EE333 FALL 2016 ASSIGNMENT#1

1. Answer the following with forty words or less for each (you get +1 bonus if the answer is shorter than 21 words and is still sensible). (8pts each)

a) What are the two effects that balance an unbiased diode?

b) Which ones dominate in forward and reverse bias?

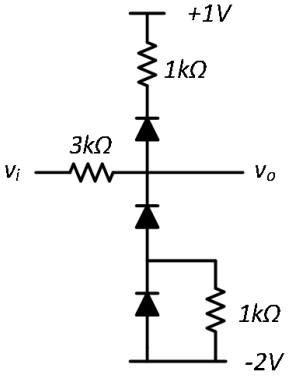
c) Explain b), which ones increase/decrease or stay the same, due to what mechanism?

d) Why is there no net charge in the depletion region but an electric field across it?

e) Can you measure the built in potential of a junction with a multimeter? Why?

2.

a) Make a hand analysis for the same circuit using a 0.7V constant voltage drop model and sketch the voltage transfer characteristics for ±10V range. (20pts)



This can be done by applying a dc voltage source at the input and running a dc sweep and plotting the output node. For your diode model to behave as desired, you need to calculate the saturation current Is and define it in the model yourself. E.g., if you find that I_s should be 5.10^{-12}A, your diode model will be:

.model mydiode D(Is=5e-12)

Note that the default temperature Spice uses for the diode calculation is 27°C and the default value of n is 1, so we do not specify it.

b) Assuming that all diodes exhibit a 0.7V drop for a forward current of 1mA and the ideality constant n=1, run a spice analysis and plot the voltage transfer characteristics for the same range. This can be done by applying a dc voltage source at the input and running a dc sweep and plotting the output node. (20pts)

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Note that the default temperature Spice uses for the diode calculation is 27°C and the default value of n is 1, so we do not specify it.

c) Run a transient simulation by applying sine, square and triangle waves of 10kHz frequency and ±10V amplitude at the input. Plot the outputs. Comment on results. (20pts)

Bonus: We are required to collect hard copies; so let us save from ink, paper and material as much as possible. *(5%)*

Some ideas are as follows:

- Do not add a cover page or the question page, but write your name on each page. Page numbers are useful too.
- Print on both sides of the paper.
- Your explanations can be short as long as they are relevant and clear. Calculation work can be hand written on a separate page, or you can use a large enough space of a printed page; but please do not use page margins.
- Provide only the graphs that were explicitly asked for. You can have 2 or 3 waveforms in a frame if they have similar scales and if they are relevant together.
- Invert the colors of your graphs if they are plotted on a dark background. Color prints are not necessary as long as the graphs are legible.
- You can put multiple graphs on a single page and even have hand written or typed text wrapping the graphs. It is alright if your document processor does not allow you to align multiple graphs in a page very neatly. Just make sure that the graphs do not overlap; have visible axes & numbers and they show what they are supposed to show.
- You can put all the figures at the end of the report and refer to them in the text if that is easier for you or if it will save paper. You can print in landscape orientation if it helps too. Make sure that the references are clear and understandable if this is the case.
- Simply staple multiple pages. You don't have to bind them or turn them in as a booklet.