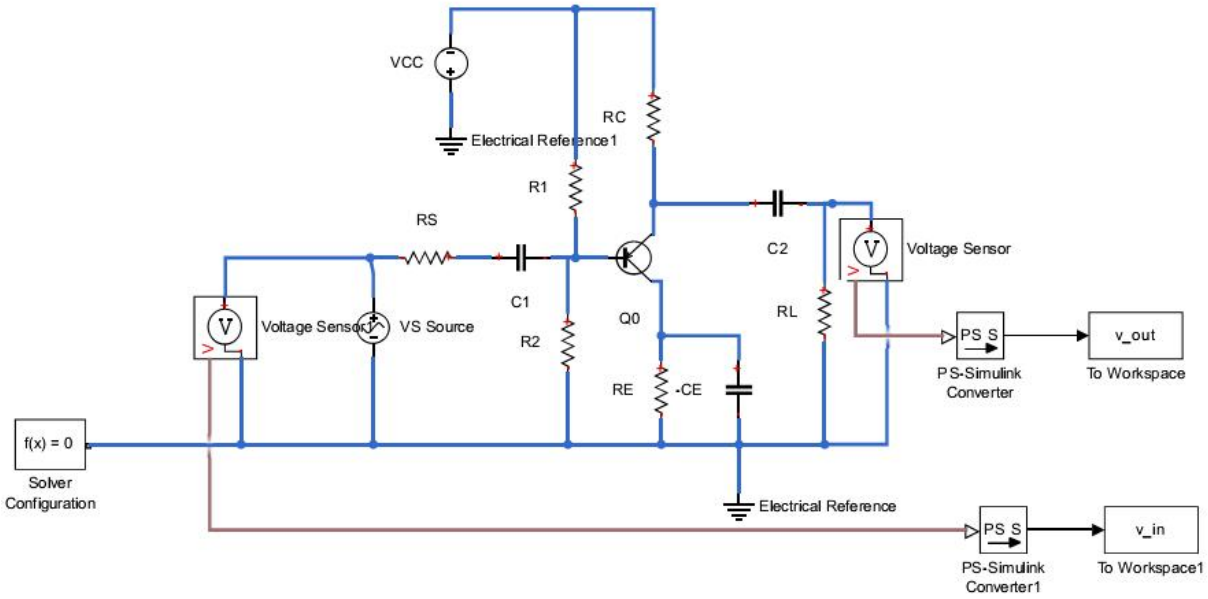
Exp 12E: Common-Emitter BJT amplifier in Simulink (Full Model Sweeping)



Step 1: Double click on RC, Change its value to **rc_x.**

Step 2: Double click on Q0, Change the forward current transfer ratio, h_fe value to **beta.**

Step 3: Study the Code below :

A. Load the model

```
load_system('exp12_E.slx');
```

B. Set model parameters

```
set_param('exp12_E/Q0', 'hfe', 'beta');
set_param('exp12_E/RC', 'R', 'rc_x');
```

C. Simulate the model

```
sim('exp12_C');
```

D. Log the results into a variable

Here we are using a compact data structure called CELL using curly braces while indexing

```
y_out{beta_index,rc_index}=v_out.signals.values(:,1);
```

E. Iterate over TWO Sweep variables **rc_x & beta** as follows

```
for beta = 100:50:300
    load_system('exp12_E.slx');
    set_param('exp12_E/Q0', 'hfe', 'beta');
    rc_index=1;
        for rc= 1:5
            set_param('exp12_E/RC', 'R', 'rc');
            sim('exp12_E');
            y_out{beta_index,rc_index}=v_out.signals.values(:,1);
            rc_index=rc_index+1;
        end
    beta_index=beta_index+1;
end
```

F. Display Results

Transient Plot for different values of **r_c**

Transient Plot for different values of **beta**

Amplifier gain as a function of **r_c and beta**

Code Section :

```
%% Interaction Section
clc; clear all; close all;
%%
beta_index=1;
for beta = 100:50:300
    load_system('exp12_E.slx');
    set_param('exp12_E/Q0', 'hfe', 'beta');
    rc_index=1;
    for rc= 1:5
        set_param('exp12_E/RC', 'R', 'rc');
        sim('exp12_E');
%         y_out(:,beta_index,rc_index)=v_out.signals.values(:,1);
        y_out{beta_index,rc_index}=v_out.signals.values(:,1);
        rc_index=rc_index+1;
    end
    beta_index=beta_index+1;
end

%% Data Cleaning
in=v_in.signals.values(2:1001);
for i=1:5
    for j=1:5
        y_out{i,j}=y_out{i,j}(2:1001,:); % Exclude the first row of data
points
    end
end
```

```
%% Display Results
i=1;
j=1;

% plot for differnet values of RC
figure('color',[0.97,0.97,0.97]);
colormap('jet');
plot(tout,in,tout,y_out{i,j},tout,y_out{i,j+1},tout,y_out{i,j+2},tout,y_out{i
,j+3},tout,y_out{i,j+4});

% Create title
title('Transient plot for differnet values of RC');

% plot for differnet values of beta
figure('color',[0.97,0.97,0.97]);
colormap('jet');
plot(tout,in,tout,y_out{i,j},tout,y_out{i+1,j},tout,y_out{i+2,j},tout,y_out{i
+3,j},tout,y_out{i+4,j});
title('Transient plot for differnet values of beta');
%% Compute Gain
% each cell of y_out holds the outputs for each sweep
% Each Row of y_out cell have constant beta
% Each cloumn of y_out cell have constant RC
% First calculate swings of each cell and store it in a cell called Av
for i= 1:5
    for j=1:5
        vout_amp=max(y_out{i,j})-min(y_out{i,j});
        vin_amp=max(in)-min(in);
        Av(i,j)=vout_amp/vin_amp;
    end
end
%% Design Visualization
% Create figure
figure1 = figure;

% Create axes
axes1 = axes('Parent',figure1);
view(axes1,[-37.5 30]);
grid(axes1,'on');
hold(axes1,'on');

% Create surf
surf(Av,'Parent',axes1);

% Create xlabel
xlabel('Rc(in Kilo Ohms)');

% Create ylabel
ylabel('Current Gain(beta)');

% Create title
title('Amplifier Gain Plot');
```