

```
clc;
clear;

battery_capacity = 2.7; % Battery capacity in Ah

% Define capacity retention from 0% to 100%
capacity = linspace(0, 1, 500); % Normalized: 0 (empty) to 1 (full)

% Voltage charging profile function (2.7V to 4.2V)
V_profile = @(x) 2.7 + 1.5 * (0.2*tanh((x - 0.05)*12) + ...
    0.6*(1 - exp(-5*x)) + ...
    0.2*tanh((x - 0.95)*12));

% Generate base curve
V_base = V_profile(capacity);

% Internal resistance voltage shift (polarization effect during charging)
shift = @(rate) 0.01 * log(rate); % Simple logarithmic model

% Define C-rates to simulate
C_rates = [0.3, 1, 2.5, 7, 20];
colors = {'b', 'r', 'm', 'g', 'k'};
V_curves = zeros(length(C_rates), length(capacity));

% Create figure
figure;
hold on;

% Plot charging curves for each C-rate
for i = 1:length(C_rates)
    rate = C_rates(i);
    current = rate * battery_capacity; % Charging current in Amps
    V_curves(i, :) = V_base + shift(rate); % Charging shift increases voltage
    legend_labels{i} = sprintf('%.1fC', rate);
    plot(capacity * 100, V_curves(i, :), 'Color', colors{i}, 'LineWidth', 2);
end

% Format plot
xlabel('Capacity Retention (%)');
ylabel('Voltage (V)');
title('Charging Behavior of 2.7Ah LiFePO_4 Battery at Different C-Rates');
legend(legend_labels, 'Location', 'SouthEast');
grid on;
ylim([2.6 4.3]);
xlim([0 100]);
```