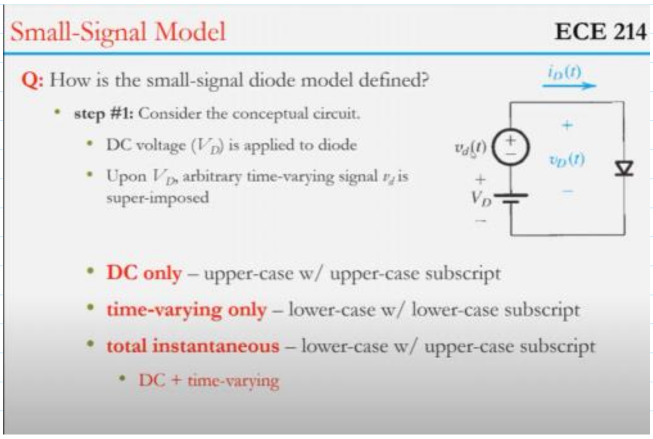
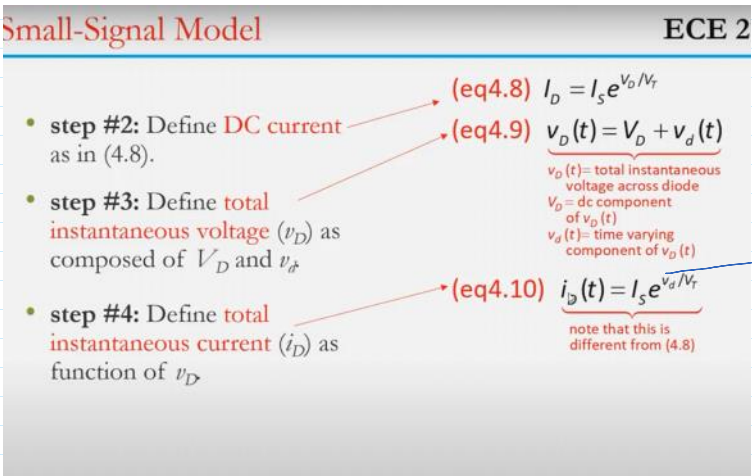
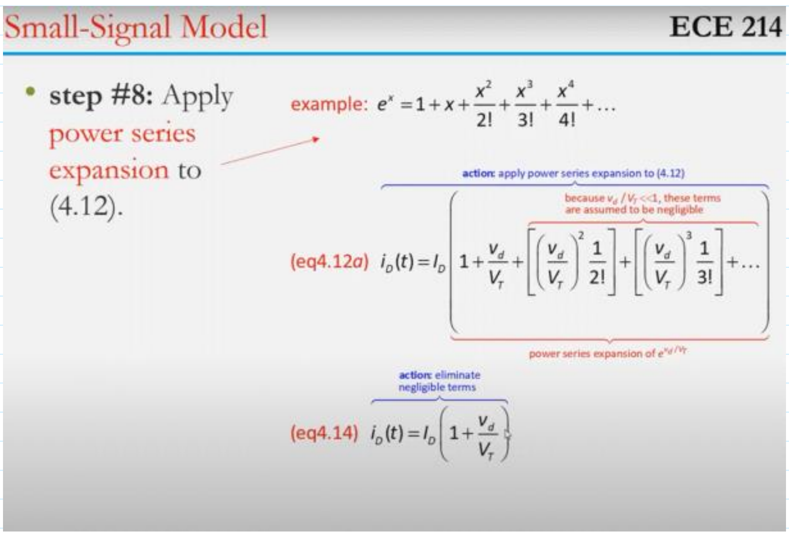




total voltage

$v_d = v_D(t)$

Step 5 : $i_D(t) = I_S e^{(V_D+v_d)/V_T} \Rightarrow i_D(t) = \underbrace{I_S e^{V_D/V_T}}_{I_D} e^{v_d/V_T} \Rightarrow i_D(t) = I_D \cdot e^{v_d/V_T}$



$i_D(t) = I_D + \frac{I_D}{V_T}(v_d)$ [we know $i_D(t) = I_D + i_d(t)$]

This is $i_d(t)$

[so $i_d(t) = \frac{I_D}{V_T} v_d = \frac{1}{r_d} v_d$]

[r_d small signal resistance $= \frac{V_T}{I_D}$]