Battery Charging and Discharging Simulation

Introduction:-

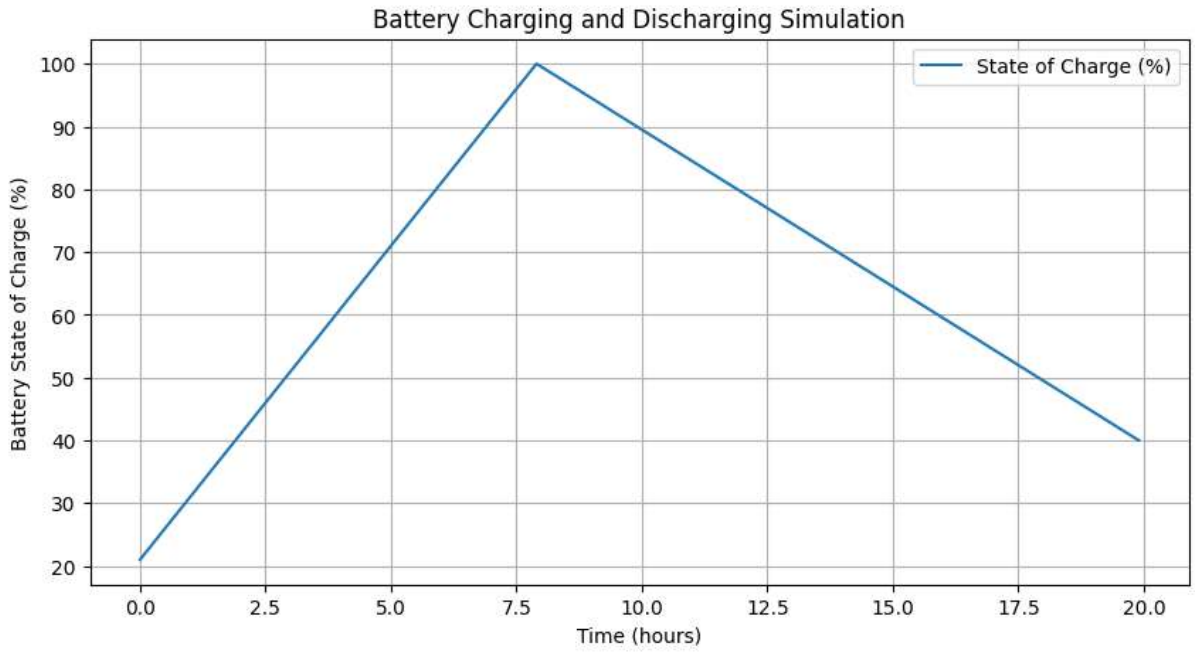
This document presents a simple Python simulation of a battery's charging and discharging cycle. The battery charges at a fixed current until fully charged, then discharges at a fixed current until depleted, continuously repeating this cycle. The simulation models the state of charge (SoC) over time and visualizes it.

Python Code:-

```
import matplotlib.pyplot as plt
import numpy as np

# Parameters
capacity = 100  # Battery capacity in Ah
charge_rate = 10  # Charging rate in A
discharge_rate = 5  # Discharging rate in A
time_step = 0.1  # time step in hours
total_time = 20  # total simulation time in hours

# Initialize arrays to store results
time = np.arange(0, total_time, time_step)
state_of_charge = np.zeros_like(time)

# Initial state of charge (SoC) in Ah
soc = 20
charging = True
```

```
for i in range(len(time)):
    if charging:
        soc += charge_rate * time_step
        if soc >= capacity:
            soc = capacity
            charging = False  # switch to
discharging
    else:
        soc -= discharge_rate * time_step
        if soc <= 0:
            soc = 0
            charging = True  # switch to charging
    state_of_charge[i] = soc

# Convert SoC to percentage
soc_percentage = (state_of_charge / capacity) * 100

# Plotting
plt.figure(figsize=(10, 5))
plt.plot(time, soc_percentage, label="State of
Charge (%)")
plt.xlabel("Time (hours)")
plt.ylabel("Battery State of Charge (%)")
plt.title("Battery Charging and Discharging
Simulation")
plt.legend()
plt.grid(True)
plt.show()
```

Output:-



Conclusion:-

The simulation effectively demonstrates the cyclic process of battery charging and discharging, showing how the battery state of charge varies over time. This simplified model assumes constant current during both charging and discharging phases. For enhanced accuracy, real-world factors such as battery internal resistance, temperature effects, and efficiency losses could be incorporated into the model.