IPCI Experiential learning 1

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Aim-

To design an open loop linearized transfer function model for a conical tank with R=10cm, H=25cm, angle=40 degrees, coefficient=0.05 and plot the step response graph for flow input Qi(t) vs h(t) matlab code with less than 10 percent pliagarism

Tools used- Matlab software

Theory-

The dynamics of the system are governed by the inflow and outflow of liquid. The rate at which the volume of liquid inside the tank changes depends on the difference between the inflow rate and the outflow rate. The outflow is related to the height of the liquid and can be expressed as being proportional to the square root of the liquid height, representing the natural draining of liquid due to gravity. The outflow coefficient, which in this case is given as 0.05, helps determine the rate at which liquid exits the tank based on the current height. To create a linearized model, we consider the behavior of the system around a steady operating point. This allows us to simplify the complex relationship between the inflow, outflow, and liquid height into a manageable equation that relates changes in inflow to changes in height. The resulting linearized transfer function gives us a clear mathematical model of how the system responds to inputs, specifically how changes in the inflow affect the liquid height over time.Once the transfer function is obtained, we can apply a step input to the inflow to simulate the system's response. By doing so, we can generate a graph that shows how the liquid height changes in response to a sudden, constant inflow rate, which provides insight into the system's dynamic behavior and stability.

Code-

```
% Parameters for conical tank
R = 10;         % Radius of the tank in cm
H = 25;         % Height of the tank in cm
theta = 40;     % Angle of the cone in degrees
k = 0.05;       % Flow coefficient

% Convert angle to radians
theta_rad = deg2rad(theta);

% Linearized transfer function constants
A0 = pi * (R^2) * tan(theta_rad);  % Area of cross section at height h
g = 9.81;                          % Acceleration due to gravity (m/s^2)

% Time constant calculation (based on geometry)
V_h = @(h) (1/3) * pi * tan(theta_rad) * h^3;   % Volume as a function of height h
dh_dt = @(h) k * sqrt(2*g*h);                     % Flow rate as a function of height
```

```
% System linearization (based on mass balance at equilibrium)
h_eq = H / 2;  % Choose equilibrium height as half the tank height
A_h = pi * tan(theta_rad) * h_eq^2;  % Area at height h_eq

% Transfer function model: G(s) = k / (tau*s + 1)
k_sys = k;     % System gain (approximated as k)
tau = A_h / k; % Time constant

% Create transfer function
sys = tf(k_sys, [tau 1]);

% Plot step response (flow rate input vs height)
figure;
step(sys);
title('Step Response of Conical Tank System');
xlabel('Time (seconds)');
ylabel('Height h(t) (cm)');
grid on;
```

Result-