

1. For the shown network (Fig. 1), please answer the following questions:
 - (a) (5%) Determine the range of R_L and I_L that will result in V_L being maintained at 10 V.
 - (b) (5%) Determine the maximum wattage rating of the diode.

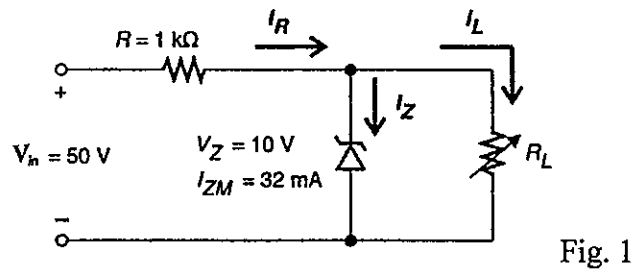


Fig. 1

2. (20%) For the circuit in Fig. 2, find V_B , V_E , and V_C for (a) $R_B = 100 \text{ k}\Omega$ and (b) $R_B = 10 \text{ k}\Omega$. Let $\beta = 100$.

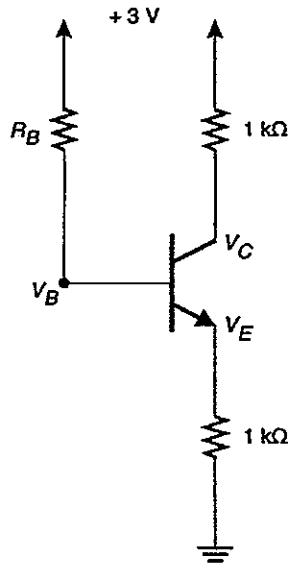


Fig. 2

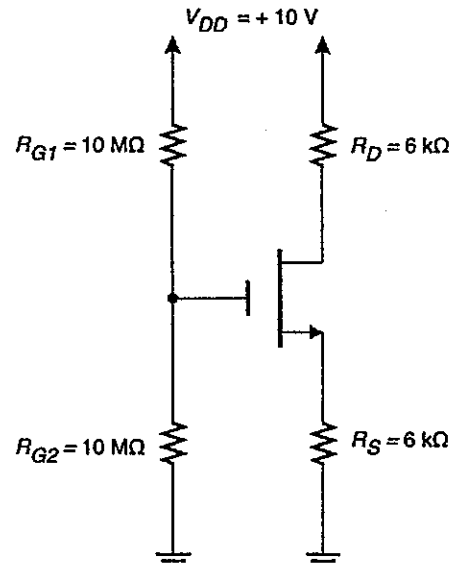


Fig. 3

3. Analyze the circuit shown in Fig. 3.
 - (a) (10%) Determine the voltages at all nodes and the currents through all branches. Let $V_{tn} = 1 \text{ V}$ and $k'_n(W/L) = 1 \text{ mA/V}^2$. Neglect the channel-length modulation effect (i.e., assume $\lambda = 0$).
 - (b) (10%) Solve the above problem, after replacing NMOS with PMOS (P-channel MOSFET) with $V_{t(\text{PMOS})} = -1 \text{ V}$.
4. Analyze the circuit shown in Fig. 4.
 - (a) (10%) Assuming ideal amplifiers, find the minimum and maximum output voltage V_o , that is, $V_o(\text{min})$ and $V_o(\text{max})$, of the instrumentation amplifier shown in Fig. 4 when the $10 \text{ k}\Omega$ potentiometer R_p is adjusted through its entire range.

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(b) (10%) Find V_{o1} and V_{o2} when R_P is set in the middle of its resistance range.

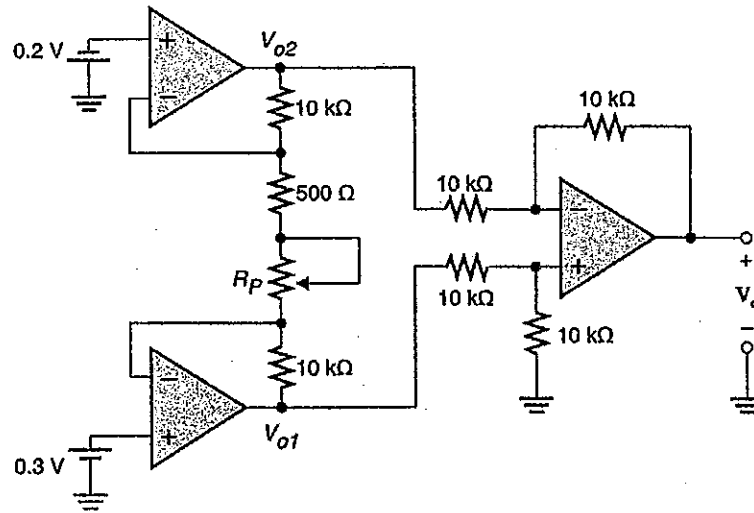


Fig. 4

5. (30%) Derive an expression for the voltage transfer ratio of each of the circuits shown in Fig. 5. Also, sketch the magnitude Bode plots to scale. Assume that the operational amplifiers are ideal.

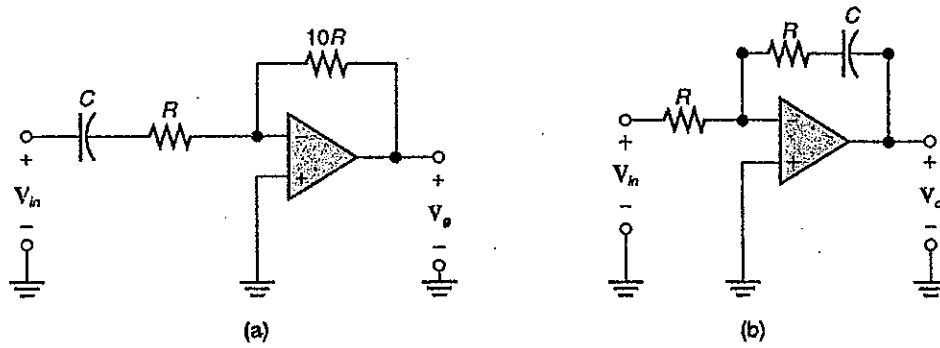


Fig. 5

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