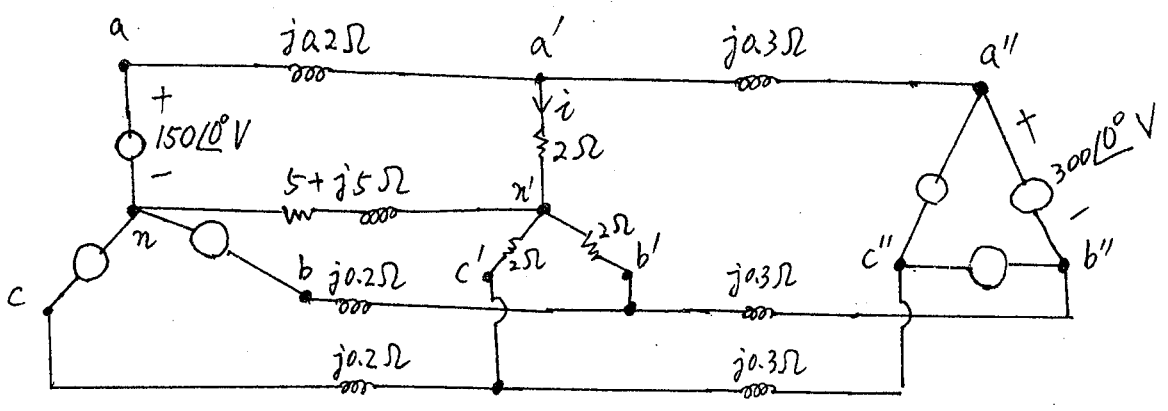
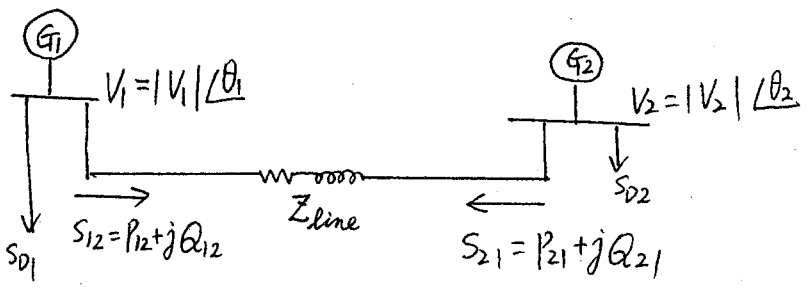
1. Consider the 60Hz, balanced three-phase system shown below, find i(t). (12%)



2. Let $|V_1| = 1.03$, $|V_2|=1$, $Z_{line}=1\angle 80^\circ$, $\theta_{12}=\theta_1-\theta_2$.
What is the maximum power, $-P_{21}$, that can be received by V_2? (11%)



3. The resistance, leakage reactance and number of turns for the high-voltage winding of a single phase transformer are $R_1 = 0.5\Omega, X_{l1} = 2\Omega$, and $N_1 = 2000$, respectively. On the other hand, the resistance, leakage reactance, and number of turns for the low-voltage winding are $R_2 = 0.005\Omega$, $X_{l2} = 0.02\Omega$, and $N_2 = 200$, respectively. Neglect the exciting current of the transformer.

Select a base of 30kVA and 1000V for the high voltage winding. Compute the per unit values for the resistances and leakage reactances for the two windings and draw an impedance diagram with per unit impedances for the transformer. (10%)

4. The rotor of a six-pole synchronous generator is rotating at a mechanical speed of 1200 r/min.
(a) Express this mechanical speed in radians per second. (8%)
(b) What is the frequency of the generated voltage in hertz? (8%)

5. The manufacturer's data sheet for a 26 kV, 720 MVA, 60 Hz three-phase synchronous generator indicates that it has a synchronous reactance $X_s = 1.92$ and a leakage reactance $X_{al} = 0.19$, both in per unit on the generator base. Calculate
(a) the synchronous inductance in millihenrys. (9%)
(b) the leakage inductance in millihenrys. (8%)

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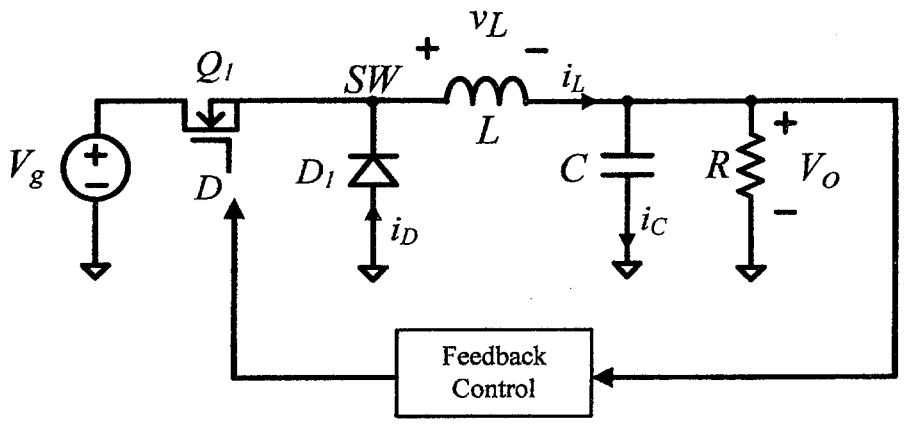
6. A buck converter operates at steady-state. Assume the switch and diode are ideal. V_g =10V, V_o =1V, L =1uH, C is very large, Switching frequency f_s =100kHz, Output Resistance R =0.5 ohm.



(a) Derive the peak and valley values of i_L and i_C. (8%)

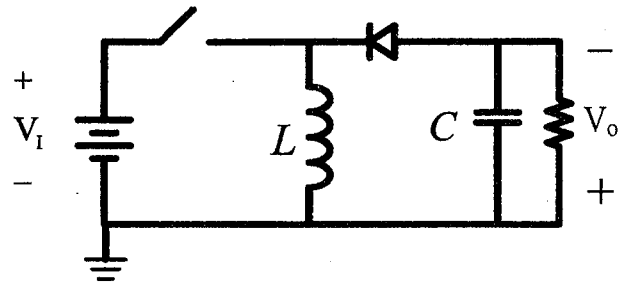
(b) Sketch the time waveforms of D, SW voltage, i_L, i_C. (6%)

(c) Is the operation in continuous conduction mode (CCM) or discontinuous conduction mode (DCM)? (4%)

(d) What is the assumption that transform the derivation of the converter current from second order equations to first order equations? (2%)

7. Assume the open-loop output impedance transfer function of a switching converter has a zero at origin, a complex poles at 1KHz, a left-half-plane zero at 100kHz. Gain is -40dB at 1MHz. Draw the Bode plot (gain and phase) of this transfer function. (8%)

8. A buck-boost converter in CCM operation as below. Assume the switch and diode both have forward voltage drop Vx at conduction. Please derive input to output dc gain (V_o/V_I). Please write down the derivation process. (6%)



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