一、For the circuit shown in Fig. 1, assume the forward voltage drop of each diode is 0.7 V. Sketch and clearly label (including the breakpoints and the slopes) the transfer characteristic of the circuit over a ± 5 V range of input signals. (本題 20%)

二、Consider the circuit shown in Fig. 2. The dc voltage V_{GSQ} biases M_D in the saturation region at the quiescent point and the drain current is 0.2 mA. Assume the transistor parameters of M_D : $V_T = 0.8$ V, $K = 1$ mA/V^2, $\lambda = 0.01$ V^{-1}; M_L : $V_T = -1.5$ V, $K = 0.2$ mA/V^2, $\lambda = 0.01$ V^{-1}. Determine the small-signal voltage gain. ($K = W\mu_n C_{ox}/L$, V_T : threshold voltage, μ_n : electron mobility, C_{ox} : oxide capacitance, L : channel length, W : channel width, λ : channel length modulation factor) (本題 20%)

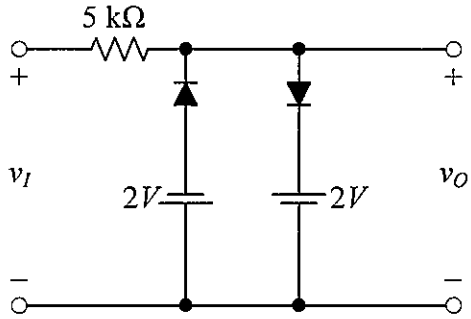

Fig. 1

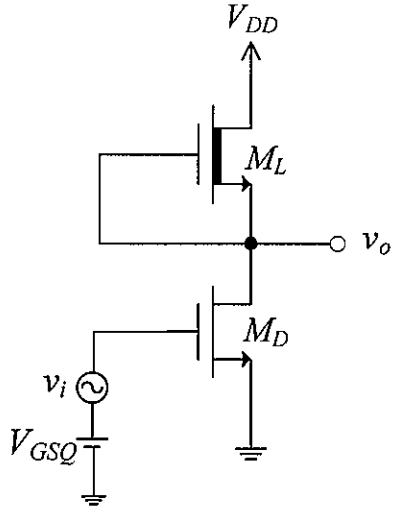

Fig. 2

三、A Miller integrator whose output voltages is initially zero and whose time constant is 2 ms is driven with a string of pulses of 5 μs duration and 1 V amplitude rising from 0 V (shown in Fig. 3). Assume the op-amps are ideal. Calculate and sketch the output waveform. (本題 20%)

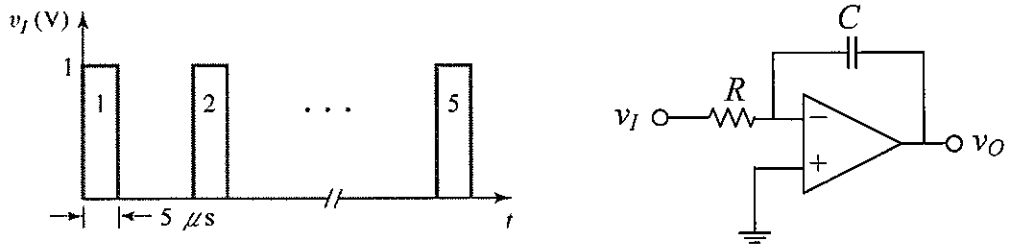

Fig. 3

～背面尚有試題～

四、For the circuit in Fig. 4, neglect output resistance r_o in small-signal model, and assume the current source to be ideal. For R_s = 1 kΩ, R_C = R_L = 10 kΩ, common-emitter current gain β = 80, and I = 2 mA, find small-signal voltage gain. (本題 20%)

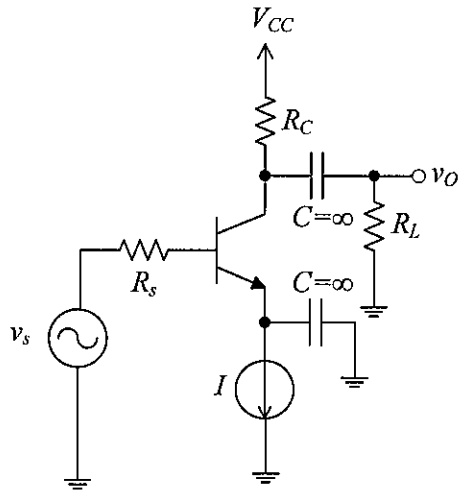

Fig. 4

五、Calculate the concentration of electrons and holes in silicon at temperature 300 K. The concentration of donor atoms is 2×10^{16} cm^{-3} and the intrinsic carrier concentration at 300 K is 1.5×10^{10} cm^{-3}. (本題 20%)