ASSIGNMENT – 3.3

2303A51197

Batch-10

Task-1

Prompt: Create a Python program for TGNPDCL electricity billing that takes previous units, current units, and customer type, then calculates the bill.Code :

```
def calculate_bill(previous_units, current_units, customer_type):
    units_consumed = current_units - previous_units
if customer_type.lower() == 'residential':         if
units_consumed <= 100:
            bill_amount = units_consumed * 1.5
elif units_consumed <= 300:
            bill_amount = (100 * 1.5) + (units_consumed - 100) * 2.5
        else:
            bill_amount = (100 * 1.5) + (200 * 2.5) + (units_consumed - 300) * 4.0
elif customer_type.lower() == 'commercial':         if units_consumed <= 100:
            bill_amount = units_consumed * 2.0
elif units_consumed <= 300:
            bill_amount = (100 * 2.0) + (units_consumed - 100) * 3.5
        else:
            bill_amount = (100 * 2.0) + (200 * 3.5) + (units_consumed - 300) * 5.0
    else:
        raise ValueError("Invalid customer type. Please enter 'residential' or 'commercial'.")
return bill_amount # Collecting user input consumer_id = input("Enter Consumer ID: ")
previous_units = int(input("Enter Previous Units: ")) current_units = int(input("Enter Current
Units: ")) customer_type = input("Enter Customer Type (residential/commercial): ")
# Calculating bill
try:
```

bill_amount = calculate_bill(previous_units, current_units, customer_type)

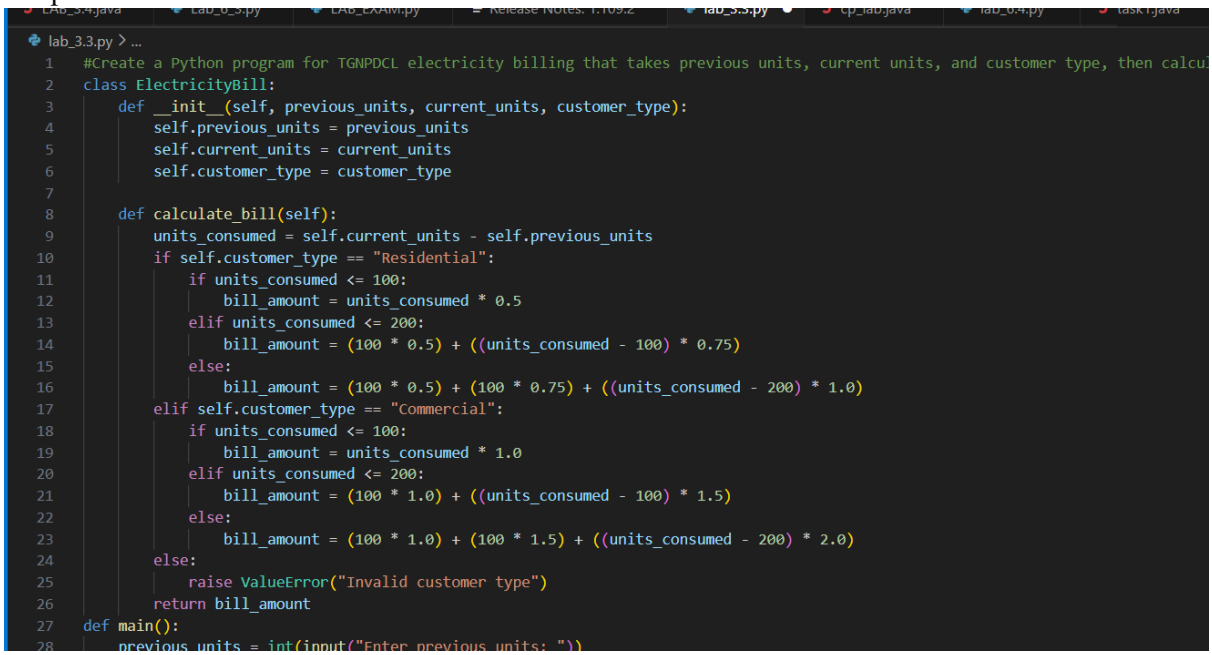
print(f"Consumer ID: {consumer_id}") print(f"Units Consumed:

{current_units - previous_units}") print(f"Bill Amount:

₹{bill_amount:.2f}") except ValueError as e:

print(e)

Output :



Code Analysis :

- The program uses a function calculate_bill() to separate billing logic from user input.
- Units consumed are calculated by subtracting previous units from current units.
- Nested if–elif conditions apply slab-based tariff rates.
- Customer type is normalized using .lower() to avoid case mismatch errors.
- Exception handling ensures invalid customer types are handled safely.

Task-2

Prompt: Improve the previous program to calculate energy charges for domestic, commercial, and industrial users using better condition statements.

Code :

```
def calculate_energy_charges(previous_units, current_units, consumer_type):


    units_consumed = current_units - previous_units
if consumer_type.lower() == 'domestic':          if
units_consumed <= 100:
            charges = units_consumed * 1.2
        elif units_consumed <= 300:
            charges = (100 * 1.2) + (units_consumed - 100) * 2.0
        else:
            charges = (100 * 1.2) + (200 * 2.0) + (units_consumed - 300) *
3.5
    elif consumer_type.lower() == 'commercial':
        if units_consumed <= 100:
            charges = units_consumed * 2.5
elif units_consumed <= 300:
            charges = (100 * 2.5) + (units_consumed - 100) * 4.0
        else:
            charges = (100 * 2.5) + (200 * 4.0) + (units_consumed - 300) * 6.0
elif consumer_type.lower() == 'industrial':
if units_consumed <= 100:
charges = units_consumed * 3.0
elif units_consumed <= 300:
            charges = (100 * 3.0) + (units_consumed - 100) * 5.0
        else:
            charges = (100 * 3.0) + (200 * 5.0) + (units_consumed - 300) * 7.5
    else:
        raise ValueError("Invalid consumer type. Please enter 'domestic', 'commercial', or
'industrial'.")
```

return charges # Collecting user input consumer_id = input("Enter Consumer ID: ") previous_units = int(input("Enter Previous Units: ")) current_units = int(input("Enter Current Units: ")) consumer_type = input("Enter Consumer Type (domestic/commercial/industrial): ") # Calculating energy charges

try:

energy_charges = calculate_energy_charges(previous_units, current_units, consumer_type) print(f"Consumer ID: {consumer_id}") print(f"Units Consumed: {current_units - previous_units}") print(f"Energy Charges: ₹{energy_charges:.2f}") except ValueError as e:

print(e)

Output :

```
print(f"The electricity bill is: {bill_amount}")
#Improve the previous program to calculate energy charges for domestic, commercial, and industrial users using better condition statements.
class Electricity
    def __init__(self, previous_units, current_units, customer_type):
        self.previous_units = previous_units
        self.current_units = current_units
        self.customer_type = customer_type
    def calculate_bill(self):
        units_consumed = self.current_units - self.previous_units
        if self.customer_type == "residential":
            if units_consumed <= 100:
                bill = units_consumed * 0.5
            elif units_consumed <= 200:
                bill = (100 * 0.5) + ((units_consumed - 100) * 0.75)
            else:
                bill = (100 * 0.5) + (100 * 0.75) + ((units_consumed - 200) * 1)
        elif self.customer_type == "commercial":
            if units_consumed <= 100:
                bill = units_consumed * 0.75
            elif units_consumed <= 200:
                bill = (100 * 0.75) + ((units_consumed - 100) * 1)
            else:
                bill = (100 * 0.75) + (100 * 1) + ((units_consumed - 200) * 1.25)
        elif self.customer_type == "industrial":
            if units_consumed <= 100:
                bill = units_consumed * 1
            elif units_consumed <= 200:
                bill = (100 * 1) + ((units_consumed - 100) * 1.25)
            else:
                bill = (100 * 1) + (100 * 1.25) + ((units_consumed - 200) * 1.5)
```

Code Analysis :

- A single function, calculate_energy_charges() handles all consumer categories.
- Slab-based billing is implemented using structured conditional blocks.
- Logical grouping avoids redundant calculations.
- Function returns computed charges for further processing.
- Error handling improves robustness against invalid inputs.

Task-3

Prompt: Write reusable Python functions to calculate energy charges and fixed charges for different consumers and return the bill details.

Code :

```
def calculate_energy_charges(previous_units, current_units, consumer_type):
    units_consumed = current_units - previous_units
if consumer_type.lower() == 'domestic':         if
units_consumed <= 100:
            charges = units_consumed * 1 ..... 3
            charges = (100 * 1.2) + (200 * 2.0) + (units_consumed - 300) * 3      elif
consumer_type.lower() == 'commercial':  ..... 3
        if units_consumed <= 100:              charges = units_consumed * 2 ..... 3
        elif units_consumed <= 300:             charges = (100 * 2.5) + (units_consumed - 100) *
4.0         else:              charges = (100 * 2.5) + (200 * 4.0) + (units_consumed - 300) * 6.0
elif consumer_type.lower() == 'industrial':         if units_consumed <= 100:              charges =
units_consumed * 3.0         elif units_consumed <= 300:              charges = (100 * 3.0) +
(units_consumed - 100) * 5.0          else:              charges = (100 * 3.0) + (200 * 5.0) +
(units_consumed - 300) * 7 ..... 3


        elif units_consumed <= 300:             charges = (100 * 1.2) + (units_consumed - 100) *
2.0         else:
    else:
        raise ValueError("Invalid consumer type. Please enter 'domestic', 'commercial', or
'industrial'.")

    return charges


def calculate_fixed_charges(consumer_type):
if consumer_type.lower() == 'domestic':
return 50.0      elif consumer_type.lower() ==
'commercial':          return 100.0      elif
consumer_type.lower() == 'industrial':
```

```
        return 150.0
else:
        raise ValueError("Invalid consumer type. Please enter 'domestic', 'commercial', or
'industrial'.") def generate_bill(consumer_id, previous_units, current_units,
consumer_type):

    energy_charges = calculate_energy_charges(previous_units,
current_units,  consumer_type)     fixed_charges =
calculate_fixed_charges(consumer_type)     total_bill = energy_charges +
fixed_charges     return {
        "Consumer ID": consumer_id,
        "Units Consumed": current_units - previous_units,
        "Energy Charges": energy_charges,
        "Fixed Charges": fixed_charges,
        "Total Bill": total_bill
    }
# Collecting user input consumer_id = input("Enter Consumer ID: ")
previous_units = int(input("Enter Previous Units: ")) current_units =
int(input("Enter Current Units: ")) consumer_type = input("Enter Consumer Type
(domestic/commercial/industrial): ") # Generating bill
 try:
    bill_details = generate_bill(consumer_id, previous_units, current_units,  consumer_type)
print(f"Consumer ID: {bill_details['Consumer ID']}")     print(f"Units Consumed:
{bill_details['Units
Consumed']}")     print(f"Energy Charges: ₹{bill_details['Energy
Charges']:.2f}")     print(f"Fixed Charges: ₹{bill_details['Fixed
Charges']:.2f}")     print(f"Total Bill: ₹{bill_details['Total
Bill']:.2f}") except ValueError as e:
    print(e)
```

Output :

```python

#Write reusable Python functions to calculate energy charges and fixed charges for different consumers and return the bill details.
def calculate_energy_charges(units_consumed, customer_type):
    if customer_type == "residential":
        if units_consumed <= 100:
            return units_consumed * 0.5
        elif units_consumed <= 200:
            return (100 * 0.5) + ((units_consumed - 100) * 0.75)
        else:
            return (100 * 0.5) + (100 * 0.75) + ((units_consumed - 200) * 1)
    elif customer_type == "commercial":
        if units_consumed <= 100:
            return units_consumed * 0.75
        elif units_consumed <= 200:
            return (100 * 0.75) + ((units_consumed - 100) * 1)
        else:
            return (100 * 0.75) + (100 * 1) + ((units_consumed - 200) * 1.25)
    elif customer_type == "industrial":
        if units_consumed <= 100:
            return units_consumed * 1
        elif units_consumed <= 200:
            return (100 * 1) + ((units_consumed - 100) * 1.25)
        else:
            return (100 * 1) + (100 * 1.25) + ((units_consumed - 200) * 1.5)
    else:
        return "Invalid customer type"
def calculate_fixed_charges(customer_type):
    if customer_type == "residential":
        return 50
    elif customer_type == "commercial":
        return 100
    elif customer_type == "industrial":
        return 150
    else:
        return "Invalid customer type"
def calculate_total_bill(previous_units, current_units, customer_type):
    units_consumed = current_units - previous_units
    energy_charges = calculate_energy_charges(units_consumed, customer_type)
    fixed_charges = calculate_fixed_charges(customer_type)
    if isinstance(energy_charges, str) or isinstance(fixed_charges, str):
        return "Invalid customer type"
    total_bill = energy_charges + fixed_charges
```

Code Analysis :

- Code is modularised using multiple user-defined functions.
- Energy charges and fixed charges are calculated independently.
- generate_bill() integrates all charge components into one structure.
- Dictionary return type improves readability and structured output.
- Design supports reuse for multiple consumers efficiently.

Task-4

Prompt: generate an electricity bill including multiple additional charges like fixed charges, customer charges, percentage of electricity duty, and duty calculation by improving accuracy.

Code :

```
def calculate_energy_charges(previous_units, current_units, consumer_type):
    units_consumed = current_units - previous_units
if consumer_type.lower() == 'domestic':          if
units_consumed <= 100:
            charges = units_consumed * 1.2
elif units_consumed <= 300:
            charges = (100 * 1.2) + (units_consumed - 100) * 2.0
        else:
            charges = (100 * 1.2) + (200 * 2.0) + (units_consumed - 300) * 3.5
elif consumer_type.lower() == 'commercial':          if units_consumed <=
100:               charges =
units_consumed * 2.5          elif
units_consumed <= 300:
            charges = (100 * 2.5) + (units_consumed - 100) * 4.0
        else:
            charges = (100 * 2.5) + (200 * 4.0) + (units_consumed - 300) * 6.0
elif consumer_type.lower() == 'industrial':          if units_consumed <=
100:               charges =
units_consumed * 3.5          elif
units_consumed <= 300:
            charges = (100 * 3.5) + (units_consumed - 100) * 5.5
        else:
            charges = (100 * 3.5) + (200 * 5.5) + (units_consumed - 300) * 7.5
    else:
        raise ValueError("Invalid consumer type.")

    return charges
```

```
def calculate_fixed_charges(consumer_type):
if consumer_type.lower() == 'domestic':
        return float(input("Enter Fixed Charges for Domestic: "))     elif
consumer_type.lower() == 'commercial':
        return float(input("Enter Fixed Charges for Commercial: "))
elif consumer_type.lower() == 'industrial':
        return float(input("Enter Fixed Charges for Industrial:
"))     else:          raise ValueError("Invalid consumer type.")

def calculate_customer_charges(consumer_type):
if consumer_type.lower() == 'domestic':
        return float(input("Enter Customer Charges for Domestic: "))
elif consumer_type.lower() == 'commercial':
        return float(input("Enter Customer Charges for Commercial: "))     elif
consumer_type.lower() == 'industrial':
        return float(input("Enter Customer Charges for Industrial: "))
    else:
        raise ValueError("Invalid consumer type.")

def calculate_electricity_duty(energy_charges, duty_percentage):
    return energy_charges * duty_percentage / float(1)

def      generate_bill(consumer_id,      previous_units,      current_units,      consumer_type):
energy_charges  =  calculate_energy_charges(previous_units,  current_units,  consumer_type)
fixed_charges  =  calculate_fixed_charges(consumer_type)                customer_charges  =
calculate_customer_charges(consumer_type)

    # Calculate electricity duty based on a fixed percentage     duty_percentage =
float(input("Enter Electricity Duty Percentage: "))       electricity_duty =
calculate_electricity_duty(energy_charges, duty_percentage)
```

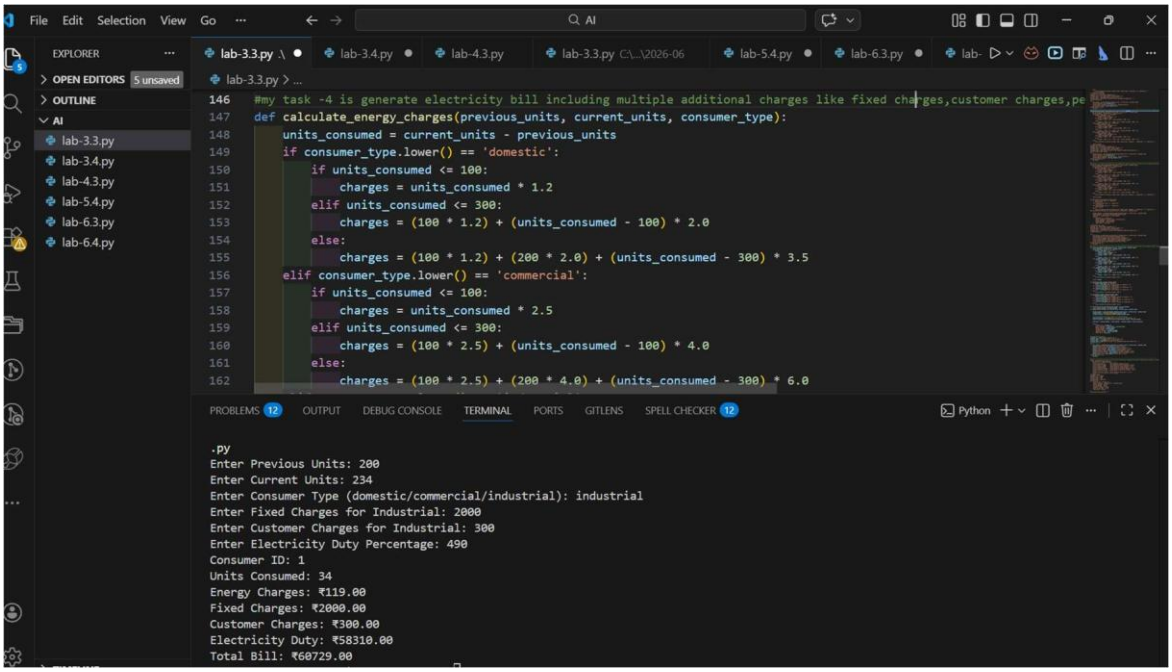
```
    total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

    return {
        "Consumer ID": consumer_id,
        "Units Consumed": current_units - previous_units,
        "Energy Charges": energy_charges,
        "Fixed Charges": fixed_charges,
        "Customer Charges": customer_charges,
        "Electricity Duty": electricity_duty,
        "Total Bill": total_bill
    }

# Collecting user input consumer_id = input("Enter Consumer ID: ")
previous_units = int(input("Enter Previous Units: "))        current_units =
int(input("Enter Current Units: "))  consumer_type = input("Enter Consumer Type
(domestic/commercial/industrial): ")
# Generating bill
try:
    bill_details = generate_bill(consumer_id, previous_units, current_units, consumer_type)
print(f"Consumer ID: {bill_details['Consumer ID']}")     print(f"Units Consumed:
{bill_details['Units Consumed']}")     print(f"Energy Charges: ₹{bill_details['Energy
Charges']:.2f}")     print(f"Fixed Charges: ₹{bill_details['Fixed Charges']:.2f}")
print(f"Customer Charges: ₹{bill_details['Customer Charges']:.2f}")      print(f"Electricity Duty:
₹{bill_details['Electricity Duty']:.2f}")     print(f"Total Bill: ₹{bill_details['Total Bill']:.2f}")
except
ValueError as e:
```

print(e) Output

:



Code Analysis :

- Additional charge components are added through dedicated functions.
- Electricity duty is computed as a percentage of energy charges.
- Dynamic user input improves billing accuracy and flexibility.
- Functions maintain separation of concerns for clarity.
- The total bill aggregates all computed components systematically.

Task 5

Prompt: generate the final bill of electricity, including all charges, with proper formatting and display in Python language.

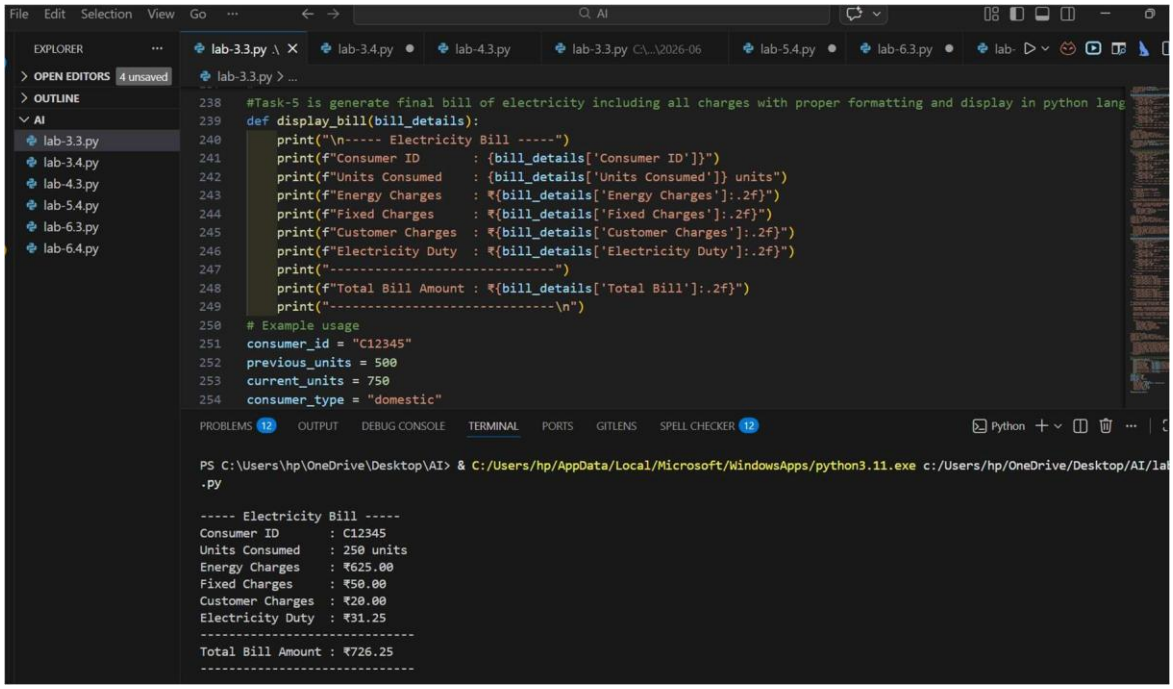
code : ef display_bill(bill_details):

print("\n----- Electricity Bill -----") print(f"Consumer ID : {bill_details['Consumer ID']}") print(f"Units Consumed : {bill_details['Units Consumed']} units")

print(f"Energy Charges : ₹{bill_details['Energy Charges']:.2f}") print(f"Fixed Charges :

```
₹{bill_details['Fixed Charges']:.2f}")     print(f"Customer
Charges  : ₹{bill_details['Customer Charges']:.2f}")
print(f"Electricity Duty  : ₹{bill_details['Electricity
Duty']:.2f}")     print("------------------------------")
print(f"Total Bill Amount : ₹{bill_details['Total Bill']:.2f}")
   print("------------------------------\n")
# Example usage consumer_id
= "C12345"   previous_units =
500     current_units = 750
consumer_type = "domestic"
bill_details = {
   "Consumer ID": consumer_id,
   "Units Consumed": current_units - previous_units,
   "Energy Charges": 625.00,
   "Fixed Charges": 50.00,
   "Customer Charges": 20.00,
   "Electricity Duty": 31.25,
   "Total Bill": 726.25
} display_bill(bill_details)
```

Output :



Code Analysis :

- Display logic is isolated in the display_bill() function.
- Formatted printing ensures professional bill presentation.
- Uses dictionary keys to access bill components safely.
- Separation of calculation and presentation improves maintainability.
- Supports easy modification for real-world billing systems.