IEC 103

Assignment-7

Bistable and Astable Multivibrators

1. Consider an usual inverting bistable multivibrator circuit with the op-amp's non inverting input terminal connected to a positive voltage source V through a resistor R_3.

   (a) Derive expressions for the threshold voltages V_{TL} and V_{TH} in terms of op-amp's saturation levels L_+ and L_-, R_1, R_2, R_3 and V.

   (b) Let $L_+ = -L_- = 13V$, $V = 15V$ and $R_1 = 10K\Omega$. Find the values of R_2 and R_3 that result in $V_{TL} = +4.9V$ and $V_{TH} = +5.1V$.

2. Consider a non-inverting comparator circuit with op-amp's negative input terminal disconnected from ground and connected to a reference voltage V_R.

   (a) Derive expressions for the threshold voltages V_{TL} and V_{TH} in terms of the op amp's saturation levels L_+ and L_-, R_1, R_2 and V_R.

   (b) Let $L_+ = -L_- = V$ and $R_1 = 10K\Omega$. Find R_2 and V_R that result in threshold voltages of 0 and V/10.

3. Consider the circuit in figure 1. Sketch and label the transfer characteristics $V_0 - V_I$. The diodes are assumed to have a constant 0.7V drop when conducting, and the op-amp saturates at $\pm 12V$. What is the maximum diode current? Suppose that R_1 is eliminated and R_2 short circuited. Sketch the transfer characteristics $V_0 - V_I$.

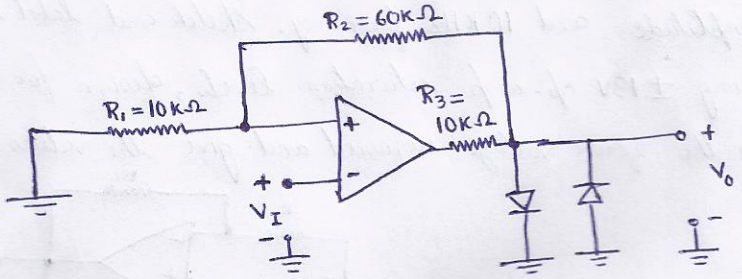


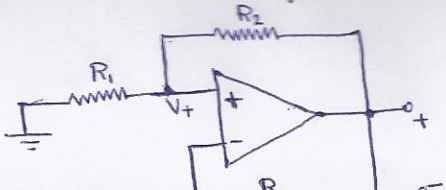
Figure 1

4. Consider a bistable circuit having a non inverting transfer characteristic with $L_+ = -L_- = 12V$. $V_{TL} = -1V$ and $V_{TH} = +1V$.

   (a) For a 0.5V sine wave (0.5V is its amplitude) having zero average, what is the output?

   (b) Show the output if a sinusoid of frequency f and amplitude of 1.1V is applied at the input. By how much can the average of this sinusoidal input shift before the output becomes a constant value.

5. Consider an astable multivibrator circuit shown in figure 2. Find the frequency of oscillation for $R_1 = 10K\Omega$, $R_2 = 16K\Omega$ $R = 62K\Omega$ and $C = 10nF$.



6. Consider the circuit shown in figure 3. Design the circuit to have an output square wave with 5V amplitude and 1 kHz frequency using a 10nF capacitor C. Use $\beta = 0.462$ and design for a current in the resistive divider approximately equal to the average current in the RC network over $\frac{1}{2}$ cycle. Assuming ±13V op amp saturation voltages, arrange that the zener operates at a current of 1mA.

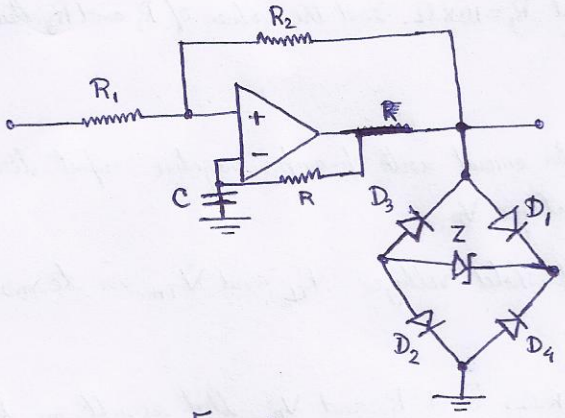


Figure 3

7. Consider the circuit in figure 4. The circuit consists of an inverting bistable multivibrator, with an output limiter and a non inverting integrator. Using equal values for all resistors except R_7 and a 0·5nF capacitor, design the circuit to obtain a square wave at the output of the bistable multivibrator of 15V peak to peak amplitude and 10 kHz frequency. Sketch and label the waveform at the integrator output. Assuming ±13V op-amp saturation levels, design for a maximum zener current of 1mA. Specify the zener voltage required and give the values of all resistors.

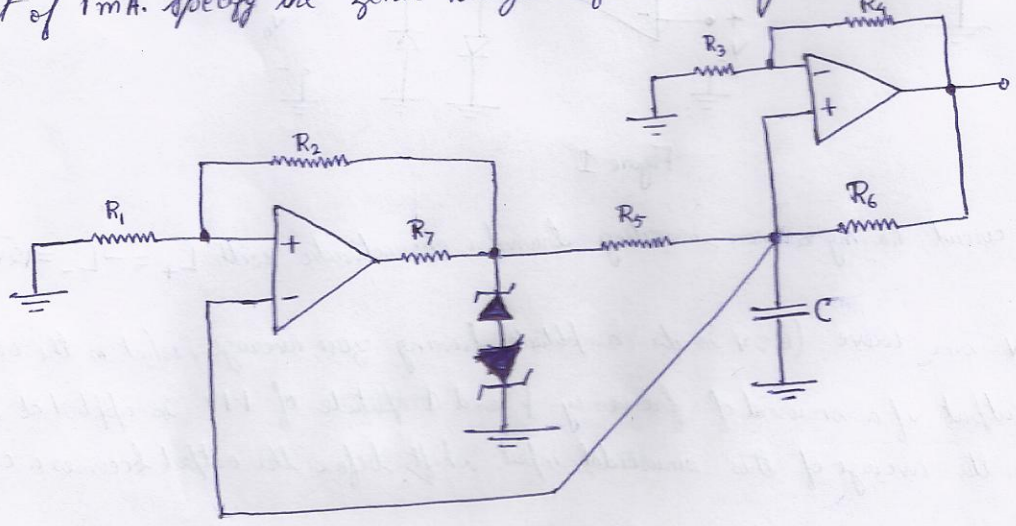


Figure 4