

ASSIGNMENT-3.3

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TASK-1:

PROMPT:

Generate a Python program that reads consumer details from a CSV file named "TGNPDCL_Customers_Apr_2025.csv", extracts Previous Units (PU), Current Units (CU), and Type of Customer (Domestic/Commercial/Industrial) for each record, calculates Units Consumed = Current Units – Previous Units, and displays the results clearly for every consumer; all logic must be written directly in the main program without using functions, include basic validation to ensure current units are not less than previous units, use simple readable code suitable for beginners, and produce correct input reading and unit consumption output .

INPUT:

B1							
Name							
	A	B	C	D	E	F	G
1	Customer	Name	Address	ConnectionType	PreviousRe	CurrentRe	BillingMonth
2	TGNP001	Rajesh Kumar	Plot No. 12, Gachibowli, Hyderabad	Domestic	1250	1406	Apr-25
3	TGNP002	Anita Sharma	Flat 302, Mayur Apartments, Secun	Domestic	890	945	Apr-25
4	TGNP003	Priya Reddy	House No. 45, Banjara Hills, Hydera	Domestic	1120	1245	Apr-25
5	TGNP004	Karthik Verma	Flat 108, Jubilee Hills, Hyderabad	Domestic	780	892	Apr-25
6	TGNP005	Sneha Patel	Plot 23, Madhapur, Hyderabad	Domestic	1560	1720	Apr-25
7	TGNP006	Arun Mehta	Sector 5, Hitech City, Hyderabad	Domestic	920	1015	Apr-25
8	TGNP007	Meera Nair	Flat 401, Kondapur, Hyderabad	Domestic	1340	1475	Apr-25
9	TGNP008	Vikram Singh	House No. 78, Begumpet, Hyderabad	Domestic	680	755	Apr-25
10	TGNP009	Sunita Rao	Plot 34, Kukatpally, Hyderabad	Domestic	1890	2040	Apr-25
11	TGNP010	Rahul Joshi	Flat 205, Ameerpet, Hyderabad	Domestic	1020	1150	Apr-25
12	TGNP011	Tech Solutions Inc	Office No. 45, Hi-Tech City	Commercial	12500	13250	Apr-25
13	TGNP012	Green Cafe	Shop No. 8, Madhapur Main Road	Commercial	3400	3580	Apr-25
14	TGNP013	MediCare Pharmacy	Shop No. 15, Banjara Hills	Commercial	1250	1420	Apr-25
15	TGNP014	Smart Retail Mart	Ground Floor, Jubilee Hills	Commercial	8900	9250	Apr-25
16	TGNP015	CodeHub IT Services	3rd Floor, Hitech City	Commercial	4560	4890	Apr-25
17	TGNP016	Urban Diner Restaurant	Plot 67, Madhapur	Commercial	2340	2560	Apr-25
18	TGNP017	Bright Future School	Sector 2, Gachibowli	Commercial	15600	15980	Apr-25
19	TGNP018	Steel Factory Ltd	Industrial Area, Kondapur	Industrial	45200	47800	Apr-25
20	TGNP019	Textile Mills Hyderabad	Patancheru Industrial Zone	Industrial	125600	127800	Apr-25
21	TGNP020	Plastic Products Unit	IDA Nacharam	Industrial	56700	58900	Apr-25
22	TGNP021	Pharma Manufacturing Co	Bollaram Industrial Area	Industrial	89200	91000	Apr-25
23	TGNP022	Automobile Parts Ltd	Medchal Industrial Park	Industrial	123400	125600	Apr-25
24	TGNP023	Food Processing Plant	Shamirpet Industrial Area	Industrial	45600	47850	Apr-25
25	TGNP024	Cement Products Unit	Patancheru, Hyderabad	Industrial	78900	81200	Apr-25
26	TGNP025	Chemical Industries Ltd	Jeedimetla Industrial Area	Industrial	134500	137200	Apr-25

CODE:

```

# generate a Python program that reads consumer details from a CSV file named "TGNPDCL_Customers_Apr_2025.csv", extracts Previous Units (PU), Current Units (CU), and Units Consumed (UC)
import csv
# Open the CSV file for reading
with open(r'c:\Users\ksair\Downloads\TGNPDCL_Customers_Apr_2025.csv', mode='r') as file:
    # Create a CSV reader object
    csv_reader = csv.reader(file)

    # Skip the header row
    next(csv_reader)

    # Print the header for the output
    print(f"{'Consumer ID':<15} {'Type of Customer':<20} {'Previous Units':<15} {'Current Units':<15} {'Units Consumed':<15}")
    print("-" * 80)

    # Iterate through each row in the CSV file
    for row in csv_reader:
        consumer_id = row[0] # Assuming Consumer ID is in the first column
        type_of_customer = row[3] # Assuming Type of Customer is in the second column
        previous_units = int(row[4]) # Assuming Previous Units is in the third column
        current_units = int(row[5]) # Assuming Current Units is in the fourth column

        # Validate that current units are not less than previous units
        if current_units < previous_units:
            print(f"Error for Consumer ID {consumer_id}: Current Units ({current_units}) cannot be less than Previous Units ({previous_units}).")
            continue

        # Calculate Units Consumed
        units_consumed = current_units - previous_units

        # Display the results
        print(f"{'consumer_id':<15} {'type_of_customer':<20} {'previous_units':<15} {'current_units':<15} {'units_consumed':<15}")

```

OUTPUT:

```

PS C:\Users\ksair\Downloads\Competitive Programming> & C:/Users/ksair/AppData/Local/Microsoft/WindowsApps/python3.11.exe "c:/Users/ksair/Downloads/Competitive Programming/AAC-assignment-3.py"

```

Consumer ID	Type of Customer	Previous Units	Current Units	Units Consumed
TGNP001	Domestic	1250	1406	156
TGNP002	Domestic	890	945	55
TGNP003	Domestic	1120	1245	125
TGNP004	Domestic	780	892	112
TGNP005	Domestic	1560	1720	160
TGNP006	Domestic	920	1015	95
TGNP007	Domestic	1340	1475	135
TGNP008	Domestic	680	755	75
TGNP009	Domestic	1890	2040	150
TGNP010	Domestic	1020	1150	130
TGNP011	Commercial	12500	13250	750
TGNP012	Commercial	3400	3580	180
TGNP013	Commercial	1250	1420	170
TGNP014	Commercial	8900	9250	350
TGNP015	Commercial	4560	4890	330
TGNP016	Commercial	2340	2560	220
TGNP017	Commercial	15600	15980	380
TGNP018	Industrial	45200	47800	2600
TGNP019	Industrial	125600	127800	2200
TGNP020	Industrial	56700	58900	2200
TGNP021	Industrial	89200	91000	1800
TGNP022	Industrial	123400	125600	2200
TGNP023	Industrial	45600	47850	2250
TGNP024	Industrial	78900	81200	2300
TGNP025	Industrial	134500	137200	2700

```

PS C:\Users\ksair\Downloads\Competitive Programming>

```

JUSTIFICATION:

This Python program successfully reads electricity consumer data from "TGNPDCL_Customers_Apr_2025.csv" using the CSV module with proper file handling and header skipping. It correctly extracts CustomerID, ConnectionType, PreviousReading, and CurrentReading from columns 0, 3, 4, and 5 respectively, matching the CSV structure. The

program implements data validation to ensure current units are not less than previous units, preventing logical billing errors, and calculates units consumed using the formula [current units - previous units](#). Output is displayed in a clean tabular format using f-string formatting with left alignment for readability, including proper headers and separator lines. The code maintains simplicity without functions, includes clear comments for beginners, and fulfills all requirements for accurate data extraction, validation, calculation, and professional presentation suitable for documentation and demonstration.

TASK-2

Generate a Python program that extends the Task 1 CSV-based electricity billing code to calculate Energy Charges (EC) using conditional statements for Domestic, Commercial, and Industrial consumers based on units consumed, implements all logic directly in the main program without functions, improves readability by simplifying and optimizing the conditional logic, and displays Customer Type, Units Consumed, and correct Energy Charges (EC) with sample execution output.

AI -GENERATED Code:

```
# Generate a Python program that extends the Task 1 CSV-based electricity billing code to calculate **Energy Charges (EC)** using **co
Keep Undo

# Task 2: Energy Charges Calculation Based on Units Consumed
import csv

# Open the CSV file for reading
with open(r'c:\Users\ksair\Downloads\TGNPDCL_Customers_Apr_2025.csv', mode='r') as file:
    # Create a CSV reader object
    csv_reader = csv.reader(file)

    # Skip the header row
    next(csv_reader)

    # Print the header for the output
    print(f'{"Consumer ID":<12} {"Type":<12} {"Prev":<8} {"Curr":<8} {"Units":<8} {"Energy Charges":<18} {"Fixed":<10} {"Total Bill":<12}")
    print("-" * 100)

    # Iterate through each row in the CSV file
    for row in csv_reader:
        consumer_id = row[0] # CustomerID is in the first column
        type_of_customer = row[3] # ConnectionType is in the fourth column
        previous_units = int(row[4]) # PreviousReading is in the fifth column
        current_units = int(row[5]) # CurrentReading is in the sixth column

        # Validate that current units are not less than previous units
        if current_units < previous_units:
            print(f"Error for Consumer ID {consumer_id}: Current Units cannot be less than Previous Units.")
            continue

        # Calculate Units Consumed
        units_consumed = current_units - previous_units
```

```

# Validate that current units are not less than previous units
if current_units < previous_units:
    print(f"Error for Consumer ID {consumer_id}: Current Units cannot be less than Previous Units.")
    continue

# Calculate Units Consumed
units_consumed = current_units - previous_units

# Initialize energy charges and fixed charges
energy_charges = 0.0
fixed_charges = 0.0

# Calculate Energy Charges based on customer type and consumption slabs
if type_of_customer == "Domestic":
    # Domestic tariff: 0-50@2.50, 51-100@3.00, 101-200@4.50, >200@6.00
    if units_consumed <= 50:
        energy_charges = units_consumed * 2.50
    elif units_consumed <= 100:
        energy_charges = (50 * 2.50) + ((units_consumed - 50) * 3.00)
    elif units_consumed <= 200:
        energy_charges = (50 * 2.50) + (50 * 3.00) + ((units_consumed - 100) * 4.50)
    else:
        energy_charges = (50 * 2.50) + (50 * 3.00) + (100 * 4.50) + ((units_consumed - 200) * 6.00)
    fixed_charges = 50.0

elif type_of_customer == "Commercial":
    # Commercial tariff: 0-100@5.00, 101-200@6.50, >200@8.00
    if units_consumed <= 100:
        energy_charges = units_consumed * 5.00
    elif units_consumed <= 200:
        energy_charges = (100 * 5.00) + ((units_consumed - 100) * 6.50)
    else:
        energy_charges = (100 * 5.00) + (100 * 6.50) + ((units_consumed - 200) * 8.00)
    fixed_charges = 200.0

elif type_of_customer == "Industrial":
    # Industrial tariff: 0-500@6.00, 501-1000@7.00, >1000@8.50
    if units_consumed <= 500:
        energy_charges = units_consumed * 6.00
    elif units_consumed <= 1000:
        energy_charges = (500 * 6.00) + ((units_consumed - 500) * 7.00)
    else:
        energy_charges = (500 * 6.00) + (500 * 7.00) + ((units_consumed - 1000) * 8.50)
    fixed_charges = 500.0

else:
    print(f"Error: Unknown customer type '{type_of_customer}' for Consumer ID {consumer_id}")
    continue

# Calculate Total Bill
total_bill = energy_charges + fixed_charges

# Display the results with proper formatting
print(f"consumer_id:<12> {type_of_customer:<12> {previous_units:<8> {current_units:<8> {units_consumed:<8> ₹{energy_charges:<16.2f} ₹{fixed_charges:<16.2f} ₹{total_bill:<16.2f}")

print("-" * 100)
print("Billing completed successfully!")

```

OUTPUT:

```
PS C:\Users\ksair\Downloads\Competitive Programming> & C:/Users/ksair/AppData/Local/Microsoft/WindowsApps/python3.11.exe "c:/Users/ksair/Downloads/Competitive Programming/AAC-assignment-3.py"
```

TGNP021	Industrial	89200	91000	1800			
TGNP022	Industrial	123400	125600	2200			
TGNP023	Industrial	45600	47850	2250			
TGNP024	Industrial	78900	81200	2300			
TGNP025	Industrial	134500	137200	2700			
Consumer ID	Type	Prev	Curr	Units	Energy Charges	Fixed	Total Bill
TGNP001	Domestic	1250	1406	156	₹527.00	₹50.00	₹577.00
TGNP002	Domestic	890	945	55	₹140.00	₹50.00	₹190.00
TGNP003	Domestic	1120	1245	125	₹387.50	₹50.00	₹437.50
TGNP004	Domestic	780	892	112	₹329.00	₹50.00	₹379.00
TGNP005	Domestic	1560	1720	160	₹545.00	₹50.00	₹595.00
TGNP006	Domestic	920	1015	95	₹260.00	₹50.00	₹310.00
TGNP007	Domestic	1340	1475	135	₹432.50	₹50.00	₹482.50
TGNP008	Domestic	680	755	75	₹200.00	₹50.00	₹250.00
TGNP009	Domestic	1890	2040	150	₹500.00	₹50.00	₹550.00
TGNP010	Domestic	1020	1150	130	₹410.00	₹50.00	₹460.00
TGNP011	Commercial	12500	13250	750	₹5550.00	₹200.00	₹5750.00
TGNP012	Commercial	3400	3580	180	₹1020.00	₹200.00	₹1220.00
TGNP013	Commercial	1250	1420	170	₹955.00	₹200.00	₹1155.00
TGNP014	Commercial	8900	9250	350	₹2350.00	₹200.00	₹2550.00
TGNP015	Commercial	4560	4890	330	₹2190.00	₹200.00	₹2390.00
TGNP016	Commercial	2340	2560	220	₹1310.00	₹200.00	₹1510.00
TGNP017	Commercial	15600	15980	380	₹2590.00	₹200.00	₹2790.00
TGNP018	Industrial	45200	47800	2600	₹20100.00	₹500.00	₹20600.00
TGNP019	Industrial	125600	127800	2200	₹16700.00	₹500.00	₹17200.00
TGNP020	Industrial	56700	58900	2200	₹16700.00	₹500.00	₹17200.00
TGNP021	Industrial	89200	91000	1800	₹13300.00	₹500.00	₹13800.00
TGNP022	Industrial	123400	125600	2200	₹16700.00	₹500.00	₹17200.00
TGNP023	Industrial	45600	47850	2250	₹17125.00	₹500.00	₹17625.00
TGNP024	Industrial	78900	81200	2300	₹17550.00	₹500.00	₹18050.00
TGNP025	Industrial	134500	137200	2700	₹20950.00	₹500.00	₹21450.00

Billine completed successfully!

JUSTIFICATION:

This program extends Task 1 by implementing slab-based energy charge calculations using conditional statements for three customer types (Domestic, Commercial, Industrial) with cumulative tariff structures. Fixed charges are applied per customer type (Domestic: ₹50, Commercial: ₹200, Industrial: ₹500), and Total Bill is calculated as Energy Charges plus Fixed Charges with currency formatted to 2 decimals. The optimized conditional logic ensures accurate billing while displaying comprehensive results in a well-aligned tabular format.

TASK -3:

PROMPT:

Generate a Python program for an electricity billing system that applies a modular design using user-defined functions, where separate functions calculate Energy Charges (EC) and Fixed Charges (FC) and return the computed values, includes meaningful comments for clarity, processes multiple consumers correctly, and produces a function-based program with accurate EC and FC results, test cases with outputs, and screenshots showing the AI-assisted function generation.

AI -GENERATED -CODE:

```

# Function to calculate energy charges based on customer type and units consumed
def calculate_energy_charges(customer_type, units_consumed):
    """
    Calculate energy charges based on customer type and consumption slabs.

    Parameters:
        customer_type (str): Type of customer (Domestic/Commercial/Industrial)
        units_consumed (int): Total units consumed by the customer

    Returns:
        float: Calculated energy charges in rupees
    """
    energy_charges = 0.0

    if customer_type == "Domestic":
        # Domestic tariff: 0-50@2.50, 51-100@3.00, 101-200@4.50, >200@6.00
        if units_consumed <= 50:
            energy_charges = units_consumed * 2.50
        elif units_consumed <= 100:
            energy_charges = (50 * 2.50) + ((units_consumed - 50) * 3.00)
        elif units_consumed <= 200:
            energy_charges = (50 * 2.50) + (50 * 3.00) + ((units_consumed - 100) * 4.50)
        else:
            energy_charges = (50 * 2.50) + (50 * 3.00) + (100 * 4.50) + ((units_consumed - 200) * 6.00)

    elif customer_type == "Commercial":
        # Commercial tariff: 0-100@5.00, 101-200@6.50, >200@8.00
        if units_consumed <= 100:
            energy_charges = units_consumed * 5.00
        elif units_consumed <= 200:
            energy_charges = (100 * 5.00) + ((units_consumed - 100) * 6.50)
        else:
            energy_charges = (100 * 5.00) + (100 * 6.50) + ((units_consumed - 200) * 8.00)

```

```

    elif customer_type == "Industrial":
        # Industrial tariff: 0-500@6.00, 501-1000@7.00, >1000@8.50
        if units_consumed <= 500:
            energy_charges = units_consumed * 6.00
        elif units_consumed <= 1000:
            energy_charges = (500 * 6.00) + ((units_consumed - 500) * 7.00)
        else:
            energy_charges = (500 * 6.00) + (500 * 7.00) + ((units_consumed - 1000) * 8.50)

```

```

    return energy_charges

```

Function to calculate fixed charges based on customer type

```

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

    Parameters:
        customer_type (str): Type of customer (Domestic/Commercial/Industrial)

    Returns:
        float: Fixed charges in rupees
    """
    if customer_type == "Domestic":
        return 50.0
    elif customer_type == "Commercial":
        return 200.0
    elif customer_type == "Industrial":
        return 500.0
    else:
        return 0.0

```

```
# Main program to read CSV and calculate billing using functions
with open(r'c:\Users\ksair\Downloads\TGNDCL_Customers_Apr_2025.csv', mode='r') as file:
    csv_reader = csv.reader(file)
    next(csv_reader) # Skip header

    print("\nTask 3: Function-Based Billing System")
    print(f'Consumer ID:<12> { 'Type':<12> { 'Prev':<8> { 'Curr':<8> { 'Units':<8> { 'Energy Charges':<18> { 'Fixed':<10> { 'Total Bill':<12>}"
    print("-" * 100)

    for row in csv_reader:
        consumer_id = row[0]
        type_of_customer = row[3]
        previous_units = int(row[4])
        current_units = int(row[5])

        # Validate data
        if current_units < previous_units:
            print(f"Error for {consumer_id}: Invalid readings")
            continue

        # Calculate units consumed
        units_consumed = current_units - previous_units

        # Call functions to calculate charges
        energy_charges = calculate_energy_charges(type_of_customer, units_consumed)
        fixed_charges = calculate_fixed_charges(type_of_customer)
        total_bill = energy_charges + fixed_charges

        # Display results
        print(f"Consumer ID:<12> {type_of_customer:<12> {previous_units:<8> {current_units:<8> {units_consumed:<8> ₹{energy_charges:<16.2f} ₹{fixed_charges:<8.2f} ₹{total_bill:<12.2f}"
        print("-" * 100)
```

```
# Validate data
if current_units < previous_units:
    print(f"Error for {consumer_id}: Invalid readings")
    continue

# Calculate units consumed
units_consumed = current_units - previous_units

# Call functions to calculate charges
energy_charges = calculate_energy_charges(type_of_customer, units_consumed)
fixed_charges = calculate_fixed_charges(type_of_customer)
total_bill = energy_charges + fixed_charges

# Display results
print(f"Consumer ID:<12> {type_of_customer:<12> {previous_units:<8> {current_units:<8> {units_consumed:<8> ₹{energy_charges:<16.2f} ₹{fixed_charges:<8.2f} ₹{total_bill:<12.2f}"
print("-" * 100)

# Test Cases
print("\n=== TEST CASES ===")
print("\nTest Case 1: Domestic - 75 units")
ec1 = calculate_energy_charges("Domestic", 75)
fc1 = calculate_fixed_charges("Domestic")
print(f"Energy Charges: ₹{ec1:.2f}, Fixed Charges: ₹{fc1:.2f}, Total: ₹{ec1+fc1:.2f}")

print("\nTest Case 2: Commercial - 150 units")
ec2 = calculate_energy_charges("Commercial", 150)
fc2 = calculate_fixed_charges("Commercial")
print(f"Energy Charges: ₹{ec2:.2f}, Fixed Charges: ₹{fc2:.2f}, Total: ₹{ec2+fc2:.2f}")

print("\nTest Case 3: Industrial - 800 units")
ec3 = calculate_energy_charges("Industrial", 800)
fc3 = calculate_fixed_charges("Industrial")
print(f"Energy Charges: ₹{ec3:.2f}, Fixed Charges: ₹{fc3:.2f}, Total: ₹{ec3+fc3:.2f}")

print("\nAll test cases executed successfully!")
```

OUTPUT:

```
=== TEST CASES ===
```

```
Test Case 1: Domestic - 75 units
Energy Charges: ₹200.00, Fixed Charges: ₹50.00, Total: ₹250.00
```

```
Test Case 2: Commercial - 150 units
Energy Charges: ₹825.00, Fixed Charges: ₹200.00, Total: ₹1025.00
```

```
Test Case 3: Industrial - 800 units
Energy Charges: ₹5100.00, Fixed Charges: ₹500.00, Total: ₹5600.00
```

```
All test cases executed successfully!
```

JUSTIFICATION:

This program implements modular design with two reusable functions: `calculate_energy_charges(customer_type, units_consumed)` for slab-based tariff calculations and `calculate_fixed_charges(customer_type)` for type-specific fixed charges, both with docstrings. This approach improves code maintainability, eliminates duplication, and includes test cases for Domestic (75 units), Commercial (150 units), and Industrial (800 units) consumers demonstrating correct billing calculations

TASK-4

PROMPT :

Extend the existing electricity billing Python program using AI assistance to calculate additional charges, including Fixed Charges (FC), Customer Charges (CC), and Electricity Duty (ED) calculated as a percentage of Energy Charges (EC), improve overall billing accuracy, and display each charge separately with a well-structured output, ensuring correct duty calculation and clearly verified intermediate results suitable for real-world electricity billing.

AI-GENERATED-CODE:

```
# Task 4: Calculation of Additional Charges (FC, CC, ED)
import csv

# Open the CSV file for reading
with open(r'c:\Users\ksair\Downloads\TGNPDCL_Customers_Apr_2025.csv', mode='r') as file:
    csv_reader = csv.reader(file)
    next(csv_reader) # Skip header

    print("\n\nTask 4: Billing with Additional Charges")
    print(f"{'ID':<10} {'Type':<12} {'Units':<8} {'EC':<12} {'FC':<10} {'CC':<10} {'ED':<12} {'Total':<12}")
    print("-" * 100)

    for row in csv_reader:
        consumer_id = row[0]
        type_of_customer = row[3]
        previous_units = int(row[4])
        current_units = int(row[5])

        # Validate data
        if current_units < previous_units:
            continue

        # Calculate units consumed
        units_consumed = current_units - previous_units

        # Calculate Energy Charges (EC)
        energy_charges = 0.0
        if type_of_customer == "Domestic":
            if units_consumed <= 50:
                energy_charges = units_consumed * 2.50
            elif units_consumed <= 100:
                energy_charges = (50 * 2.50) + ((units_consumed - 50) * 3.00)
            elif units_consumed <= 200:
                energy_charges = (50 * 2.50) + (50 * 3.00) + ((units_consumed - 100) * 4.50)
            else:
                energy_charges = (50 * 2.50) + (50 * 3.00) + (100 * 4.50) + ((units_consumed - 200) * 6.00)
```

```

elif type_of_customer == "Commercial":
    if units_consumed <= 100:
        energy_charges = units_consumed * 5.00
    elif units_consumed <= 200:
        energy_charges = (100 * 5.00) + ((units_consumed - 100) * 6.50)
    else:
        energy_charges = (100 * 5.00) + (100 * 6.50) + ((units_consumed - 200) * 8.00)
elif type_of_customer == "Industrial":
    if units_consumed <= 500:
        energy_charges = units_consumed * 6.00
    elif units_consumed <= 1000:
        energy_charges = (500 * 6.00) + ((units_consumed - 500) * 7.00)
    else:
        energy_charges = (500 * 6.00) + (500 * 7.00) + ((units_consumed - 1000) * 8.50)

# Calculate Fixed Charges (FC) based on customer type
if type_of_customer == "Domestic":
    fixed_charges = 50.0
elif type_of_customer == "Commercial":
    fixed_charges = 200.0
elif type_of_customer == "Industrial":
    fixed_charges = 500.0
else:
    fixed_charges = 0.0

# Calculate Customer Charges (CC) - flat rate based on customer type
if type_of_customer == "Domestic":
    customer_charges = 25.0
elif type_of_customer == "Commercial":
    customer_charges = 75.0
elif type_of_customer == "Industrial":
    customer_charges = 150.0
else:
    customer_charges = 0.0

# Calculate Electricity Duty (ED) - percentage of Energy Charges
if type_of_customer == "Domestic":
    electricity_duty = energy_charges * 0.05 # 5% for Domestic
elif type_of_customer == "Commercial":
    electricity_duty = energy_charges * 0.10 # 10% for Commercial
elif type_of_customer == "Industrial":
    electricity_duty = energy_charges * 0.15 # 15% for Industrial
else:
    electricity_duty = 0.0

# Calculate Total Bill
total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

# Display individual charge values
print(f"consumer_id:<10> {type_of_customer:<12>} {units_consumed:<8}& {energy_charges:<10.2f}& {fixed_charges:<8.2f}& {customer_charges:<8.2f}& {electricity_duty:<8.2f}& {total_bill:<10.2f}&")

print("-" * 100)
print("Task 4: Billing with all additional charges completed!")

```

OUTPUT:

```
PS C:\Users\ksair\Downloads\Competitive Programing> & C:/Users/ksair/AppData/Local/Microsoft/WindowsApps/python3.11.exe "c:/User
.py"
```

All test cases executed successfully!

Task 4: Billing with Additional Charges

ID	Type	Units	EC	FC	CC	ED	Total
TGNP001	Domestic	156	₹527.00	₹50.00	₹25.00	₹26.35	₹628.35
TGNP002	Domestic	55	₹140.00	₹50.00	₹25.00	₹7.00	₹222.00
TGNP003	Domestic	125	₹387.50	₹50.00	₹25.00	₹19.38	₹481.88
TGNP004	Domestic	112	₹329.00	₹50.00	₹25.00	₹16.45	₹420.45
TGNP005	Domestic	160	₹545.00	₹50.00	₹25.00	₹27.25	₹647.25
TGNP006	Domestic	95	₹260.00	₹50.00	₹25.00	₹13.00	₹348.00
TGNP007	Domestic	135	₹432.50	₹50.00	₹25.00	₹21.62	₹529.12
TGNP008	Domestic	75	₹200.00	₹50.00	₹25.00	₹10.00	₹285.00
TGNP009	Domestic	150	₹500.00	₹50.00	₹25.00	₹25.00	₹600.00
TGNP010	Domestic	130	₹410.00	₹50.00	₹25.00	₹20.50	₹505.50
TGNP011	Commercial	750	₹5550.00	₹200.00	₹75.00	₹555.00	₹6380.00
TGNP012	Commercial	180	₹1020.00	₹200.00	₹75.00	₹102.00	₹1397.00
TGNP013	Commercial	170	₹955.00	₹200.00	₹75.00	₹95.50	₹1325.50
TGNP014	Commercial	350	₹2350.00	₹200.00	₹75.00	₹235.00	₹2860.00
TGNP015	Commercial	330	₹2190.00	₹200.00	₹75.00	₹219.00	₹2684.00
TGNP016	Commercial	220	₹1310.00	₹200.00	₹75.00	₹131.00	₹1716.00
TGNP017	Commercial	380	₹2590.00	₹200.00	₹75.00	₹259.00	₹3124.00
TGNP018	Industrial	2600	₹20100.00	₹500.00	₹150.00	₹3015.00	₹23765.00
TGNP019	Industrial	2200	₹16700.00	₹500.00	₹150.00	₹2505.00	₹19855.00
TGNP020	Industrial	2200	₹16700.00	₹500.00	₹150.00	₹2505.00	₹19855.00
TGNP021	Industrial	1800	₹13300.00	₹500.00	₹150.00	₹1995.00	₹15945.00
TGNP022	Industrial	2200	₹16700.00	₹500.00	₹150.00	₹2505.00	₹19855.00
TGNP023	Industrial	2250	₹17125.00	₹500.00	₹150.00	₹2568.75	₹20343.75
TGNP024	Industrial	2300	₹17550.00	₹500.00	₹150.00	₹2632.50	₹20832.50
TGNP025	Industrial	2700	₹20950.00	₹500.00	₹150.00	₹3142.50	₹24742.50

Task 4: Billing with all additional charges completed!

JUSTIFICATION:

This program extends billing accuracy by calculating three additional charges: Fixed Charges (FC) based on customer type (Domestic: ₹50, Commercial: ₹200, Industrial: ₹500), Customer Charges (CC) as flat rates (Domestic: ₹25, Commercial: ₹75, Industrial: ₹150), and Electricity Duty (ED) as a percentage of Energy Charges (Domestic: 5%, Commercial: 10%, Industrial: 15%), displaying all individual charge values in a well-structured tabular format with correct duty calculations and verified intermediate results for comprehensive billing.

TASK-5:

PROMPT:

Develop the final Python electricity billing application using AI assistance to calculate the total bill amount as $\text{Total Bill} = \text{EC} + \text{FC} + \text{CC} + \text{ED}$, clearly display Energy Charges (EC), Fixed Charges (FC), Customer Charges (CC), Electricity Duty (ED), and the Total Bill Amount, and present the output in a neatly formatted bill layout, along with sample input/output and a short analysis paragraph evaluating the program's accuracy, readability, and real-world applicability.

AI-GENERATED CODE:

```

# Task 5: Final Bill Generation and Output Analysis
import csv

print("\n\n" + "="*100)
print(" " * 30 + "TASK 5: FINAL ELECTRICITY BILL GENERATION")
print("="*100)

# Open the CSV file for reading
with open(r'c:\Users\ksair\Downloads\TGNPDCL_Customers_Apr_2025.csv', mode='r') as file:
    csv_reader = csv.reader(file)
    next(csv_reader) # Skip header

    for row in csv_reader:
        consumer_id = row[0]
        consumer_name = row[1]
        type_of_customer = row[3]
        previous_units = int(row[4])
        current_units = int(row[5])
        billing_month = row[6]

        # Validate data
        if current_units < previous_units:
            continue

        # Calculate units consumed
        units_consumed = current_units - previous_units

        # Calculate Energy Charges (EC) - same logic from Task 4
        energy_charges = 0.0
        if type_of_customer == "Domestic":
            if units_consumed <= 50:
                energy_charges = units_consumed * 2.50
            elif units_consumed <= 100:
                energy_charges = (50 * 2.50) + ((units_consumed - 50) * 3.00)
            elif units_consumed <= 200:
                energy_charges = (50 * 2.50) + (50 * 3.00) + ((units_consumed - 100) * 4.50)
            else:
                energy_charges = (50 * 2.50) + (50 * 3.00) + ((units_consumed - 100) * 4.50)
        elif type_of_customer == "Commercial":
            if units_consumed <= 100:
                energy_charges = units_consumed * 5.00
            elif units_consumed <= 200:
                energy_charges = (100 * 5.00) + ((units_consumed - 100) * 6.50)
            else:
                energy_charges = (100 * 5.00) + (100 * 6.50) + ((units_consumed - 200) * 8.00)
        elif type_of_customer == "Industrial":
            if units_consumed <= 500:
                energy_charges = units_consumed * 6.00
            elif units_consumed <= 1000:
                energy_charges = (500 * 6.00) + ((units_consumed - 500) * 7.00)
            else:
                energy_charges = (500 * 6.00) + (500 * 7.00) + ((units_consumed - 1000) * 8.50)

        # Calculate Fixed Charges (FC)
        if type_of_customer == "Domestic":
            fixed_charges = 50.0
        elif type_of_customer == "Commercial":
            fixed_charges = 200.0
        elif type_of_customer == "Industrial":
            fixed_charges = 500.0
        else:
            fixed_charges = 0.0

        # Calculate Customer Charges (CC)
        if type_of_customer == "Domestic":
            customer_charges = 25.0
        elif type_of_customer == "Commercial":
            customer_charges = 75.0
        elif type_of_customer == "Industrial":
            customer_charges = 150.0
        else:

```

```

# Calculate Fixed Charges (FC)
if type_of_customer == "Domestic":
    fixed_charges = 50.0
elif type_of_customer == "Commercial":
    fixed_charges = 200.0
elif type_of_customer == "Industrial":
    fixed_charges = 500.0
else:
    fixed_charges = 0.0

# Calculate Customer Charges (CC)
if type_of_customer == "Domestic":
    customer_charges = 25.0
elif type_of_customer == "Commercial":
    customer_charges = 75.0
elif type_of_customer == "Industrial":
    customer_charges = 150.0
else:
    customer_charges = 0.0

# Calculate Electricity Duty (ED)
if type_of_customer == "Domestic":
    electricity_duty = energy_charges * 0.05
elif type_of_customer == "Commercial":
    electricity_duty = energy_charges * 0.10
elif type_of_customer == "Industrial":
    electricity_duty = energy_charges * 0.15
else:
    electricity_duty = 0.0

```

```

# Calculate Electricity Duty (ED)
if type_of_customer == "Domestic":
    electricity_duty = energy_charges * 0.05
elif type_of_customer == "Commercial":
    electricity_duty = energy_charges * 0.10
elif type_of_customer == "Industrial":
    electricity_duty = energy_charges * 0.15
else:
    electricity_duty = 0.0

# Calculate Total Bill = EC + FC + CC + ED
total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

# Display Final Bill with detailed breakdown
print("\n" + "-"*100)
print(f"Consumer ID: {consumer_id:<20} | Name: {consumer_name:<30} | Billing Month: {billing_month}")
print(f"Customer Type: {type_of_customer:<15} | Previous Reading: {previous_units:<10} | Current Reading: {current_units:<10} | Units Consumed: {units_consumed}")
print("-"*100)
print(f"{'CHARGE DESCRIPTION':<50} {'AMOUNT (₹)':<20}")
print("-"*100)
print(f"{'Energy Charges (EC)':<50} {'₹' + str(f'{energy_charges:.2f}'):<20}")
print(f"{'Fixed Charges (FC)':<50} {'₹' + str(f'{fixed_charges:.2f}'):<20}")
print(f"{'Customer Charges (CC)':<50} {'₹' + str(f'{customer_charges:.2f}'):<20}")
print(f"{'Electricity Duty (ED)':<50} {'₹' + str(f'{electricity_duty:.2f}'):<20}")
print("-"*100)
print(f"{'TOTAL BILL AMOUNT':<50} {'₹' + str(f'{total_bill:.2f}'):<20}")
print("-"*100)

```

OUTPUT:

=====

TASK 5: FINAL ELECTRICITY BILL GENERATION

=====

Consumer ID: TGNP001	Name: Rajesh Kumar	Billing Month: Apr-25
Customer Type: Domestic	Previous Reading: 1250	Current Reading: 1406 Units Consumed: 156

CHARGE DESCRIPTION	AMOUNT (₹)
Energy Charges (EC)	₹527.00
Fixed Charges (FC)	₹50.00
Customer Charges (CC)	₹25.00
Electricity Duty (ED)	₹26.35
TOTAL BILL AMOUNT	₹628.35

=====

Consumer ID: TGNP002	Name: Anita Sharma	Billing Month: Apr-25
Customer Type: Domestic	Previous Reading: 890	Current Reading: 945 Units Consumed: 55

CHARGE DESCRIPTION	AMOUNT (₹)
Energy Charges (EC)	₹140.00
Fixed Charges (FC)	₹50.00
Customer Charges (CC)	₹25.00
Electricity Duty (ED)	₹7.00
TOTAL BILL AMOUNT	₹222.00

=====

Consumer ID: TGNP004	Name: Karthik Verma	Billing Month: Apr-25
Customer Type: Domestic	Previous Reading: 780	Current Reading: 892 Units Consumed: 112

CHARGE DESCRIPTION	AMOUNT (₹)
Energy Charges (EC)	₹329.00
Fixed Charges (FC)	₹50.00
Customer Charges (CC)	₹25.00
Electricity Duty (ED)	₹16.45
TOTAL BILL AMOUNT	₹420.45

=====

Consumer ID: TGNP005	Name: Sneha Patel	Billing Month: Apr-25
Customer Type: Domestic	Previous Reading: 1560	Current Reading: 1720 Units Consumed: 160

CHARGE DESCRIPTION	AMOUNT (₹)
Energy Charges (EC)	₹545.00
Fixed Charges (FC)	₹50.00
Customer Charges (CC)	₹25.00
Electricity Duty (ED)	₹27.25
TOTAL BILL AMOUNT	₹647.25

=====

```

-----
Consumer ID: TGNP024      | Name: Cement Products Unit      | Billing Month: Apr-25
Customer Type: Industrial | Previous Reading: 78900         | Current Reading: 81200         | Units Consumed: 2300
-----
CHARGE DESCRIPTION      AMOUNT (₹)
-----
Energy Charges (EC)     ₹17550.00
Fixed Charges (FC)      ₹500.00
Customer Charges (CC)   ₹150.00
Electricity Duty (ED)   ₹2632.50
-----
TOTAL BILL AMOUNT       ₹20832.50
=====

-----
Consumer ID: TGNP025      | Name: Chemical Industries Ltd    | Billing Month: Apr-25
Customer Type: Industrial | Previous Reading: 134500         | Current Reading: 137200         | Units Consumed: 2700
-----
CHARGE DESCRIPTION      AMOUNT (₹)
-----
Energy Charges (EC)     ₹20950.00
Fixed Charges (FC)      ₹500.00
Customer Charges (CC)   ₹150.00
Electricity Duty (ED)   ₹3142.50
-----
TOTAL BILL AMOUNT       ₹24742.50
=====

=====
ALL BILLS GENERATED SUCCESSFULLY!
PS C:\Users\ksair\Downloads\Competitive Programing> █

```

JUSTIFICATION:

This program generates complete electricity bills by calculating Total Bill = EC + FC + CC + ED with detailed breakdowns displaying Energy Charges, Fixed Charges, Customer Charges, and Electricity Duty in a professionally formatted layout that includes consumer details, meter readings, and itemized charges, demonstrating high accuracy through precise slab-based calculations, excellent readability with well-structured code, and strong real-world applicability as a production-ready billing system suitable for actual utility company deployment.