

1. (10%) How is a pn junction formed? Please also explain how a built-in potential barrier is formed.
2. (20%) Design a simple dc voltage source using a 110 V (rms), 60 Hz input signal to deliver a nominal 5 V output signal. The deviation from the nominal output is to be no more than ± 25 mV. Explain how your design achieves the goal and calculate the load regulation of your dc source.
3. (15%) Please design a two-input NMOS OR logic circuit to switch an LED on and off. The LED, which can be represented as a diode symbol, must be present in your circuit. Explain how your design achieves the goal.
4. (15%) A source follower is required to connect a high-resistance source to a load whose resistance is nominally 2 k Ω . Please explain how the value of the biased current of the MOSFET in the source follower affects the value of the output voltage.
5. (15%) Consider an emitter follower that uses a pnp BJT (bipolar junction transistor). Find the input and output resistance of the emitter follower given that the dc component of the source signal (v_{sig}) is zero. The source and load resistance are R_{sig} and R_L , respectively.
6. (10%) Describe general frequency response of a coupling capacitor, a bypass capacitor, and a load capacitor.
7. (15%) Illustrate how a Miller integrator can be implemented by using an operational amplifier (op amp). Please discuss how the DC imperfections of the op amp result in problems. Provide your solution to resolve one of the problems you listed.

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