#1) Slide 12 Lecture 8:
Talking about the energy in a capacitor.

You have P(t) = V(t)I(t) = Vc(t) C dVc(t)/dt.
Then you say E = integral 0 to t of P(t)dt = 1/2CVc(t)^2.

I remember I figured this out once before.

Aren't you doing the integral P(t) = integral C*V*dV/dt. And you are integrating with respect to time, so how do you handle dV? I think it's something with the fact that we are misusing t as our variable or something, but it's not clicking at the moment.

Actually the dummy variable doesn't affect anything. What's bothering you, I think, is that the dts seemingly cancel. I guess you can think of them as canceling, but that's probably just confusing. Instead I'd treat $\frac{dV_C(t)}{dt}$ as a single object. At any rate, we turn to the 2nd fundamental theorem of calculus, which says that if $f(t) = \frac{dF(t)}{dt}$ then:

$$\int_0^t f(q)dq = F(t) - F(0)$$

If you believe this theorem, you should see that there's no dt cancellation problem. At that point, it's just a matter of defining $F(t) = V_C^2(t)$, in which case $f(t) = 2V_C(t)\frac{dV_C(t)}{dt}$, and a straightforward application of the theorem gets us our result.

#2) When doing the intuitive method to solve an RL or RC circuit, we need Req where Req is the equivalent resistance as seen from the Capacitor/Inductor. Does this mean we Short-Circuit Voltage Sources and Open Circuit Current Sources to calculate Req?

Yes.

#3) Your slide says that Zero Input Response is same as f(t)=0 (AKA the homogenous soln). Say we are doing the intuitive method with a RC-V circuit, so Vc(t) = (Vi - Vf) e^(-t/T) + Vf. Is (Vi-Vf)*e^-t/T (AKA the Natural Response) the Homogenous solution and Vf (the Forced Response) the particular solution? (I ended up doing all my problems actually solving the ODE rather than the intuitive method on the homeworks).

Yes, the homogeneous solution is just $(V_i - V_f)e^{-t/\tau}$. Note that $39.2V_i^{3723}e^{-t/\tau}$ is also a homogeneous solution, because it also satisfies the ODE when the forcing function is set to zero. The difference is that $39.2V_i^{3723}e^{-t/\tau}$ doesn't meet the initial condition, but strictly speaking, from a terminology point of view, it is still a solution to the homogeneous ODE that we get when we set f(t)=0. And yes, the particular solution is V_f.

#4) On your lecture notes about halfway through you say T (tau) = 1 / Req*C for an RC circuit. I believe this is a typo: T = RC. (since e^-t / T).

Yeah, you’re right. I was accidentally writing the root of the characteristic polynomial for some reason on that first day of capacitors and inductors.