INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
DEPARTMENT OF ELECTRONICS & ELECTRICAL ENGINEERING

EE 101: Electrical Sciences

Tutorial-10

*(First question is the **Pre-Tutorial Assignment problem** to be done in the space provided.)*

Name: Roll No.: Tutorial Group:

Question 1:

An ideal opamp with a diode in the feedback path is shown below. Assume $R_1 = 1\ k\Omega$ and $I_s = 10^{-13}$ A.

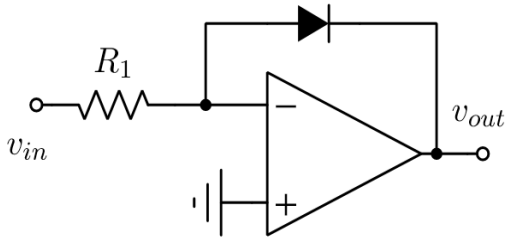

Figure 1: Opamp with a diode in the feedback

(i) If the diode is an ideal diode, what is the approximate output voltage for an input voltage $V_{in} = 2\sin\omega_0 t$.

(ii) If the diode is a Si PN-junction diode, what is the approximate output voltage for an input voltage $V_{in} = 2\sin\omega_0 t$.

(iii) If the diode is a Si PN-junction diode, what is the approximate output voltage for an input voltage $V_{in} = 0.75 + 0.05\sin\omega_0 t$.

Suggestion: You need to derive the output voltage expression for the third case.

Question 2:

A 3-terminal transistor chip GU781039 is shown in Fig. 2(a). The transistor GU781039

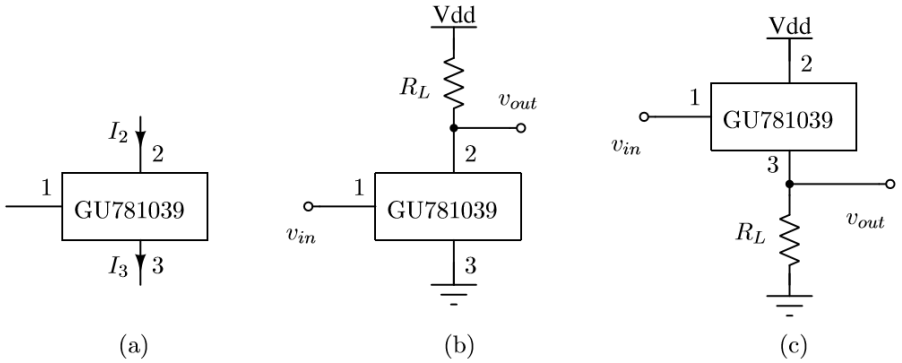

Figure 2: A transistor GU781039 and two circuits using this transistor.

has the following DC characteristics.

$$I_2 = I_3 = I_s ln(\frac{V_{13}}{V_T}),$$

where V_T is the thermal voltage. Impedance seen into the terminal 1 is infinity.

Derive the voltage gain expressions for the circuits in Fig. 2(b) and Fig. 2(c).

Question 3:

A zener diode based shunt regulator is shown below. The zener diode has a reverse breakdown voltage $V_{Z0} = 3.5$ V and $r_z = 10\ \Omega$. What is the change in output voltage (across the 7 $k\Omega$ resistor) if the input voltage varies from 4.5 to 5.5 V.

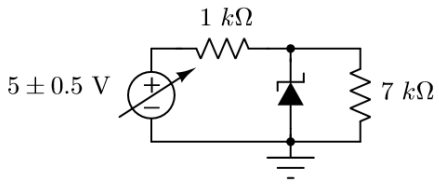

Figure 3: A zener diode based shunt regulator

Question 4:

Let I_S=2cos 10t A in the circuit shown in Figure 4. Find the total energy stored at t = 0, if: (i) a-b is open circuited, (ii) a-b is short circuited.

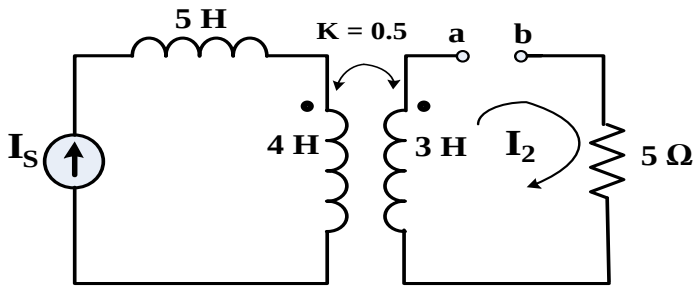

Figure 4

Question 5:

For the RC circuit given below, compute the frequency response. Draw the magnitude and the phase plot. (RC = 10^{-6} sec.)