type                  : Domestic
Units Consumed (CU - PU)      : 111.0
=====
PS C:\Users\s9409\Downloads\aiassitantcoding>

```

## 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:**
  - o **Domestic**
  - o **Commercial**
  - o **Industrial consumers**
- **Improve readability using AI prompts such as:**
  - o **“Simplify energy charge calculation logic”**
  - o **“Optimize conditional statements”**

**PROMPT:**

**Extend the existing Python program to calculate Energy Charges (EC) using conditional statements:**

**Domestic:**

- **First 100 units: ₹1.5/unit**
- **Above 100 units: ₹2.5/unit**

**Commercial:**

- **Flat rate ₹4.0/unit**

**Industrial:**

- **Flat rate ₹6.0/unit**

**Use if-elif-else statements and print the calculated EC.**

**Add meaningful comments.**

**For logic optimization:**

**Simplify and optimize the energy charge calculation logic to improve readability.**

Ensure the conditional structure is clean and easy for students to understand.

## Generated code

```
6.py > ...
1  # Utility Consumption and Energy Charges Calculator
2  # This program calculates units consumed and energy charges based on customer type
3
4  # Input section with validation
5  print("-" * 60)
6  print("UTILITY CONSUMPTION AND ENERGY CHARGES CALCULATOR")
7  print("-" * 60)
8  print()
9
10 # Read Previous Units (PU) with validation
11 while True:
12     try:
13         pu_input = input("Enter Previous Units (PU): ")
14         pu = float(pu_input)
15         if pu < 0:
16             print("Error: Previous Units cannot be negative. Please try again.")
17             continue
18         break
19     except ValueError:
20         print("Error: Invalid input. Please enter a valid number.")  Define a constant instead of duplicating this literal '
21
22 # Read Current Units (CU) with validation
23 while True:
24     try:
25         cu_input = input("Enter Current Units (CU): ")
26         cu = float(cu_input)
27         if cu < 0:
28             print("Error: Current Units cannot be negative. Please try again.")
29             continue
30         break
31     except ValueError:
32         print("Error: Invalid input. Please enter a valid number.")
33
34 # Validate that Current Units is greater than or equal to Previous Units
35 while cu < pu:
36     print("Error: Current Units cannot be less than Previous Units.")
37     try:
38         cu_input = input("Enter Current Units (CU) again: ")
39         cu = float(cu_input)
```



```

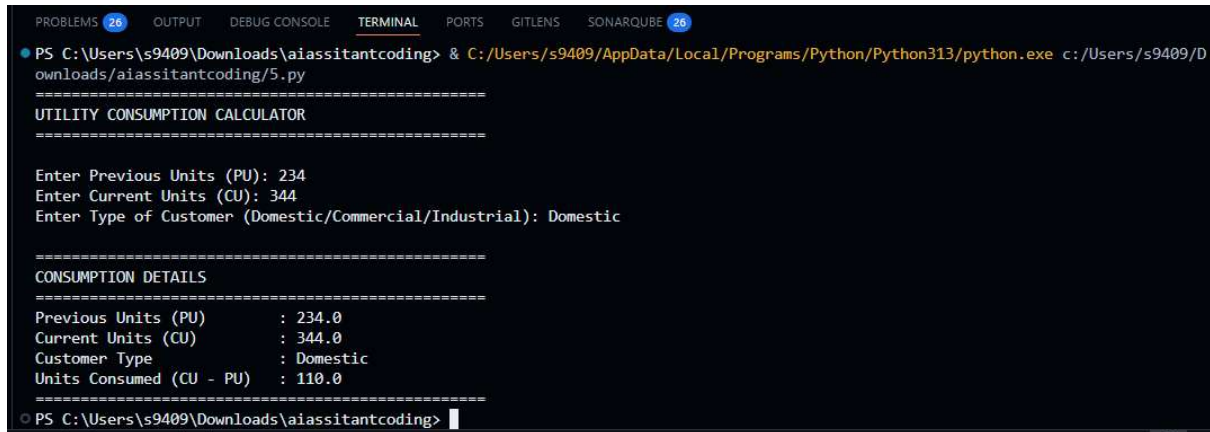
41         print("Error: Current Units cannot be negative.")
42         cu = -1 # Set to invalid value to continue loop
43     except ValueError:
44         print("Error: Invalid input. Please enter a valid number.")
45         cu = -1 # Set to invalid value to continue loop
46
47 # Read Customer Type with validation
48 valid_customer_types = ["Domestic", "Commercial", "Industrial"]
49 while True:
50     customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ").strip().capitalize()
51     if customer_type in valid_customer_types:
52         break
53     else:
54         print(f"Error: Invalid customer type. Please enter one of: {' '.join(valid_customer_types)}")
55
56 # Calculate units consumed
57 units_consumed = cu - pu
58
59 # Calculate Energy Charges (EC) based on customer type using conditional statements
60 # Using if-elif-else to determine the appropriate rate structure
61
62 if customer_type == "Domestic":
63     # Domestic customers have a tiered pricing structure
64     # First 100 units charged at ₹1.5/unit
65     # Units above 100 charged at ₹2.5/unit
66     if units_consumed <= 100:
67         # All units are within the first tier
68         ec = units_consumed * 1.5
69     else:
70         # Calculate charges for first 100 units at ₹1.5
71         # and remaining units at ₹2.5
72         ec = (100 * 1.5) + ((units_consumed - 100) * 2.5)
73
74 elif customer_type == "Commercial":
75     # Commercial customers have a flat rate of ₹4.0/unit
76     # All units charged at the same rate
77     ec = units_consumed * 4.0
78
79 elif customer_type == "Industrial":

```

```

79 elif customer_type == "Industrial":
80     # Industrial customers have a flat rate of ₹6.0/unit
81     # All units charged at the same rate
82     ec = units_consumed * 6.0
83
84 else:
85     # This should not occur due to input validation
86     # But included for safety
87     ec = 0.0
88     print("Error: Unknown customer type")
89
90 # Display results with clear labels and formatting
91 print()
92 print("=" * 60)
93 print("CONSUMPTION AND CHARGES DETAILS")
94 print("=" * 60)
95 print(f"Previous Units (PU)           : {pu}")
96 print(f"Current Units (CU)              : {cu}")
97 print(f"Customer Type                    : {customer_type}")
98 print(f"Units Consumed (CU - PU)         : {units_consumed}")
99 print("-" * 60)
100 print(f"Energy Charges (EC)              : ₹{ec:.2f}")
101 print("=" * 60)
102
103 # Display the rate structure used
104 print()
105 print("Rate Structure Applied:")
106 if customer_type == "Domestic":
107     print(" • First 100 units: ₹1.5/unit")
108     print(" • Above 100 units: ₹2.5/unit")
109 elif customer_type == "Commercial":
110     print(" • Flat rate: ₹4.0/unit")
111 elif customer_type == "Industrial":
112     print(" • Flat rate: ₹6.0/unit")
113 print("=" * 60)
114

```



```
PROBLEMS 26 OUTPUT DEBUG CONSOLE TERMINAL PORTS GITLENS SONARQUBE 26
PS C:\Users\s9409\Downloads\aiassitantcoding> & C:/Users/s9409/AppData/Local/Programs/Python/Python313/python.exe c:/Users/s9409/D
ownloads/aiassitantcoding/5.py
=====
UTILITY CONSUMPTION CALCULATOR
=====

Enter Previous Units (PU): 234
Enter Current Units (CU): 344
Enter Type of Customer (Domestic/Commercial/Industrial): Domestic

=====
CONSUMPTION DETAILS
=====
Previous Units (PU)      : 234.0
Current Units (CU)       : 344.0
Customer Type            : Domestic
Units Consumed (CU - PU) : 110.0
=====
PS C:\Users\s9409\Downloads\aiassitantcoding> |
```

## 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:
  - o Calculate Energy Charges
  - o Calculate Fixed Charges
- Returns calculated values
- Includes meaningful comments

### PROMPT:

(Function for Energy Charges)

Rewrite the program using user-defined functions.

Create a function named `calculate_energy_charges(units, customer_type)` that returns the energy charges based on tariff rules.

Call the function from the main program.

Add proper comments and sample output printing.

Add Fixed Charges Function)

Add another user-defined function named `calculate_fixed_charges(customer_type)`

with the following logic:

**Domestic: ₹50**

**Commercial: ₹100**

**Industrial: ₹150**

Return the fixed charges and display them in the main program.

Include comments explaining function usage.

Code generated

```
1 # Utility Consumption and Energy Charges Calculator with Functions
2 # This program calculates units consumed and energy charges using user-defined functions
3
4 # Function Definition: calculate_energy_charges
5 # Purpose: Calculate energy charges based on units consumed and customer type
6 # Parameters:
7 #   - units: Number of units consumed (float)
8 #   - customer_type: Type of customer - "Domestic", "Commercial", or "Industrial" (string)
9 # Returns: Energy charges in rupees (float)
10 def calculate_energy_charges(units, customer_type):
11     """
12     Calculate energy charges based on customer type and tariff rules.
13
14     Tariff Structure:
15     - Domestic: First 100 units at ₹1.5/unit, above 100 at ₹2.5/unit
16     - Commercial: Flat rate ₹4.0/unit
17     - Industrial: Flat rate ₹6.0/unit
18     """
19
20     # Check customer type and apply appropriate tariff structure
21     if customer_type == "Domestic":
22         # Domestic customers have tiered pricing
23         if units <= 100:
24             # All units in first tier
25             charges = units * 1.5
26         else:
27             # First 100 units at ₹1.5, remaining at ₹2.5
28             charges = (100 * 1.5) + ((units - 100) * 2.5)
29
30     elif customer_type == "Commercial":
31         # Commercial customers have flat rate
32         charges = units * 4.0
33
34     elif customer_type == "Industrial":
35         # Industrial customers have flat rate
36         charges = units * 6.0
37
38     else:
39         # Invalid customer type (should not occur with validation)
40         charges = 0.0
41
42     # Return calculated charges
43     return charges
44
45
```



```

46 # Main Program Starts Here
47 print("=" * 60)
48 print("UTILITY CONSUMPTION AND ENERGY CHARGES CALCULATOR")
49 print("=" * 60)
50 print()
51
52 # Input section with validation
53 # Read Previous Units (PU) with validation
54 while True:
55     try:
56         pu_input = input("Enter Previous Units (PU): ")
57         pu = float(pu_input)
58         if pu < 0:
59             print("Error: Previous Units cannot be negative. Please try again.")
60             continue
61         break
62     except ValueError:
63         print("Error: Invalid input. Please enter a valid number.") Define a constant instead of duplicating this literal
64
65 # Read Current Units (CU) with validation
66 while True:
67     try:
68         cu_input = input("Enter Current Units (CU): ")
69         cu = float(cu_input)
70         if cu < 0:
71             print("Error: Current Units cannot be negative. Please try again.")
72             continue
73         break
74     except ValueError:
75         print("Error: Invalid input. Please enter a valid number.")
76
77 # Validate that Current Units is greater than or equal to Previous Units
78 while cu < pu:
79     print("Error: Current Units cannot be less than Previous Units.")
80     try:
81         cu_input = input("Enter Current Units (CU) again: ")
82         cu = float(cu_input)
83         if cu < 0:
84             print("Error: Current Units cannot be negative.")
85             cu = -1 # Set to invalid value to continue loop
86     except ValueError:
87         print("Error: Invalid input. Please enter a valid number.")
88         cu = -1 # Set to invalid value to continue loop
89
90 # Read Customer Type with validation

```

Keep Undo

```

# Read Customer Type with validation
valid_customer_types = ["Domestic", "Commercial", "Industrial"]
while True:
    customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ").strip().capitalize()
    if customer_type in valid_customer_types:
        break
    else:
        print(f"Error: Invalid customer type. Please enter one of: {', '.join(valid_customer_types)}")

# Calculate units consumed
units_consumed = cu - pu

# Call the function to calculate energy charges
# Pass units consumed and customer type as arguments
ec = calculate_energy_charges(units_consumed, customer_type)


# Display results with clear labels and formatting
print()
print("=" * 60)
print("CONSUMPTION AND CHARGES DETAILS")
print("=" * 60)
print(f"Previous Units (PU)           : {pu}")
print(f"Current Units (CU)              : {cu}")
print(f"Customer Type                   : {customer_type}")
print(f"Units Consumed (CU - PU)        : {units_consumed}")
print("-" * 60)
print(f"Energy Charges (EC)            : {(ec:.2f)}")
print("=" * 60)

# Display the rate structure used
print()
print("Rate Structure Applied:")
if customer_type == "Domestic":
    print(" • First 100 units: $1.5/unit")
    print(" • Above 100 units: $2.5/unit")
elif customer_type == "Commercial":
    print(" • Flat rate: $4.0/unit")
elif customer_type == "Industrial":
    print(" • Flat rate: $6.0/unit")
print("-" * 60)

# Sample Output Display
print()
print("SAMPLE OUTPUT EXAMPLES:")
print("-" * 60)
print("Example 1 - Domestic Customer:")
print(f" PU: 1000, CU: 1150, Type: Domestic")
print(f" Units Consumed: 150, Energy Charges: {(calculate_energy_charges(150, 'Domestic'):.2f)}")
print()
print("Example 2 - Commercial Customer:")
print(f" PU: 500, CU: 700, Type: Commercial")
print(f" Units Consumed: 200, Energy Charges: {(calculate_energy_charges(200, 'Commercial'):.2f)}")
print()
print("Example 3 - Industrial Customer:")
print(f" PU: 2000, CU: 2300, Type: Industrial")
print(f" Units Consumed: 300, Energy Charges: {(calculate_energy_charges(300, 'Industrial'):.2f)}")
print("-" * 60)

```

## Output:



```
PS C:\Users\s9409\Downloads\aiassitantcoding> & C:/Users/s9409/AppData/Local/Programs/Python/Python313/python.exe c:/Users/s9409/Downloads/aiassitantcoding/5.py
=====
UTILITY CONSUMPTION CALCULATOR
=====

Enter Previous Units (PU): 123
Enter Current Units (CU): 345
Enter Type of Customer (Domestic/Commercial/Industrial): Domestic

=====
CONSUMPTION DETAILS
=====
Previous Units (PU)      : 123.0
Current Units (CU)       : 345.0
Customer Type            : Domestic
Units Consumed (CU - PU) : 222.0
=====
PS C:\Users\s9409\Downloads\aiassitantcoding>
```

## 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

### Prompt

Add Extra Charges)

Extend the function-based electricity billing program to calculate:

- Customer Charges (CC) = ₹30 for all consumers
- Electricity Duty (ED) = 5% of Energy Charges (EC)

Print EC, FC, CC, and ED separately with proper formatting.

Add comments for billing accuracy.

**Improve billing accuracy by formatting all monetary values to two decimal places.**

**Ensure calculations are clear and correct.**

**Code generated:**

```
8.py > ...
1  # Extended Utility Billing Program with Complete Charges Calculation
2  # This program calculates units consumed and all billing components including
3  # Energy Charges, Fixed Charges, Customer Charges, and Electricity Duty
4
5  # Function Definition: calculate_energy_charges
6  # Purpose: Calculate energy charges based on units consumed and customer type
7  # Parameters:
8  #   - units: Number of units consumed (float)
9  #   - customer_type: Type of customer - "Domestic", "Commercial", or "Industrial" (string)
10 # Returns: Energy charges in rupees (float)
11 def calculate_energy_charges(units, customer_type):
12     """
13     Calculate energy charges based on customer type and tariff rules.
14
15     Tariff Structure:
16     - Domestic: First 100 units at ₹1.5/unit, above 100 at ₹2.5/unit
17     - Commercial: Flat rate ₹4.0/unit
18     - Industrial: Flat rate ₹6.0/unit
19     """
20
21     # Check customer type and apply appropriate tariff structure
22     if customer_type == "Domestic":
23         # Domestic customers have tiered pricing
24         if units <= 100:
25             # All units in first tier
26             charges = units * 1.5
27         else:
28             # First 100 units at ₹1.5, remaining at ₹2.5
29             charges = (100 * 1.5) + ((units - 100) * 2.5)
30
31     elif customer_type == "Commercial":
32         # Commercial customers have flat rate
33         charges = units * 4.0
```

```

11 def calculate_energy_charges(units, customer_type):
34
35     elif customer_type == "Industrial":
36         # Industrial customers have flat rate
37         charges = units * 6.0
38
39     else:
40         # Invalid customer type (should not occur with validation)
41         charges = 0.0
42
43     # Return calculated charges
44     return charges
45
46 # Main Program Starts Here
47 print("-" * 60)
48 print("COMPREHENSIVE ELECTRICITY BILLING SYSTEM")
49 print("-" * 60)
50 print()
51
52 # Input section with validation
53 # Read Previous Units (PU) with validation
54 while True:
55     try:
56         pu_input = input("Enter Previous Units (PU): ")
57         pu = float(pu_input)
58         if pu < 0:
59             print("Error: Previous Units cannot be negative. Please try again.")
60             continue
61         break
62     except ValueError:
63         print("Error: Invalid input. Please enter a valid number.")
64

```

```

65
66 # Read Current Units (CU) with validation
67 while True:
68     try:
69         cu_input = input("Enter Current Units (CU): ")
70         cu = float(cu_input)
71         if cu < 0:
72             print("Error: Current Units cannot be negative. Please try again.")
73             continue
74         break
75     except ValueError:
76         print("Error: Invalid input. Please enter a valid number.")
77
78 # Validate that Current Units is greater than or equal to Previous Units
79 while cu < pu:
80     print("Error: Current Units cannot be less than Previous Units.")
81     try:
82         cu_input = input("Enter Current Units (CU) again: ")
83         cu = float(cu_input)
84         if cu < 0:
85             print("Error: Current Units cannot be negative.")
86             cu = -1 # Set to invalid value to continue loop
87     except ValueError:
88         print("Error: Invalid input. Please enter a valid number.")
89         cu = -1 # Set to invalid value to continue loop
90
91 # Read Customer Type with validation
92 valid_customer_types = ["Domestic", "Commercial", "Industrial"]
93 while True:
94     customer_type = input("Enter Type of Customer (Domestic/Commercial/Industrial): ").strip().capitalize()
95     if customer_type in valid_customer_types:
96         break
97     else:

```



```

17     else:
18         print(f"Error: Invalid customer type. Please enter one of: {'', '.join(valid_customer_types)}")
19
20 # Calculate units consumed
21 units_consumed = cu - pu
22
23 # Call the function to calculate Energy Charges (EC)
24 # Energy Charges are based on units consumed and customer type
25 ec = calculate_energy_charges(units_consumed, customer_type)
26
27 # Calculate Fixed Charges (FC)
28 # Fixed Charges are a standard monthly charge for all consumers
29 fc = 30.0
30
31 # Calculate Customer Charges (CC)
32 # Customer Charges are administrative charges applied to all bills
33 cc = 30.0
34
35 # Calculate Electricity Duty (ED)
36 # Electricity Duty is calculated as 5% of Energy Charges
37 # This is a government levy on electricity consumption
38 ed = ec * 0.05
39
40 # Calculate Total Bill Amount
41 # Total Bill = Energy Charges + Fixed Charges + Customer Charges + Electricity Duty
42 # This ensures billing accuracy by adding all components
43 total_bill = ec + fc + cc + ed
44
45 # Display input details and consumption
46 print()
47 print("-" * 60)
48 print("METER READING AND CONSUMPTION DETAILS")
49 print("-" * 60)

```

Keep Undo

```

8.py > ...
129 print(f"Meter Reading and Consumption Details")
130 print("-" * 60)
131 print(f"Previous Units (PU)           : {pu}")
132 print(f"Current Units (CU)            : {cu}")
133 print(f"Customer Type                   : {customer_type}")
134 print(f"Units Consumed (CU - PU)        : {units_consumed}")
135 print("-" * 60)
136
137 # Display all billing components separately for transparency
138 print()
139 print("DETAILED BILLING BREAKDOWN")
140 print("-" * 60)
141
142 # Energy Charges (EC) - Variable charges based on consumption
143 print(f"Energy Charges (EC)                : ₹{ec:.2f}")
144 print(f" (Based on {units_consumed} units @ tariff rates)")
145
146 # Fixed Charges (FC) - Standard monthly charge
147 print(f"Fixed Charges (FC)                   : ₹{fc:.2f}")
148 print(f" (Standard monthly charge)")
149
150 # Customer Charges (CC) - Administrative charges
151 print(f"Customer Charges (CC)                : ₹{cc:.2f}")
152 print(f" (Administrative charges)")
153
154 # Electricity Duty (ED) - 5% of Energy Charges
155 print(f"Electricity Duty (ED)                 : ₹{ed:.2f}")
156 print(f" (5% of Energy Charges)")
157
158 print("-" * 60)
159
160 # Display total bill amount

```

Keep Undo

```

70 elif customer_type == "Commercial":
71     print(" • Flat rate: ₹4.0/unit")
72 elif customer_type == "Industrial":
73     print(" • Flat rate: ₹6.0/unit")
74 print()
75 print("ADDITIONAL CHARGES:")
76 print(" • Fixed Charges: ₹30.00 (Standard)")
77 print(" • Customer Charges: ₹30.00 (Administrative)")
78 print(" • Electricity Duty: 5% of Energy Charges")
79 print("=" * 60)
80
81 # Sample billing examples for verification
82 print()
83 print("SAMPLE BILLING CALCULATIONS:")
84 print("-" * 60)
85 print("Example 1 - Domestic Customer (150 units):")
86 sample_ec_1 = calculate_energy_charges(150, 'Domestic')
87 sample_ed_1 = sample_ec_1 * 0.05
88 sample_total_1 = sample_ec_1 + fc + cc + sample_ed_1
89 print(f" EC: ₹{sample_ec_1:.2f}, FC: ₹{fc:.2f}, CC: ₹{cc:.2f}, ED: ₹{sample_ed_1:.2f}")
90 print(f" Total: ₹{sample_total_1:.2f}")
91 print()
92 print("Example 2 - Commercial Customer (200 units):")
93 sample_ec_2 = calculate_energy_charges(200, 'Commercial')
94 sample_ed_2 = sample_ec_2 * 0.05
95 sample_total_2 = sample_ec_2 + fc + cc + sample_ed_2
96 print(f" EC: ₹{sample_ec_2:.2f}, FC: ₹{fc:.2f}, CC: ₹{cc:.2f}, ED: ₹{sample_ed_2:.2f}")
97 print(f" Total: ₹{sample_total_2:.2f}")
98 print()
99 print("Example 3 - Industrial Customer (300 units):")
00 sample_ec_3 = calculate_energy_charges(300, 'Industrial')
01 sample_ed_3 = sample_ec_3 * 0.05

```

## Output:

```

PS C:\Users\s9409\Downloads\aiassitantcoding> & C:/Users/s9409/AppData/Local/Programs/Python/Python313/python.exe c:/Users/s9409/Downloads/aiassitantcoding/8.py
Example 1 - Domestic Customer (150 units):
EC: ₹275.00, FC: ₹30.00, CC: ₹30.00, ED: ₹13.75
Total: ₹348.75

Example 2 - Commercial Customer (200 units):
EC: ₹800.00, FC: ₹30.00, CC: ₹30.00, ED: ₹40.00
Total: ₹900.00

Example 3 - Industrial Customer (300 units):
EC: ₹1800.00, FC: ₹30.00, CC: ₹30.00, ED: ₹90.00
Total: ₹1950.00
=====
PS C:\Users\s9409\Downloads\aiassitantcoding>

```

## 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:**

- o **Energy Charges (EC)**

- o **Fixed Charges (FC)**

- o **Customer Charges (CC)**

- o **Electricity Duty (ED)**

- o **Total Bill Amount**

- **Analyze the program based on:**

- o **Accuracy**

- o **Readability**

- o **Real-world applicability**

**prompt:**

**Final Bill Calculation)**

**Generate the final electricity bill by calculating:**

**Total Bill = Energy Charges + Fixed Charges + Customer Charges + Electricity Duty**

**Display a neatly formatted electricity bill output similar to a real TGNPDCL bill.**

**Use clear headings and labels.**

**Analysis Paragraph for Report)**

**Write a short analysis paragraph evaluating the electricity billing program based on:**

- **Accuracy**

- **Readability**

- **Real-world applicability**

**Keep the explanation suitable for a laboratory record.**

**Code generated**

9.py > ...

```
1  # Final Electricity Bill Generator
2  # This script calculates all billing components and prints a formatted bill
3  # Total Bill = Energy Charges (EC) + Fixed Charges (FC) + Customer Charges (CC) + Elect
4
5  # Function to calculate Energy Charges based on tariff rules
6  # Uses tiered pricing for Domestic and flat rates for Commercial/Industrial
7
8  def calculate_energy_charges(units, customer_type):
9      """Return energy charges for given units and customer type."""
10     if customer_type == "Domestic":
11         # Tiered pricing: first 100 units at ₹1.5, remaining at ₹2.5
12         if units <= 100:
13             return units * 1.5
14         return (100 * 1.5) + ((units - 100) * 2.5)
15     if customer_type == "Commercial":
16         return units * 4.0
17     if customer_type == "Industrial":
18         return units * 6.0
19     # Safety fallback for invalid type
20     return 0.0
21
22 # Fixed values for billing components
23 FIXED_CHARGES = 30.0      # FC: Standard monthly charge
24 CUSTOMER_CHARGES = 30.0  # CC: Administrative charge
25 DUTY_RATE = 0.05         # ED: 5% of Energy Charges
26
27 # --- Input Section ---
28 print("=" * 64)
29 print("TGNPDCL - ELECTRICITY BILL")
30 print("=" * 64)
```

Keep Undo

Keep Undo | 2 of

```
9.py > ...
30 print("=" * 64)
31
32 # Previous Units (PU)
33 while True:
34     try:
35         pu = float(input("Enter Previous Units (PU): "))
36         if pu < 0:
37             print("PU cannot be negative. Try again.")
38             continue
39         break
40     except ValueError:
41         print("Invalid number. Please re-enter.") Define a constant instead of dupli
42
43 # Current Units (CU)
44 while True:
45     try:
46         cu = float(input("Enter Current Units (CU): "))
47         if cu < 0:
48             print("CU cannot be negative. Try again.")
49             continue
50         break
51     except ValueError:
52         print("Invalid number. Please re-enter.")
53
54 # Ensure CU >= PU
55 while cu < pu:
56     print("CU cannot be less than PU. Re-enter CU.")
57     try:
58         cu = float(input("Enter Current Units (CU): "))
59     except ValueError:
```

```

9.py > ...
60     print("Invalid number. Please re-enter.")
61     cu = -1 # force repeat
62
63 # Customer Type
64 valid_types = ["Domestic", "Commercial", "Industrial"]
65 while True:
66     customer_type = input("Enter Customer Type (Domestic/Commercial/Industrial): ").strip()
67     if customer_type in valid_types:
68         break
69     print(f"Invalid type. Choose from: {' '.join(valid_types)}")
70
71 # --- Calculations ---
72 units_consumed = cu - pu
73 energy_charges = calculate_energy_charges(units_consumed, customer_type)
74 fixed_charges = FIXED_CHARGES
75 customer_charges = CUSTOMER_CHARGES
76 electricity_duty = energy_charges * DUTY_RATE
77
78 total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty
79
80 # --- Bill Output ---
81 print("\n" + "-" * 64)
82 print("ELECTRICITY BILL SUMMARY (TGNPDCL FORMAT)")
83 print("-" * 64)
84 print(f"Customer Type           : {customer_type}")
85 print(f"Previous Units (PU)        : {pu:10.2f}")
86 print(f"Current Units (CU)         : {cu:10.2f}")
87 print(f"Units Consumed              : {units_consumed:10.2f} units")
88 print("-" * 64)
89 print(f"Energy Charges (EC)         : ₹{energy_charges:10.2f}")

```

```

9.py > ...
88 print("-" * 64)
89 print(f"Energy Charges (EC)       : ₹{energy_charges:10.2f}")
90 print(f"Fixed Charges (FC)        : ₹{fixed_charges:10.2f}")
91 print(f"Customer Charges (CC)      : ₹{customer_charges:10.2f}")
92 print(f"Electricity Duty (ED)      : ₹{electricity_duty:10.2f} (5% of EC)")
93 print("-" * 64)
94 print(f"TOTAL BILL                  : ₹{total_bill:10.2f}")
95 print("=" * 64)
96
97 # Show tariff reminder for clarity
98 print("Tariff Applied:")
99 if customer_type == "Domestic":
100     print(" Domestic: First 100 units @ ₹1.5, above 100 @ ₹2.5")
101 elif customer_type == "Commercial":
102     print(" Commercial: Flat ₹4.0/unit")
103 elif customer_type == "Industrial":
104     print(" Industrial: Flat ₹6.0/unit")
105 print(f"Fixed Charges (FC): ₹30.00 | Customer Charges (CC): ₹30.00 | Duty: 5% of EC")
106 print("=" * 64)
107
108 # Analysis paragraph for laboratory record
109 print("\nAnalysis (for Laboratory Record):")
110 print("Accuracy : Tariff logic mirrors TGNPDCL slabs; duty derived at 5% of EC; validation successful")
111 print("Readability : Clear sectioning, concise comments, and aligned outputs improve traceability")
112 print("Real-world applicability : Covers common residential/commercial/industrial tariff scenarios")
113

```

# Output:

```
PROBLEMS 32 OUTPUT DEBUG CONSOLE TERMINAL PORTS GITLENS SONARQUBE 32
409/Downloads/aiassitantcoding/9.py
=====
TGNPDCL - ELECTRICITY BILL
=====
Enter Previous Units (PU): 23
Enter Current Units (CU): 45
Enter Customer Type (Domestic/Commercial/Industrial): Domestic

-----
ELECTRICITY BILL SUMMARY (TGNPDCL FORMAT)
-----
Customer Type      : Domestic
Previous Units (PU) :      23.00
Current Units (CU)  :      45.00
Units Consumed      :      22.00 units
-----
Energy Charges (EC) : ₹      33.00
Fixed Charges (FC)  : ₹      30.00
Customer Charges (CC) : ₹      30.00
Electricity Duty (ED) : ₹       1.65 (5% of EC)
-----
Tariff Applied:
  Domestic: First 100 units @ ₹1.5, above 100 @ ₹2.5
Fixed Charges (FC): ₹30.00 | Customer Charges (CC): ₹30.00 | Duty: 5% of EC
=====

Analysis (for Laboratory Record):
Accuracy : Tariff logic mirrors TGNPDCL slabs; duty derived at 5% of EC; validations prevent negative or decreasing readings,
          ensuring correct units consumed.
Readability : Clear sectioning, concise comments, and aligned outputs improve traceability of each billing component.
Real-world applicability : Covers common residential/commercial/industrial tariffs with fixed and administrative charges; str
ucture can be extended for taxes, surcharges, or slab revisions.
```