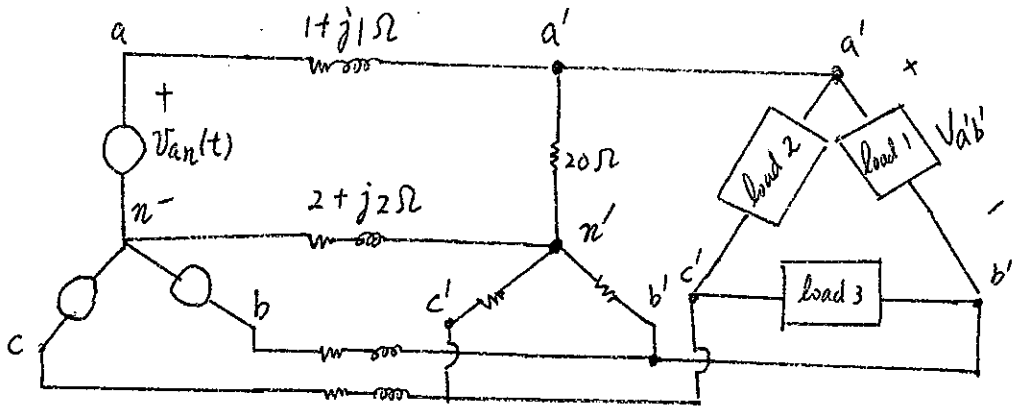
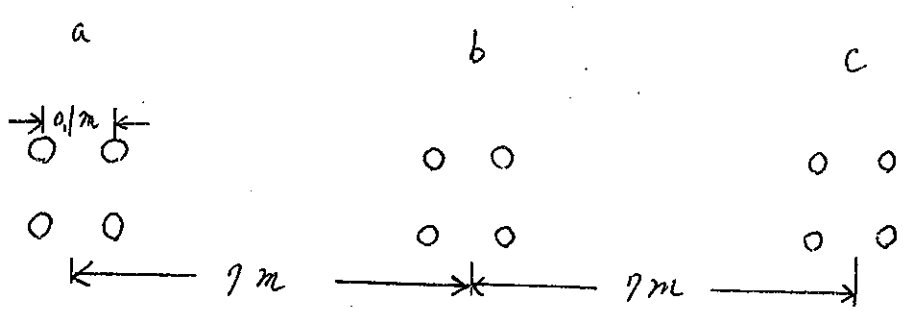
國立臺灣大學 112 學年度碩士班招生考試試題

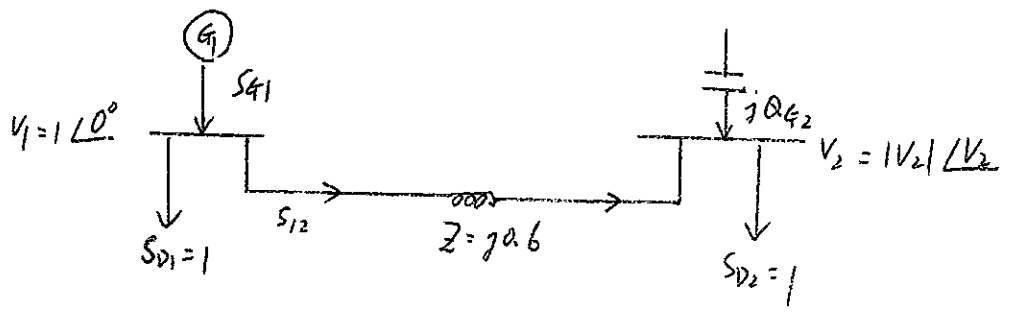
1. Given the 60 Hz, balanced three-phase system shown below, find $v_{an}(t)$ when each of the three loads (load1, load2, load3) consumes P = 500 W at a power factor of 0.85 lagging and $V_{a'b'} = 100\sqrt{3}\angle 30^\circ$ V . (12%)



2. Find the per phase inductance in H/m and per phase capacitance to neutral in F/m for the following 345 KV, 60 Hz, completely transposed, balanced three phase line. Assume that the radius of each sub-conductor is 1 cm. (10%)



3. For the system shown below, all quantities are per phase values. Assume that $-90^\circ \leq \angle V2 \leq 90^\circ$. Pick Q_{G2} so that $|V2| = 1.03$.(11%)



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4. A magnetic circuit with a single air gap is shown in Fig.1. The core dimensions are:

$A_C = 1.8 \times 10^{-3}\ m^2,\ l_C = 0.6\ \text{m},\ g = 2.3\ \text{mm},\ \text{N} = 83\ \text{turns}$

Assume that the core is of infinite permeability ($\mu \to \infty$) and neglect the effects of fringing fields at the air gap and leakage flux.

a. **(8%)** Calculate the reluctance of the core R_C and that of the gap R_g.

b. **(8%)** For a current of $\text{i} = 1.5$ A. calculate the total flux φ, the flux linkages λ of the coil, and the coil inductance *L*.

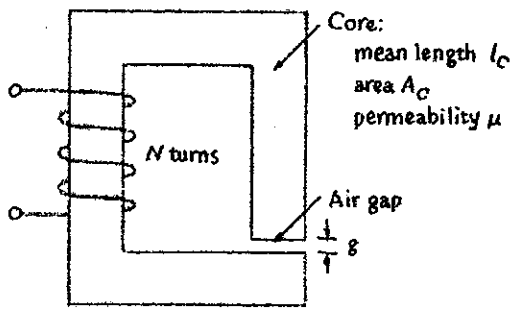

Fig. 1

5. **(8%)** For a 24 poles AC rotating machine, if the magnetic field speed is 300rpm (rotation per minute), what is the frequency of stator current?

6. **(9%)** If a three-phase induction motor operated by 3ϕ, 110V, 60Hz AC source has a slip rate $\text{s} = 1\%$, then find the frequency of rotor winding voltage.

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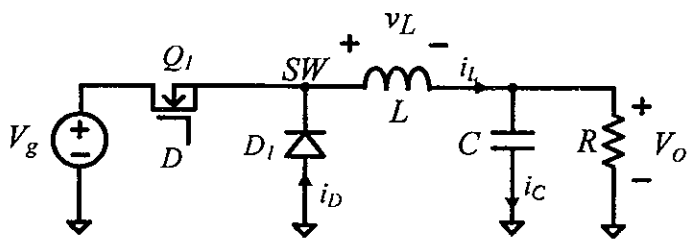
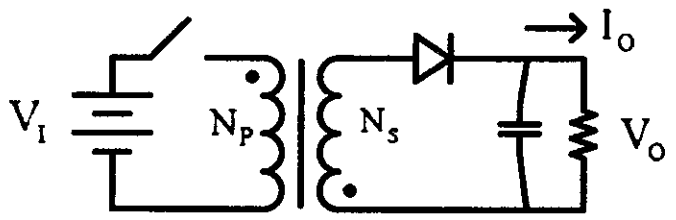
7. A buck converter below operates at steady-state. Assume the converter is ideal except diode D_1 has a 1V forward voltage drop. V_g =10V, V_o =5V, L =100uH, C is very large, Switching frequency f_s =100kHz, Output Resistance R =0.5 ohm.



(a) Derive the input to output dc gain (V_g/V_o) as a function of duty cycle D. (5%)
(b) Sketch the time waveforms of D, SW voltage, i_L, i_D. Mark peak and valley values (8%)
(c) Derive the root-mean-square (rms) value of i_L. (3%)
(d) Determine the inductance of L if the converter is operating at the boundary conduction mode when R =5 ohm.. (4%)

8. Answer below questions. Explanation or mathematic derivations are required.

(a) What is the value of integration of inductor voltage across a switching period at steady-state? (3%)
(b) Draw the two equivalent circuits during active switch turn-on and turn-off, respectively, of the Flyback converter below. (Hint: use ideal transformer model; consider the magnetizing inductance of a real transformer; use short circuit and open circuit to express a switch in on and off state, respectively.) (4%)



(c) Name one property difference of the real transformer in problem (b) compared with an ideal transformer model. (3%)
(d) Draw the Bode plot (gain and phase plots) of the transfer function $T = \frac{10(s-10)}{s+1000}$ (4%)

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