(20%) 1. Fig.1a and Fig.1b are bistable circuits with inverting and non-inverting topologies, respectively. Both have output saturation vlotages $L_+ = -L_- = 15V$, and the threshold voltages of $V_{TH} = -V_{TL} = 5V$.

(a) Please sketch the transfer characteristic curves of both inverting and non-inverting topologies (mark the L_+, L_-, V_{TH}, V_{TL}, and the direction of the transfer operation on your plots). (10%)

(b) Let $R_1 = 1k\Omega$, please find R_2 and R_3. (10%)

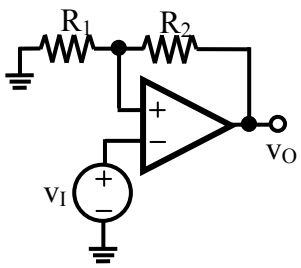


Fig.1a

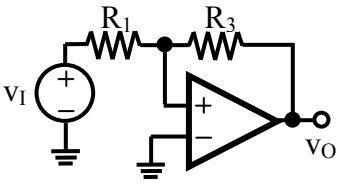


Fig.1b

(16%) 2. Fig.2a shows a inverter-based multivibrator circuit and its waveforms. Assume R = 10kΩ, C = 1nF, and inverter's transition threshold voltage $V_T = 0.5V_{DD}$.

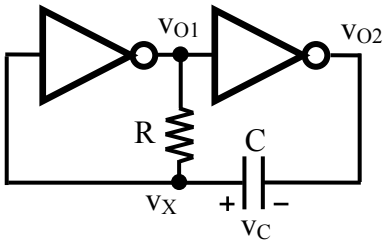
(a) Which type of multivibrator is it? (bistable, astable, monostable) (5%)

(b) Sketch the waveform of $v_C(t)$. (5%)

(c) Calculate T_1 and find the oscillation frequency f_0 of the multivibrator. (6%)

(Hint: RC circuit complete response

$v(t) = v(\infty)+[v(0)-v(\infty)]e^{-t/\tau}$)



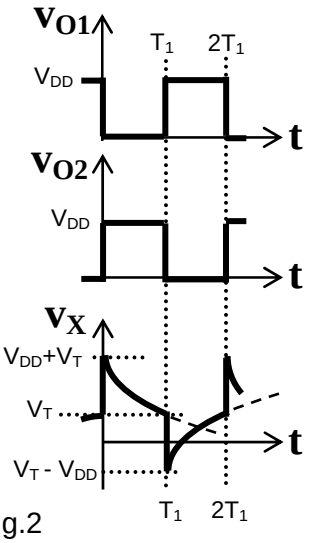


Fig.2

(18%) 3. For the emitter follower of Fig.3, let $V_{CC} = 10V$, $I_{bias} = 200mA$, and $R_L = 100\Omega$. If the output v_O is an 8-V-peak sinusoid, please find

(a) the power delivered to the load R_L. (6%)

(b) the average power drawn from the supplies. (6%)

(c) the power-conversion efficiency η. (6%)

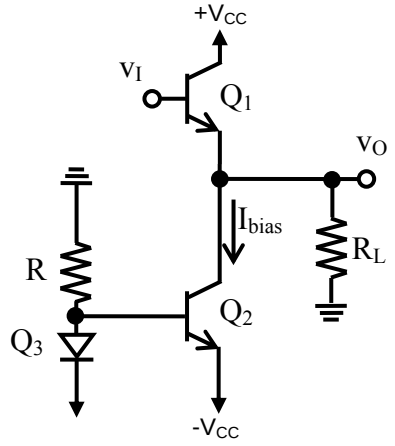


Fig.3

(13%) 4. Fig.4 shows a class B output stage.

(a) Please sketch the transfer characteristic, and explain why the crossover distortion occurs. (8%)

(b) Draw a modified output stage to eliminate the crossover distortion. (5%)

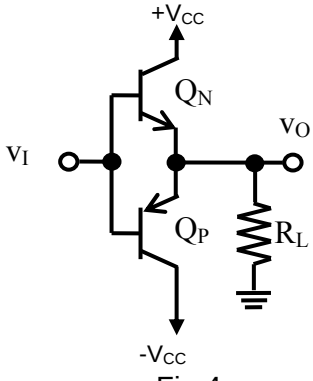


Fig.4

(18%) 5. When a power transistor is operated at junction temperature T_J of 150°C with a heat sink, the case temperature T_C is found to be 100°C. The case is attached to the heat sink with a bond having a thermal resistance θ_{CS} = 0.6°C/W and the thermal resistance of the heat sink θ_{SA} = 0.1°C/W, as shown in Fig.5. If the ambient temperature T_A is 30°C, please calculate

(a) heat sink temperature T_S. (6%)

(b) power dissipated in the device P_D. (6%)

(c) thermal resistance from junction to case, θ_{JC}. (6%)

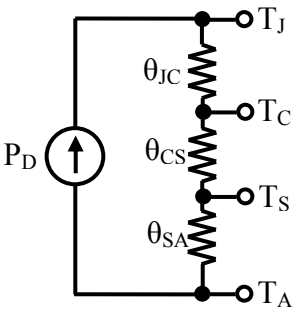


Fig.5

(15%) 6. Briefly explain the following terms

(a) THD (5%)

(b) Inter-modulation distortion (5%)

(c) Darlington configuration *npn* compound device (5%)