American University of Beirut
Department of Electrical and Computer Engineering

EECE 310 – Electronics   Fall 2011 – 2012

<u>Homework 1</u>
<u>Due Wednesday October 5, 2011 at 9:00 am</u>

Problem 1. [50 points]
An amplifier has the transfer characteristic: $v_O = 12 - 10\,(v_I - 3)^2$ V.
where v_O and v_I are in volts. This transfer characteristic applies for $3 < v_I < v_O + 3$ V, and v_O positive.
At the limits of this region, the amplifier saturates.

a) **[15 points]** Sketch and clearly label the transfer characteristic. What are the saturation levels $L+$ and $L-$ and the corresponding values of v_I?

b) **[10 points]** Bias the amplifier to obtain a DC output voltage of 6 V. What value of input DC voltage V_I is required?

c) **[10 points]** Calculate the value of the voltage gain (in V/V and in dB) at the bias point.

d) **[15 points]** If a sinusoidal input signal is superimposed on the DC bias voltage V_I, that is:
$v_I = V_I + V_i \cos(\omega t)$, find the resulting v_O. Express v_O as the sum of a DC component, a signal component at ω with amplitude A_1 and another component at 2ω, with amplitude A_2. The component at 2ω is **undesirable** and is the result of the nonlinear transfer characteristic of the amplifier. If it is required to limit the ratio $\left|\dfrac{A_2}{A_1}\right|$ to 1%, what is the corresponding upper limit on V_i?

Problem 2. [50 points]
An amplifier operating from +/– 12.7 V power supplies has a linear transfer characteristic except for output saturation at +/– 11 V.

a) **[12 points]** The *peak-to-peak* value of the largest sinusoidal wave that can be applied at the amplifier input without output distortion is 0.5 V. Find the amplifier voltage gain in V/V and in dB.

b) **[8 points]** What is the corresponding output power for an 32 Ω load?

c) **[20 points]** What is the power gain, in W/W and in dB, if the input power is 10 mW? What is the current gain of the amplifier, in A/A and in dB?

d) **[10 points]** What is the amplifier efficiency (in %) if the DC current drawn from each power supply is 200 mA?