1. (20%)

Consider a power MOSFET for which the thermal resistance parameters are:

 $\theta_{dev-case} = 1.75 \,^{\circ}C/W \qquad \theta_{case-snk} = 1 \,^{\circ}C/W$ $\theta_{snk-amb} = 5 \,^{\circ}C/W \qquad \theta_{case-amb} = 50 \,^{\circ}C/W$

The ambient temperature is $T_{\text{amb}} = 30 \text{ °C}$, and the maximum junction or device temperature is $T_{i,\text{max}} = T_{\text{dev}} = 150 \text{ °C}$.

- (a) Determine the maximum power dissipation in a transistor, with and without the heat sink.
- (b) With sink, determine the temperature of the transistor case and the heat sink.
- 2. (30%) Consider the class-B output stage with complementary MOSFETs. The transistor parameters are $V_{\text{TN}} = V_{\text{TP}} = 0$ and $K_n = K_p = 0.4 \text{ mA}/\text{V}^2$. Let $R_{\text{L}} = 5\text{k}\Omega$.
 - (a) Find the maximum output voltage such that Mn remains biased in the saturation region. What are the corresponding values of i_{L} and v_{I} for this condition?
 - (b) Determine the conversion efficiency for a symmetrical sine-wave output signal with the peak value found in part (a).



3. (15%) Find the condition such that the load current i_L is proportional to the input voltage v_l and is independent of the load impedance Z_L .



4. (15%)

- (a) Determine the closed-loop voltage gain $A_{\nu} = v_0 / v_1$ for the ideal op-amp circuit. (5%)
- (b) Let $R = 30k\Omega$. For $v_1 = -0.15 V$, determine the currents in all resistors of the T-network. (10%)



5. (20%) Assume that $R_2 / R_1 = 2$, $R_4 / R_3 = 10$, and $R_6 / R_5 = 11$. Determine CMRR(dB). (20%)

