NANYANG TECHNOLOGICAL UNIVERSITY
SCHOOL OF ELECTRICAL & ELECTRONIC ENGINEERING
EE4341 ADVANCED ANALOG CIRCUITS
TUTORIAL 2

1. Calculate the mean-squared noise-voltage spectral density in V^2/Hz at v_o for the circuit in Fig. 1 and then calculate the rms noise voltage in a 100 kHz equivalent noise bandwidth. Neglect capacitive effects, flicker noise and series resistance in the diode. Assume that V_D = 0.60V. Boltzmann's constant k = 1.38 $\times$ 10^{-23} J/K, q = 1.6$\times$$10^{-19}$ C and T = 300K. If a 1000 pF capacitor is now connected across the diode, including flicker noise, calculate and plot the output mean-squared noise voltage spectral density at v_o in V^2/Hz on log scales from f = 1Hz to f =10 MHz. Flicker noise spectral density = 3 $\times$ 10^{-16}(I_D/f) A^2/Hz.

Answer $\overline{v_o^2} = \left(4.6\times10^{-19} + \dfrac{4.3\times10^{-16}}{f}\right)\dfrac{1}{1+\left(\dfrac{f}{f_o}\right)^2}\ \mathrm{V^2/Hz}$

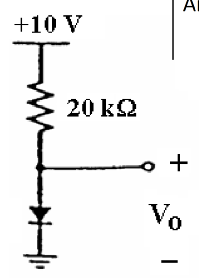

Fig. 1

2. The amplifier circuit in Fig. 2 has a -3dB bandwidth of 10 kHz (single-pole response). Boltzmann's constant k = 1.38 $\times$ 10^{-23} J/K, q = 1.6$\times$$10^{-19}$ C and T = 300K. Ignoring flicker noise and the thermal noise of the load resistance, determine the value of v_s so that SNR = 0 dB. Show that if a BJT is driven from a signal source with a source resistance R_s, the value of biasing collector current for maximum sensitivity is given by the following expression.

$$I_c = \frac{V_T\sqrt{\beta}}{R_s + r_{bb}'}, \text{ where } V_T = kT/q.$$

Determine the value of I_c for max SNR for the amplifier circuit shown in Fig. 2. What is v_s for SNR = 0 dB under the new biasing condition? Answer $I_C = 2.9$ mA $V_s = 176$ nV

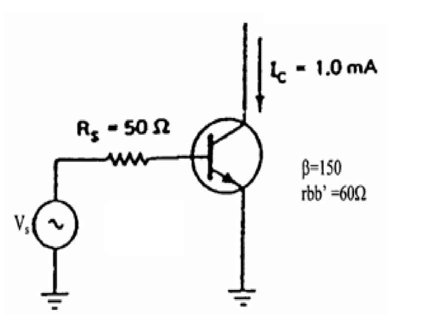

Fig. 2