EE223 Final Exam: Student Objectives Review Sheet

1. **First order switched DC circuits**: Given a circuit with (any number of resistors) and (one capacitor or inductor) and any number of sources that have one steady value and (a switch that changes position at t=0) and/or (sources that have a u(t) function),
   A. Find $i_L(t)$ or $v_C(t)$ (method: plug 'n chug equation with v_0, v_∞, τ)
   B. Tweaks:
      - Ask for a voltage or current other than $i_L(t)$ or $v_C(t)$ (method: use i=Cv', v=Li', Ω's Law, KVL, KCL, etc. to find)
      - Add an opamp (method: above plus do KCL at the opamp input terminals, never the outputs)

2. **Lab-based design problem**: Design a circuit using comparators to solve a given problem. It may begin with a sensor that outputs a voltage, or it may begin with a voltage directly (as was done in the comparator lab).
   Tweaks:
      - You might need to use voltage dividers or opamp gain stages to scale in the input voltage
      - Keep designed resistors to reasonable values (I will tell you what the limits are in the problem, but realize that values of 10kΩ are fine but 1Ω are not)

3. **Second order circuit solving**: Given a circuit *that can be simplified* into a series or parallel LRC circuit for t≥0 and a source that changes between two values (it may have a switch or a u(t) function,
   A. Find $i_L(t)$ or $v_C(t)$ (method: plug and chug with α and ω_o)
   B. Tweaks:
      - Ask for a voltage or current other than $i_L(t)$ or $v_C(t)$ (method: use i=Cv', v=Li', Ω's Law, KVL, KCL, etc. to find)
      - Use opamps (use KCL at inputs, never outputs, and use Golden Rule of inputs at same voltage if negative feedback, no input current

4. **Phasor Analysis**: Given a circuit with any number of resistors, capacitors, and inductors, and any number of sources at the same frequency, but with no switches or u(t)'s (ie SSS – Sinusoidal Steady State)
   A. Find any current, voltage, impedance, or Norton/Thevenin equivalent (method: convert to phasor domain, then use EE122 techniques)
   B. Tweaks:
      - Use opamps (use KCL at inputs, never outputs, and use Golden Rule of inputs at same voltage if negative feedback, no input current
      - Use dependent sources (add an additional equation if solving using nodal or mesh methods)

5. **Complex Power**: Given a simple SSS circuit with source voltages/currents given in either V, A, or V_{rms}, A_{rms}, and including a number of resistors, inductors, and capacitors (total component

number will only be between 2 and 4 – this isn't meant to be the tougher phasor analysis problem #4)

A. Find the complex power phasor delivered to any component or by the source, or any of the two components of the complex power phasor (ie the real power part or the imaginary reactive power part)
B. Find the power factor and whether it is leading or lagging.
C. Determine the component, its value, and where to add the component, in order to correct the power factor to 1

6. **Ideal transformers and power**: Given a simple SSS circuit, with a Thevenin model of a single source (i.e. voltage source phasor and series impedance) connected to a load impedance
   A. Find the power dissipated in the load
   B. Find the turns ratio of the transformer inserted between the Thevenin source model and the load that will cause the maximum power to be dissipated by the load
   C. Determine what the new power dissipated by the load is, once the transformer is installed
   D. Tweak: may give problem as either phasors, or in time-domain requiring you to transform it into phasor domain