ECSE-2210 Microelectronics Technology
Class Activity 19

1. The base region in a BJT is narrow. What is the precise definition of "narrow"?

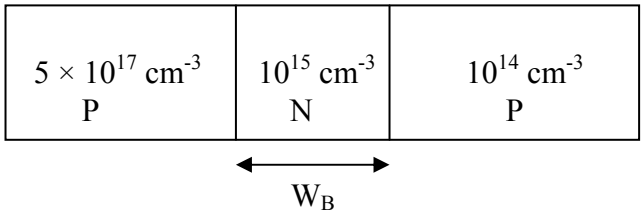
2. Why is it necessary for the base region of a BJT to be narrow?

3. Complete the table below by indicating the polarity (+ or -) of the input and output voltages associated with each of the four biasing modes for the npn transistor.

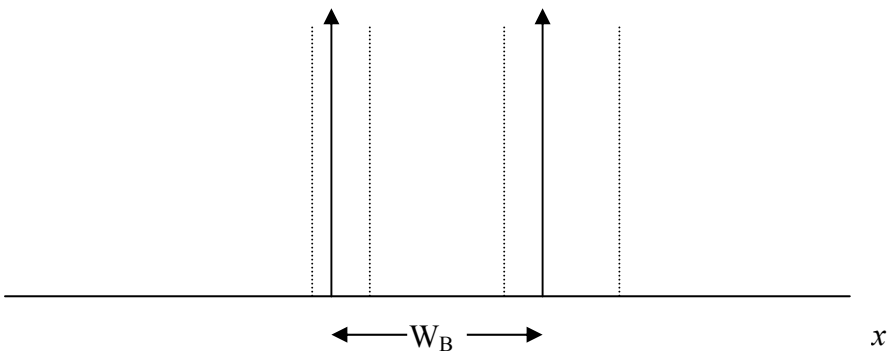
npn BJT

Mode	V_{BE}	V_{BC}
Active		
Inverted		
Saturation		
Cutoff		

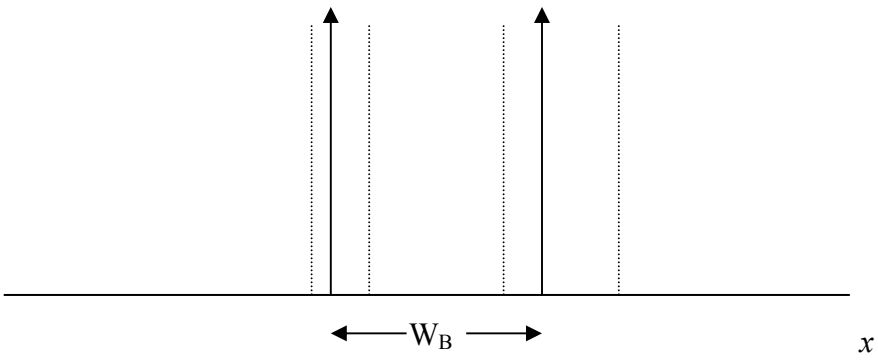
4. Consider a Si pnp BJT with $N_{AE} = 5 \times 10^{17}$ cm^{-3}, $N_{DB} = 10^{15}$ cm^{-3}, and $N_{AC}=10^{14}$ cm^{-3}.



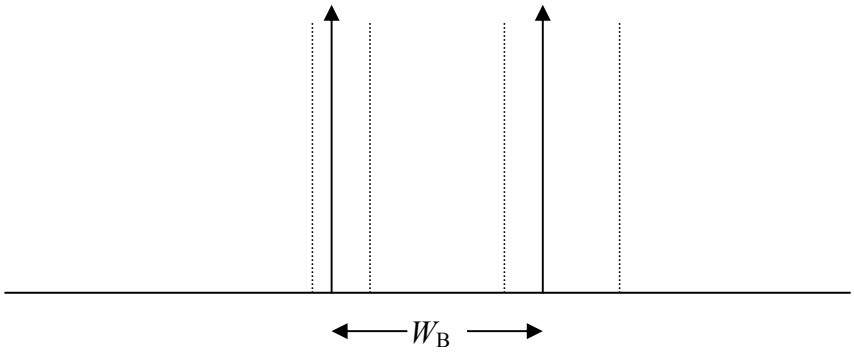
   a. Calculate the equilibrium majority and minority carrier concentrations in the emitter, base and collector of the transistor. Plot them in the figure below.



b. Roughly sketch (qualitative) the carrier distribution (both holes and electrons) in the base, emitter and collector of this transistor under forward active biasing mode when $W/L_p >> 1$.



c. Repeat part b when $W / L_p << 1$. (Note: part b corresponds to a back-to-back diode whereas part c corresponds to a real transistor).



5. What are the typical values for γ, α_T, α_{dc} and β_{dc}? What do these symbols stand for?