Analog Electronic Circuits (EC2.103) : Assignment-3

Spring 2024, IIIT Hyderabad, Due date : Fri 26-Jan-2024 (18:00 Hrs)

Instructor: Prof. Abhishek Srivastava, CVEST, IIIT Hyderabad

Instructions:

1. Submit your assignment as a single pdf (Name_RollNo.pdf) at moodle on or before the due date
2. Hand-written/typed (latex/word/notion/others) submissions are allowed
3. Report should be self explanatory and must carry complete solution - Answers with schematics, SPICE directives, annotated waveforms, inference/discussion on results
4. Use diode 1N4148 for circuits with diodes
5. Post your queries on moodle. Discussions are highly encouraged on moodle

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1. Plot I-V characteristics (forward and reverse) of the diode using circuit shown in Figure 1 (model used: IN4148) and estimate cut-in voltage, knee voltage, reverse saturation current and incremental diode-resistance from the plot.

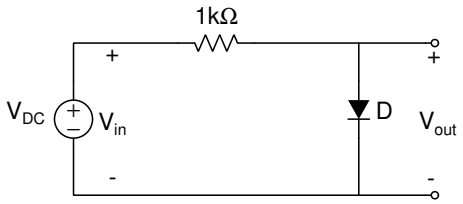

Figure 1

2. Plot V_{in} and V_{out} for the half wave rectifier circuit shown in Figure 2 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.

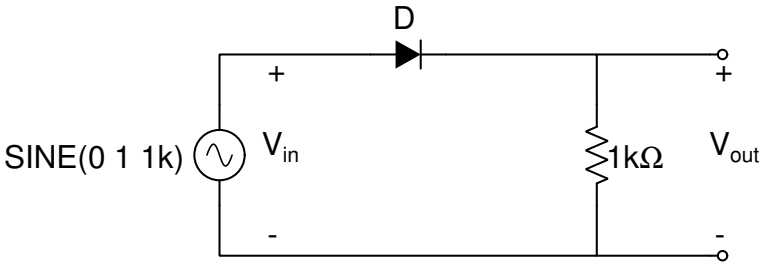

Figure 2

3. Plot V_{in} and V_{out} for the full 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.
4. For the circuit shown in Fig. 4, it is given that $v_{in} = V_m sin(\omega_0 t)$ and $V_0 = 1.2\ V$.
   (a) Find the incremental resistance (r_d) at $V_0 = 1.2\ V$ and draw the incremental (small signal) model for the given circuit.

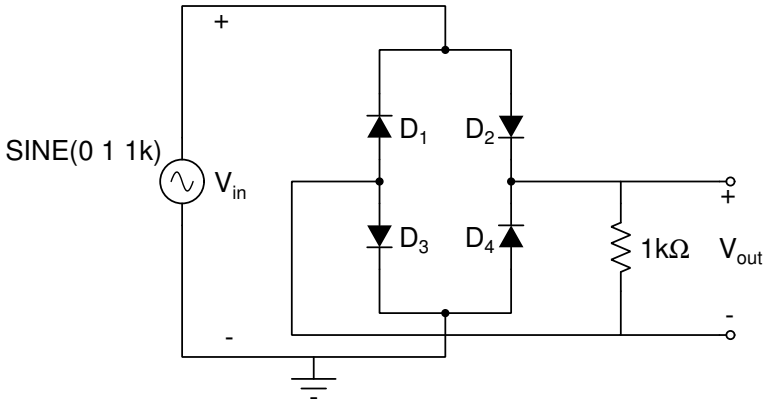

Figure 3

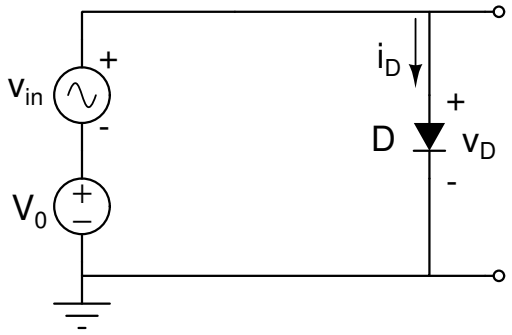

Figure 4

(b) Derive the condition for the validity of the incremental model.

(c) From SPICE simulations, plot v_D and i_D as a function of time for $V_m = 1\ mV$, $V_m = 10\ mV$ and $V_m = 200\ mV$. Comment and compare the linearity of the circuit for the three cases (give a table). Verify the condition obtained in previous part with your simulations.
