Indian Institute of Technology, Delhi
ELL304 Analog Circuits
Tutorial 2, 6 August 2015

1. A certain three-terminal device has been invented. The three terminals of this device are named A, B, and C. The device behaves in the following fashion:

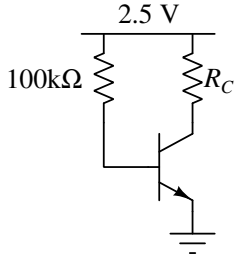
$$I_C = \alpha \cdot V_{AC}^2 / I_B \cdot (1 + \beta / I_B \cdot V_{AC})$$

$$V_{BC} = \gamma \cdot e^{V_{AC}/I_B\delta} \cdot I_B$$

   What are the units of α, β, γ, δ, respectively? Develop a small signal model for this device.

2. The collector voltage of a BJT varies from 1 V to 5 V, while the base voltage is constant. The emitter voltage is at ground. What should be the Early voltage of the BJT, such that the variation in I_C is less than 1%?

3. In analog circuits, the BJT has to be maintained in the active region. To remain in the active region, the base-collector junction is allowed to have a maximum forward bias of 0.2 V. (i.e., $V_{CB} \geq 0.2$). For the circuit below, the BJT has: $I_S = 2 \times 10^{-17}$ A, $V_A = \infty$, $\beta = 100$. Find the maximum value of R_C for the device to be in the active region.



4. For the circuit above, at the edge of the active region, estimate the small signal gain of the circuit. Input is applied to the circuit at the base, through a coupling capacitor. Output is measured at the collector, through a coupling capacitor.

5. For the same circuit as above, compute the input impedance and the output impedance.

Further problems are at the end of Chapter 4 of "Fundamentals of Microelectronics" by Razavi.