

## Midterm Exam Formula Sheet Spring 2021

### ■ BJT: NPN Modes of Operation

Mode	I-V Characteristics
Cutoff	$I_C = I_E = I_B = 0$
Active (Forward)	$V_{BE} \cong 0.7V, I_E = I_C + I_B, I_C = \beta_F I_B$
Saturation	$V_{CE} \cong 0.2V, I_E = I_C + I_B$
Reverse Active	$V_{BC} \cong 0.5V, I_C = I_E + I_B, I_E = \beta_R I_B$

### ■ BJT: Small Signal Model

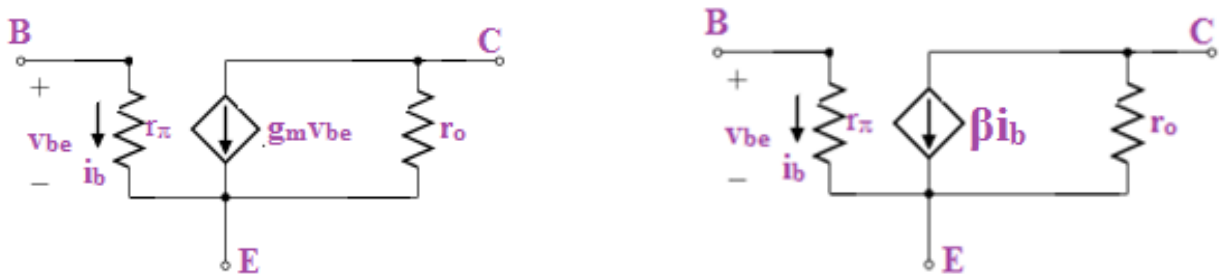


Figure 1 BJT Small-Signal Model

$$g_m = \frac{I_C}{V_T}, r_{\pi} = \frac{\beta}{g_m}, r_o = \frac{V_A}{I_C}, V_T = 25\text{mV}$$