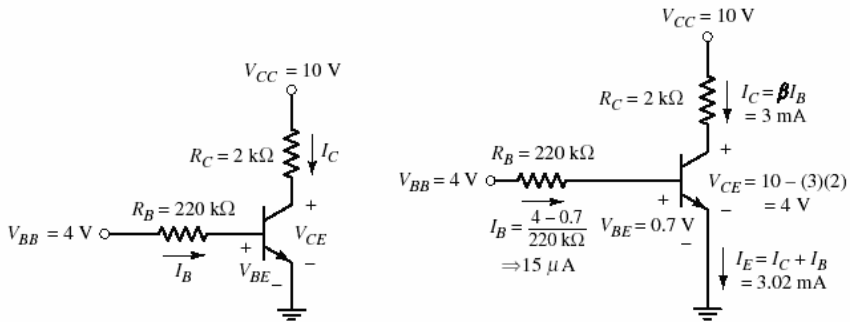


DC Analysis of Transistor Circuit

Calculate I_B , I_C , I_E

Assume: $\beta = 200$; $V_{BE} = 0.7 \text{ V}$

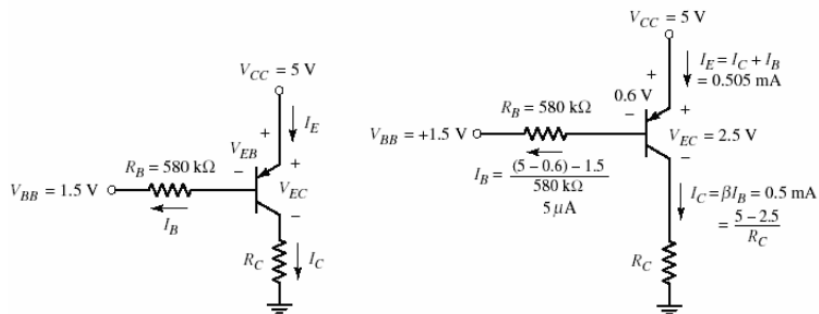


1

Common-emitter circuit with pnp transistor!

Find I_B , I_C , I_E , and R_C so that $V_{CE} = 0.5 V_{CC}$

Assume: $\beta = 100$; $V_{BE} = 0.6 \text{ V}$



2

Problem 1: Determine the small signal gain, input resistance and output resistance of the following circuit. Assume $R_s = 1 \text{ k}\Omega$, $R_1 = 93.6 \text{ k}\Omega$, $R_2 = 6.4 \text{ k}\Omega$, $R_C = 6 \text{ k}\Omega$, $\beta = 1000$, $V_A = 100 \text{ V}$

Donald A. Neamen, Electronic Circuit Analysis and Design, McGraw Hill, 2001

$$I_C \approx I_E = \beta I_B$$

$$I_B = \frac{V_{BB} - V_{BE}}{R_B} =$$

$$V_{CE} = V_{CC} - I_C R_C$$

$$r_\pi = \frac{V_T \beta}{I_C}; g_m = \frac{I_C}{V_T}; r_o = \frac{V_A}{I_C}$$

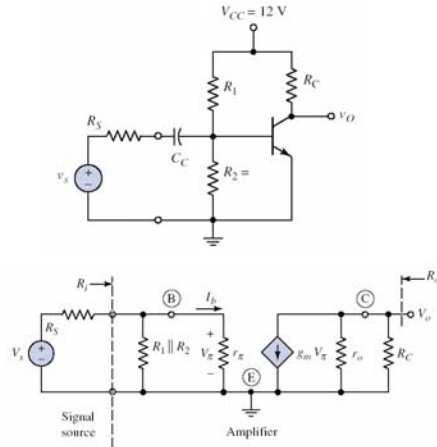
$$v_o = -(g_m v_\pi)(r_o \parallel R_C)$$

$$v_\pi = v_s \left(\frac{R_B \parallel r_\pi}{R_B \parallel r_\pi + R_s} \right), R_B = R_1 \parallel R_2$$

$$A_v = \frac{v_o}{v_s} = -g_m \left(\frac{R_B \parallel r_\pi}{R_B \parallel r_\pi + R_s} \right) (R_o \parallel R_C) =$$

$$R_i = R_B \parallel r_\pi$$

$$R_o = r_o \parallel R_C$$



3

Problem 2: Determine the small signal gain and input resistance for the following circuit. Assume $R_s = 1 \text{ k}\Omega$, $R_1 = 93.6 \text{ k}\Omega$, $R_2 = 6.4 \text{ k}\Omega$, $R_C = 6 \text{ k}\Omega$, $R_E = 400 \Omega$, $\beta = 1000$, $V_A =$

$$I_C \approx$$

$$V_{CE} = V_{CC} - I_C R_C - I_E R_E$$

$$r_\pi = \frac{V_T \beta}{I_C}; g_m = \frac{I_C}{V_T}; r_o = \infty$$

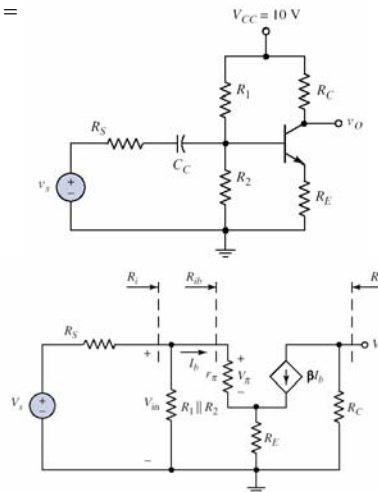
$$A_v = \frac{V_o}{V_s} = \frac{-(\beta I_b) R_C}{V_s} = -\beta R_C \left(\frac{V_{in}}{R_{ib}} \right) \left(\frac{1}{V_s} \right)$$

$$A_v = \frac{-\beta R_C}{r_\pi + (1 + \beta) R_E} \left(\frac{R_i}{R_i + R_s} \right)$$

$$R_{ib} = r_\pi + (1 + \beta) R_E$$

$$R_i = R_B \parallel R_{ib}$$

$$R_B = R_1 \parallel R_2$$



4

Problem 3: Analyze the following circuit when $R_1 = 56 \text{ k}\Omega$, $R_2 = 12.2 \text{ k}\Omega$,
 $R_C = 2 \text{ k}\Omega$, $R_E = 0.4 \text{ k}\Omega$, $V_{CC} = 12 \text{ V}$, $\beta = 100$.

$$V_{TH} = V_{CC} \left(\frac{R_2}{R_1 + R_2} \right)$$

$$R_{TH} = R_1 // R_2$$

$$V_{TH} = I_B R_{TH} + V_{BE} + I_E R_E$$

$$I_E = (\beta + 1) I_B$$

$$I_B = \frac{V_{TH} - V_{BE}}{R_{TH} + (\beta + 1) R_E}$$

$$I_C = \beta I_B$$

$$V_{CE} = V_{CC} - I_C R_C - I_E R_E$$

