ESHD: Quiz Week 6

1. Which among the following statements are NOT TRUE? 2 points

(a) Embedded systems need not contain only hardware.
(b) A digital alarm clock with snooze functionality is an embedded system.
(c) For all embedded systems, the latency for computation of the result is not a problem as long as it is correct.
(d) For all embedded systems, the correctness of the result is not a problem as long as the latency is minimal.
(e) RAM and EEPROM are typically integrated on-chip in a microcontroller
(f) Very few microcontrollers are sold per year compared to general-purpose microprocessors
(g) A microcontroller has higher computing power than a typical microprocessor
(h) A microcontroller has a rich set of on-chip peripherals in comparison to microprocessor.

2.What brown out reset (BOR) circuit does by monitoring which of the following: 1 point

(a) Clock Frequency
(b) Temperature
(c) Supply Voltage
(d) Current Draw

3. Describe types of memory used in embedded systems and for what purpose? 2 points

At least: Flash – to keep program and some constant data, RAM – to accommodate variables, EEPROM – to record and keep calibration parameters. They can be internal (in uC), external, or mixed. Other types of memories may include: DRAM, DDRAM, FRAM, MRAM, NvSRAM, ROM.

4. The input Low-pass filter of a signal conditioner is made of 10k resistor and 100pF capacitor. At what frequency is the Vout error less than 0.1%?? Demonstrate by 2 ways. 5 points

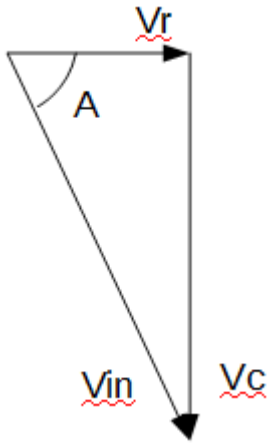
There are three ways to solve this problem: 1) by trigonometry -using vectors: Vr is 90deg to Vc:

1) The 0.1% error means that the output voltage at that frequency is 0.999 of the input voltage. Consider the triangle (not to scale) of voltage vectors on the resistor, capacitor and the voltage on the input of the LPF:

sin (A) = Vc/Vin = 0.999;
A= arcsin(0.999) = 87.44 degrees

cos (A) = Vr/Vin = 0.04467.

The current going thru resistor and capacitor is the same, and the vector of current is collinear with the vector of the voltage on the resistor.



Now we can write two equations for current: 0.04467/R = 0.999/(1/6.283*f*C);
rearranged: 0.04467/10000 = 0.999 * 6.283 * f * 10^-10, and express frequency f = 0.04467/ (6.283 * 10^4 * 10^-10) = 7109 Hz.

2) By complex numbers:
Error % = (Vin – Vout)/Vin = 0.1 %;

Vout / Vin = 0.999;

Vout/Vin = Xc/ (SQRT(R^2 + Xc^2)); square both sides:

0.998 = Xc^2 / (R^2 + Xc^2) => 0.998*(R^2 + Xc^2) = Xc^2; Let's put numbers:

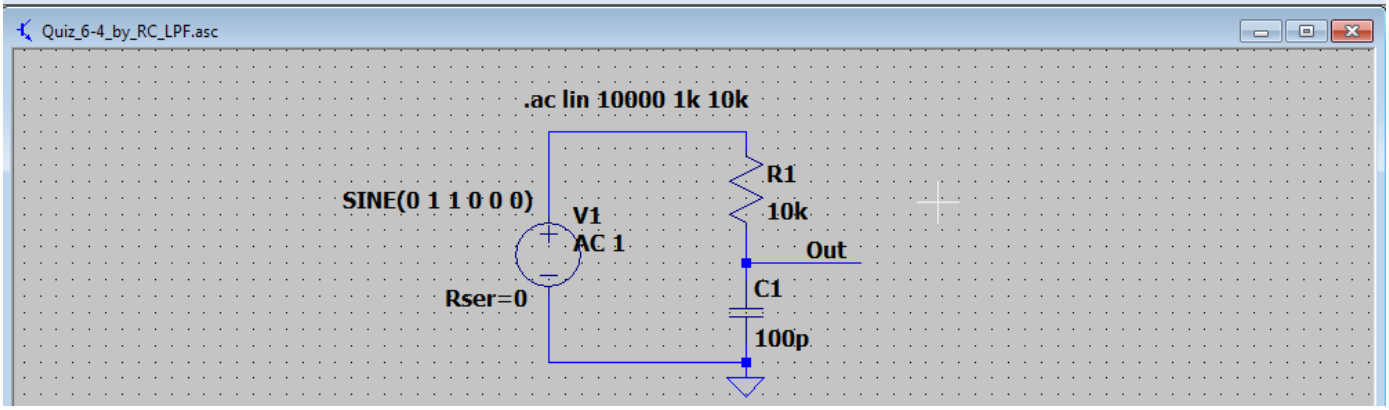
0.998 * 10^8 = 0.002 * Xc^2 => Xc^2 = 499 * 10^8, take a square root:

Xc = 22.34 * 10^4. Now express Xc = 1/(6.283* f * C) = 22.34 * 10^4, from this:

f = 1/ (6.283 * C * 22.34 * 10 ^4 = 1/(140 * 10^-6) = 7125 Hz.

3) By using simulation:

How to generate a Bode plot with LTspice



Here we can find the frequency 7.12kHz on the intersection of the green line and a horizontal line 999.00mV.