NANYANG TECHNOLOGICAL UNIVERSITY
SCHOOL OF ELECTRICAL & ELECTRONIC ENGINEERING
EE4341/EE6341 ADVANCED ANALOG CIRCUITS
TUTORIAL 7

1. Fig. 1 shows a Class AB power amplifier biased by a constant current source I_{bias} = 5 mA. The load R_L = 100 Ω and the transistor and the diode parameters are: $I_S = 10^{-13}$ A and V_T = 26 mV. Current gains β_n = 100 and β_p = 20 for npn and pnp transistors, respectively.
   (a) Determine V_{BB}, I_C and V_{BE} for each transistor when v_o = 0.
   (b) Repeat part (a) when v_o = +10 V.
   (c) What is the instantaneous powers delivered to the load and dissipated in each transistor when v_o = + 10 V?

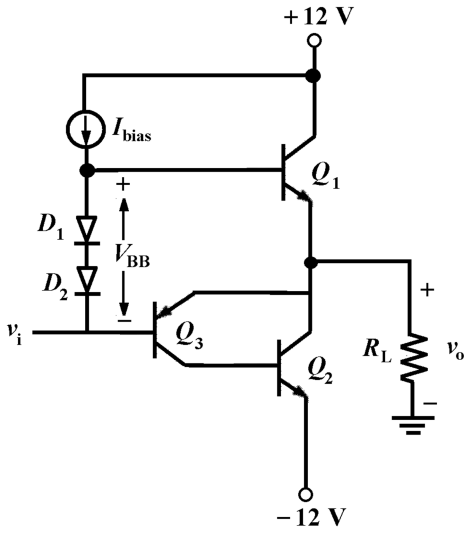

Figure 1

2. Fig. 2 shows a Class D power amplifier to drive a load R_L = 8 Ω. Assume $V_{CE(sat)}$ = 0.3 V and the LC low pass filter is lossless.
   (a) What is the maximum power that can be delivered to the load?
   (b) If each switching transition of the transistor is about 5% of the period of switching frequency, what is the conversion efficiency at maximum output power?
   (c) Repeat part (b) if faster transistors are used with the switching transition reduced to 2.5%.

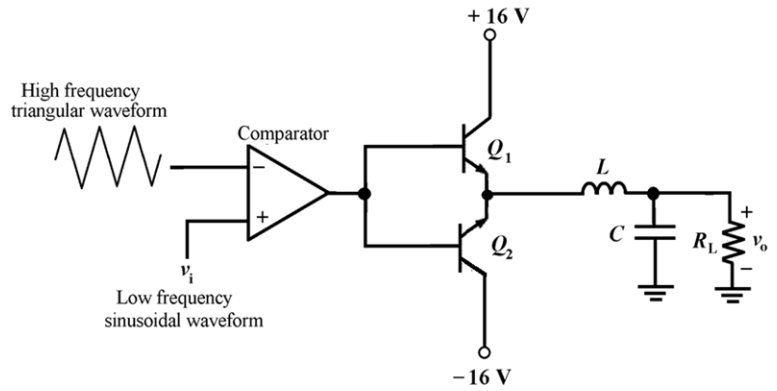

Figure 2

3. The maximum permissible junction temperature of a power transistor is 150ºC. It is desired to operate the transistor with a power dissipation of 15 W in an ambient temperature of 40ºC. The thermal resistances of the transistor: θ_{JC} = 0.5ºC/W (junction to case) and θ_{CA} = 10ºC/W (case to ambient).
   (a) Determine whether a heat sink is required for this application.
   (b) If a heat sink is needed, determine the required thermal resistance. To mount the heat sink, there is a mica washer between the transistor case and the heat sink. The thermal resistance of the mica washer θ_W = 0.5ºC/W.