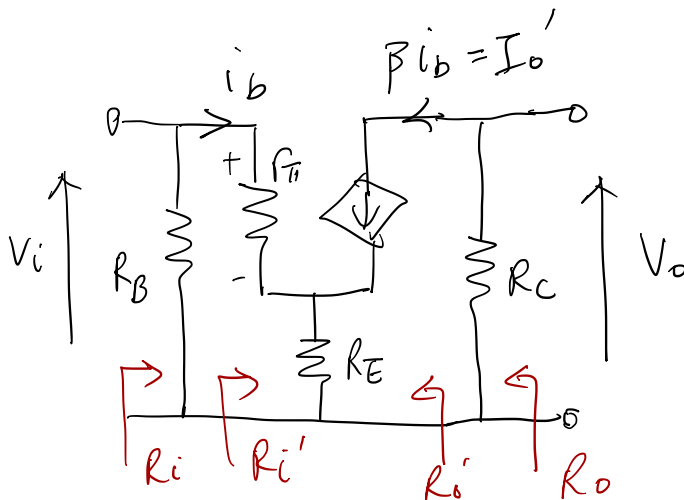
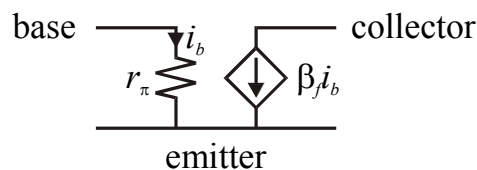
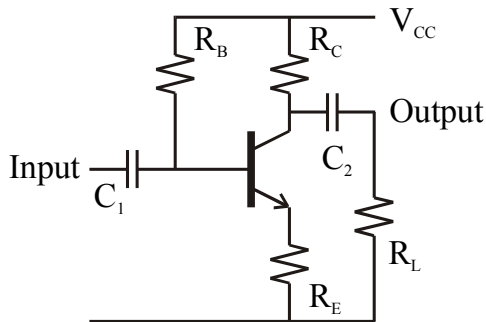


Mark:

**EE3110 Analogue Electronic Circuits**  
**Determining the frequency response of amplifiers**

Name: \_\_\_\_\_ Student Number: \_\_\_\_\_ Date : \_\_\_\_\_

1. Determine the input resistance, voltage gain and the output resistance of following amplifier. You may assume all the capacitors are short-circuit at small signal frequency. Please use the model shown below in your analysis.



$$R_i = R_B \parallel R_i'$$

$$R_i' = \frac{V_i}{i_b} = \frac{(r_{\pi} + (\beta + 1)R_E) i_b}{i_b}$$

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

$$R_i = R_B \parallel (r_{\pi} + (\beta + 1)R_E)$$

$$R_o = R_o' \parallel R_C$$

$$R_o' = \left. \frac{V_o}{I_o'} \right|_{V_i=0} = \infty$$

$$\therefore V_i = 0 \Rightarrow i_b = 0$$

$$\therefore R_o = R_C$$

$$A_v = \frac{V_o}{V_i}; V_o = -\beta R_C i_b$$

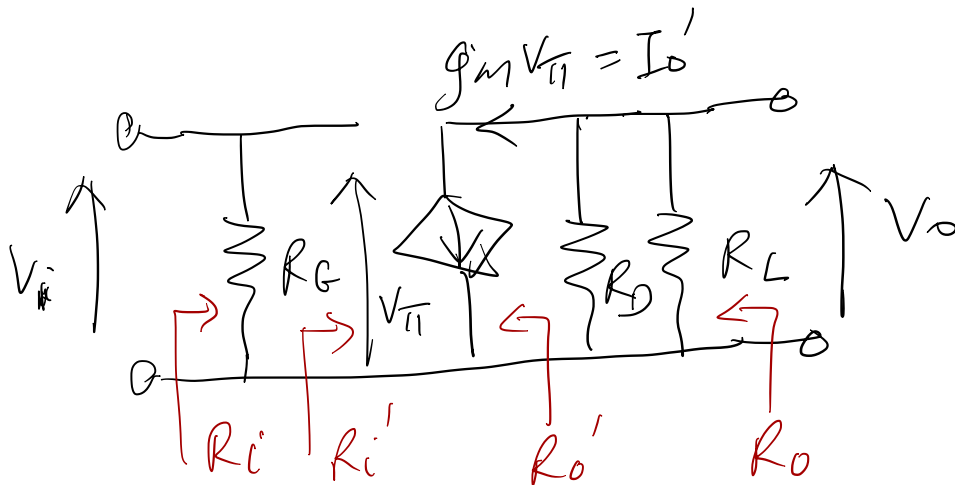
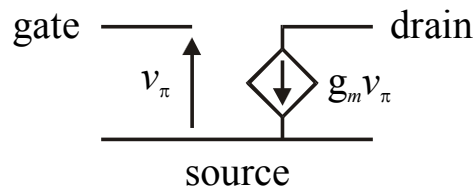
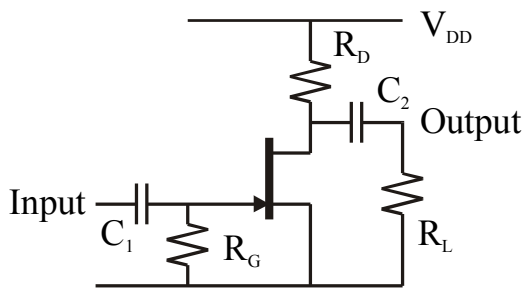
$$V_i = (r_{\pi} + (\beta + 1)R_E) i_b$$

$$\therefore A_v = -\frac{\beta R_C}{r_{\pi} + (\beta + 1)R_E}$$

$$\text{if } \beta \gg 1$$

$$A_v \approx -\frac{R_C}{R_E}$$

2. Determine the input resistance, voltage gain and the output resistance of following amplifier. You may assume all the capacitors are short-circuit at small signal frequency. Please use model shown below in your analysis.



$$R_i = R_i' \parallel R_G$$

$$\because R_i' \rightarrow \infty$$

$$\therefore R_i = R_G$$

$$R_o = R_o' \parallel R_D \parallel R_L$$

$$R_o' = \left. \frac{V_o}{I_o'} \right|_{V_i=0} = \infty \quad \because V_i=0 \Rightarrow V_{\pi}=0$$

$$\therefore R_o = R_D \parallel R_L$$

$$A_v = \frac{V_o}{V_i} ; \quad V_o = -g_m V_{\pi} (R_D \parallel R_L)$$

$$V_i = V_{\pi}$$

$$\therefore A_v = -g_m (R_D \parallel R_L)$$