# Analog Electronic Circuits (EC2.103) : Assignment-1

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**Instructions:**

1. Circuits of all questions mentioned at the end of the assignment.
2. Submit your assignment as a single pdf (Name RollNo.pdf) at moodle on or before the due date
3. Hand-written/typed (notion/latex/word) submissions are allowed
4. Report should be self explanatory and must carry complete solution - Answers with schematics, SPICE directives, annotated waveforms, inference/discussion on results as asked in the questions.
5. Use diode 1N4148 for circuits with diodes
6. Post your queries on moodle. Discussions are highly encouraged on moodle
7. Any form of copying/cheating will result in immediate F grade

## 1. Transient and AC analysis of RC circuits

(1.1) Theoretical: Sketch the v(out) vs time in each circuits mentioned in Figure 1 (for all). Intuitively find poles and zeros and sketch bode plot for (c), (d), (e), (f) circuits of Figure 1. No need to take suitable values for Resistors and Capacitors.

(1.2) Simulation: Implement (c), (d), (e), (f) circuits of Figure 1 in Lt spice simulator considering suitable values and keep the screenshots of circuit and final v(out) plots(time plot(.tran run) and bode plot(.ac run)).

## 2. Diode circuits and Rectifiers

(2.1) Plot I-V characteristics (forward and reverse) of the diode using circuit shown in Figure 2 (model used: IN4148) and estimate cut-in voltage, knee voltage, reverse saturation current and incremental diode-resistance from the plot.

(2.2) Plot $V_{in}$ and $V_{out}$ for the half wave rectifier circuit shown in Figure 3 using transient analysis with stop time of 10 ms and $V_{in}$ = SINE(0 1 1k) i.e., sine input with DC offset equal to 0, AC magnitude equal to 1 and frequency equal to 1 kHz. Explain the functioning of the circuit with the help of the obtained plot.

(2.3) Plot $V_{in}$ and $V_{out}$ for the full wave rectifier circuit shown in Figure 4 using transient analysis with stop time of 10 ms and $V_{in}$ = SINE(0 1 1k) i.e., sine input with DC offset equal to 0, AC magnitude equal to 1 and frequency equal to 1 kHz. Explain the functioning of the circuit with the help of the obtained plot.

## 3. PN-Junction Physics

(3.1) During the preparation of doped semi-conductors, carriers are added through the process of injection. Is KCL (Kirchhoff's Current Law) followed at the point of injection? Justify your answer in 2-3 sentences.

(3.2) Holes are being steadily injected into a region of n-type silicon. In the Steady state, the excess-hole concentration profile shown in the Fig.5 is established in the n-type silicon region. Here "excess" means over and above the concentration $p_{n0}$. If $N_D = 10^{16}/cm^3$ , $n_i = 1.5 \times 10^{10}/cm^3$ and $W = 5\mu m$, find the density of the current that will flow in the x-direction.

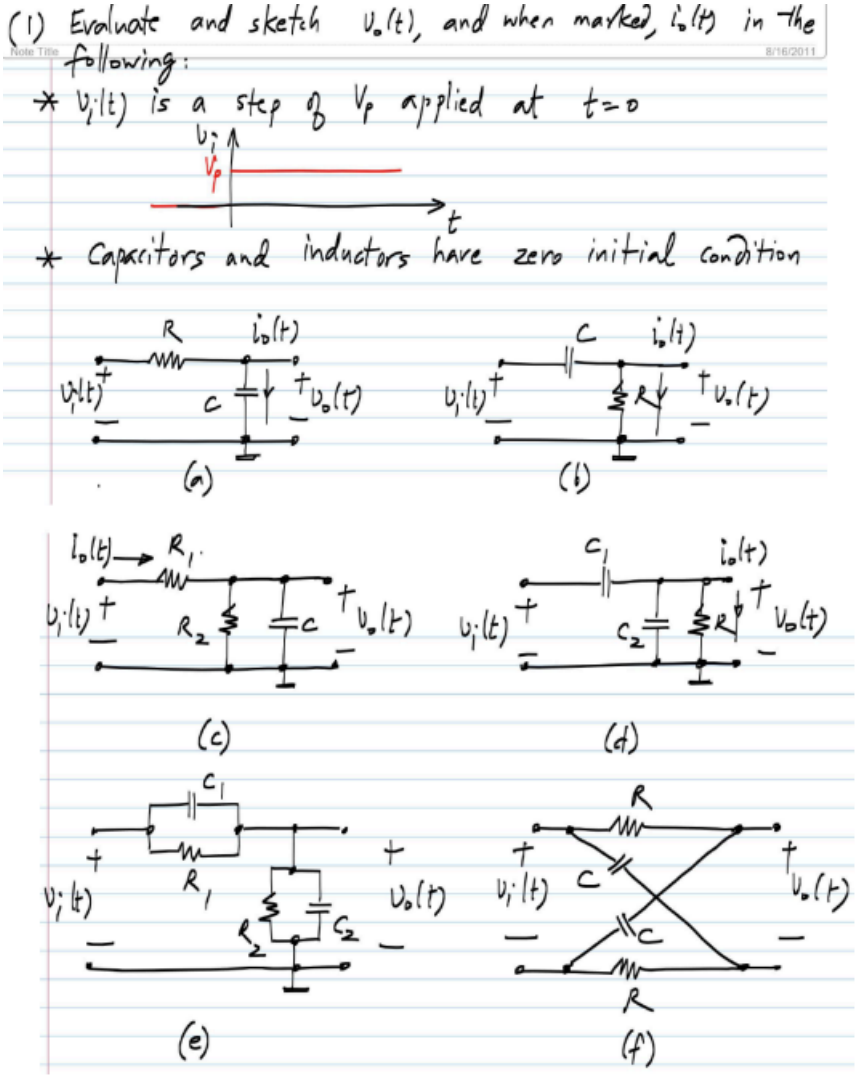


**Figure 1 (For Question 1)**

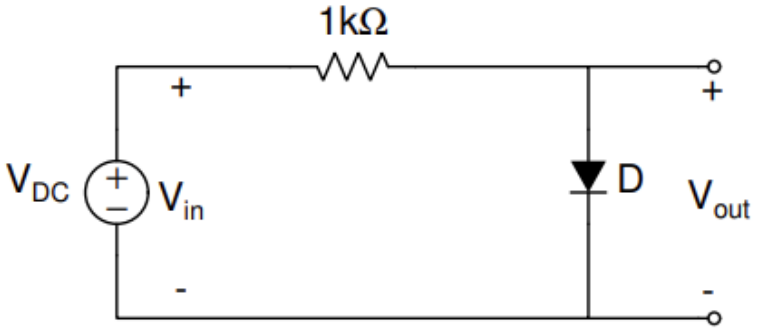


**Figure 2 (For Question 2.1)**

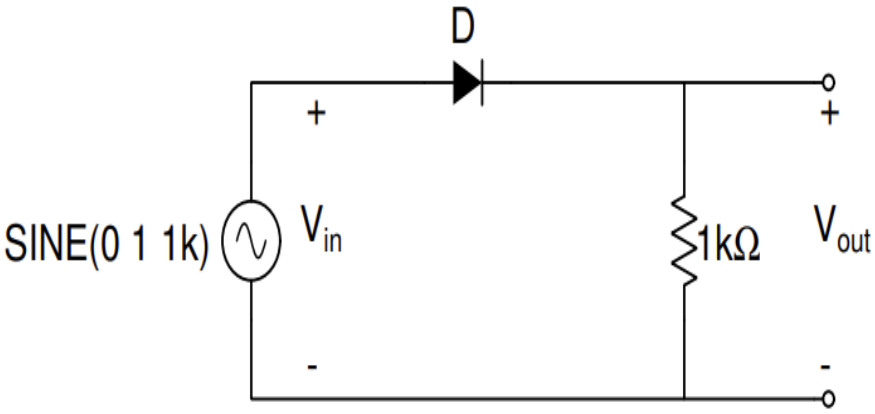


**Figure 3 (For Question 2.2)**

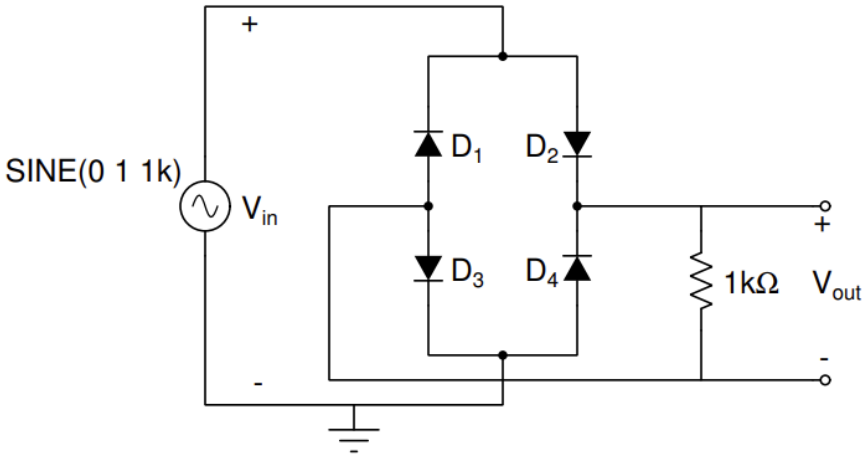


**Figure 4 (For Question 2.3)**

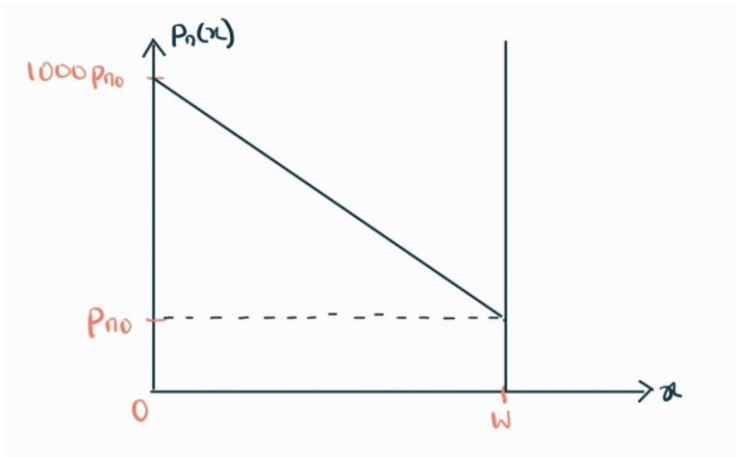


**Figure 5 (For Question 3.2)**