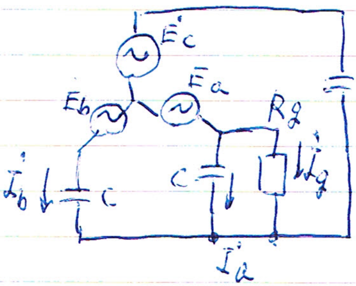
P103

問題1　一線当たりの静電容量 0.5μF
使用電圧 66kV，周波数 50Hz
中性点非接地方式．1線地絡 抵抗 1000Ω
地絡電流と中性点電位を求める．



変数6　式6

$$\begin{cases} \dot{I}_a + \dot{I}_b + \dot{I}_c + \dot{I}_g = 0 \\ \dot{I}_g R_g = \dfrac{\dot{I}_a}{j\omega C} = \dot{E}_a + \dot{E}_n \\ \dot{I}_b = j\omega C(\dot{E}_b + \dot{E}_n) \\ \dot{I}_c = j\omega C(\dot{E}_c + \dot{E}_n) \end{cases}$$

$$-\dot{E}_a = \dot{E}_b + \dot{E}_c$$

$$\dot{I}_g R_g = \frac{1}{j\omega C}(-\dot{I}_b - \dot{I}_c - \dot{I}_g) = \dot{E}_a + \dot{E}_n$$

$$= \frac{-\dot{I}_g}{j\omega C} - (\underbrace{\dot{E}_b + \dot{E}_c}_{-E_a} + 2\dot{E}_n) = \frac{-\dot{I}_g}{j\omega C} + \dot{E}_a - 2\dot{E}_n$$

左辺＝中辺　$\dot{I}_g\left(R_g + \dfrac{1}{j\omega C}\right) = E_a - 2\dot{E}_n$

中辺＝右辺　$-\dfrac{\dot{I}_g}{j\omega C} = 3\dot{E}_n$

$$\dot{I}_g\left(R_g + \frac{1}{j\omega C}\right) = \dot{E}_a - 2\left(\frac{-\dot{I}_g}{j\omega C 3}\right)$$

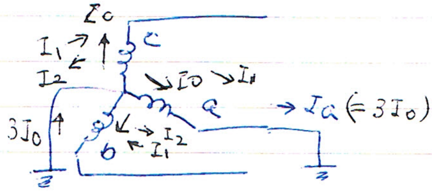
$$\dot{I}_g\left(R_g + \frac{1}{j\omega C} - \frac{2}{j3\omega C}\right) = E_a$$

$$\dot{I}_g \frac{j3\omega C R_g + 1}{j\omega C 3} = E_a \quad , \quad \dot{I}_g = \frac{j3\omega C}{1 + j3\omega C R_g} E_a$$

$$\dot{E}_n = \frac{-\dot{I}_g}{j3\omega C}$$

送電線路の故障計算

1線地絡



$$V_a = V_0 + V_1 + V_2 = 0$$
$$V_b = V_0 + \alpha^2 V_1 + \alpha V_2$$
$$V_c = V_0 + \alpha V_1 + \alpha^2 V_2$$

$$I_a = I_0 + I_1 + I_2$$
$$I_b = I_0 + \alpha^2 I_1 + \alpha I_2$$
$$I_c = I_0 + \alpha I_1 + \alpha^2 I_2$$

$I_b = I_c$, $I_a + I_b + I_c = 3I_0$
$\quad\ \ \| $
$\quad\ \ 0$

$I_a = 3I_0$

$$V_0 = \quad - Z_0 I_0$$
$$V_1 = E_a - Z_1 I_1$$
$$V_2 = \quad - I_2 I_2$$

$I_b = I_c \Rightarrow I_1 = I_2$

$$\boxed{\begin{aligned} 0 &= I_b = I_0 - I_1 \\ 0 &= I_c = I_0 - I_1 \\ I_2 &= I_1 = I_0 \end{aligned}}$$

+)

$$V_0 + V_1 + V_2 = E_a - (Z_0 I_0 + Z_1 I_1 + Z_2 I_2)$$
$\quad\ \ \|$
$\quad\ \ 0$

$$\frac{I_a}{3} = I_0 = \frac{E_a}{Z_0 + Z_1 + Z_2}$$

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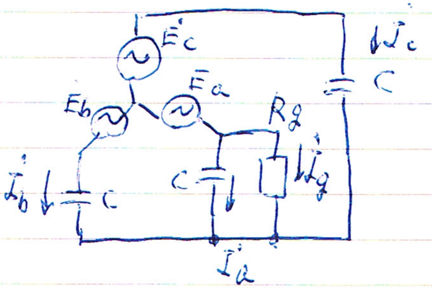


変数6 式6

$$\begin{cases} \dot I_a + \dot I_b + \dot I_c + \dot I_g = 0 \\ \dot I_g R_g = \dfrac{\dot I_a}{j\omega C} = \dot E_a + \dot E_n \\ \dot I_b = j\omega C(\dot E_b + \dot E_n) \\ \dot I_c = j\omega C(\dot E_c + \dot E_n) \end{cases}$$

$$-\dot E_a = \dot E_b + \dot E_c$$

$$\dot I_g R_g = \frac{1}{j\omega C}(-\dot I_b - \dot I_c - \dot I_g) = \dot E_a + \dot E_n$$

$$= \frac{-\dot I_g}{j\omega C} - (\underbrace{\dot E_b + \dot E_c}_{-\dot E_a} + 2\dot E_n) = \frac{-\dot I_g}{j\omega C} + \dot E_a - 2\dot E_n$$

左辺=中辺 $\dot I_g\left(R_g + \dfrac{1}{j\omega C}\right) = \dot E_a - 2\dot E_n$

中辺=右辺 $-\dfrac{\dot I_g}{j\omega C} = 3\dot E_n$

$$\dot I_g\left(R_g + \frac{1}{j\omega C}\right) = \dot E_a - 2\left(\frac{-\dot I_g}{j\omega C 3}\right)$$

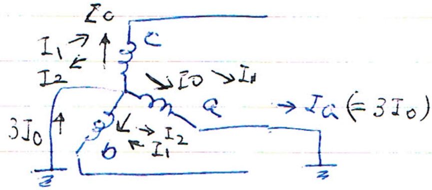
$$\dot I_g\left(R_g + \frac{1}{j\omega C} - \frac{2}{j3\omega C}\right) = \dot E_a$$

$$\dot I_g \frac{j3\omega C R_g + 1}{j\omega C 3} = \dot E_a, \quad \dot I_g = \frac{j3\omega C}{1 + j3\omega C R_g}\dot E_a$$

$$\dot E_n = \frac{-\dot I_g}{j3\omega C}$$

送電線路の故障計算

1線地絡



$$V_a = V_0 + V_1 + V_2 = 0$$
$$V_b = V_0 + \alpha^2 V_1 + \alpha V_2$$
$$V_c = V_0 + \alpha V_1 + \alpha^2 V_2$$

$$I_a = I_0 + I_1 + I_2$$
$$I_b = I_0 + \alpha^2 I_1 + \alpha I_2$$
$$I_c = I_0 + \alpha I_1 + \alpha^2 I_2$$

$\underset{0}{\underset{\parallel}{I_b}} = I_c$, $I_a + I_b + I_c = 3I_0$

$I_a = 3I_0$

$$V_0 = \quad - Z_0 I_0$$
$$V_1 = E_a - Z_1 I_1$$
$$V_2 = \quad - Z_2 I_2$$

$I_b = I_c \Rightarrow I_1 = I_2$

$$\boxed{\begin{aligned} 0 &= I_b = I_0 - I_1 \\ 0 &= I_c = I_0 - I_1 \\ I_2 &= I_1 = I_0 \end{aligned}}$$

+)

$$\underset{0}{\underset{\parallel}{V_0 + V_1 + V_2}} = E_a - (Z_0 I_0 + Z_1 I_1 + Z_2 I_2)$$

$$\frac{I_a}{3} = I_0 = \frac{E_a}{Z_0 + Z_1 + Z_2}$$

2線地絡

目標. I_b, I_c を $E_a, Z, \underset{\text{オペレータ}}{\alpha}$ で表わす

$$
\left.\begin{cases}
V_a = V_0 + V_1 + V_2 \\
V_b = V_0 + \alpha^2 V_1 + \alpha V_2 = 0 \\
V_c = V_0 + \alpha V_1 + \alpha^2 V_2 = 0
\end{cases}\right\} \cdots (1)
$$

$$
\left.\begin{cases}
I_a = I_0 + I_1 + I_2 = 0 \\
I_b = I_0 + \alpha^2 I_1 + \alpha I_2 \\
I_c = I_0 + \alpha I_1 + \alpha^2 I_2
\end{cases}\right\} \cdots (2) \qquad I_0 = -(I_1 + I_2) \cdots (4)
$$

$$
\left.\begin{cases}
V_0 = \quad\;\; - Z_0 I_0 \\
V_1 = E_a - Z_1 I_1 \\
V_2 = \quad\;\; - Z_2 I_2
\end{cases}\right\} \cdots (3)
$$

(1) V_b, V_c に $\underset{(4)}{(3)}$式 を代入.

$$
\left.\begin{aligned}
V_b &= f_1(E_a, Z, I_1, I_2) = 0 \\
V_c &= g_1(\qquad \text{〃} \qquad) = 0
\end{aligned}\right\} \cdots (5)
$$

V_b, V_c (5) + − に

$$
\left.\begin{aligned}
I_1 &= f_2(E_a, Z) \\
I_2 &= g_2(E_a, Z)
\end{aligned}\right\} \cdots (6)
$$

(2) I_b, I_c に (4), (6)式 を代入.

$$
I_b = \frac{(\alpha^2 - \alpha) Z_0 + (\alpha^2 - 1) Z_2}{\Delta Z} E_a
$$

$$
I_c = \frac{(\alpha - \alpha^2) Z_0 + (\alpha - 1) Z_2}{\Delta Z} E_a
$$

但し $\Delta Z = Z_0 Z_2 + Z_1 Z_2 + Z_0 Z_1$

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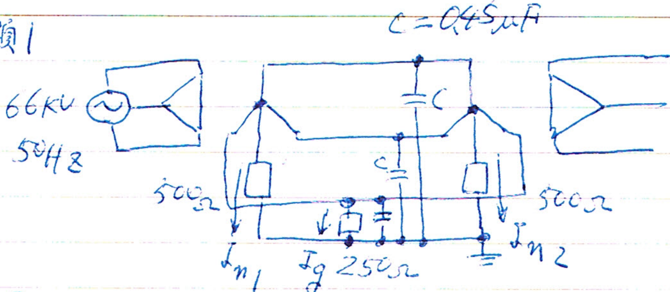
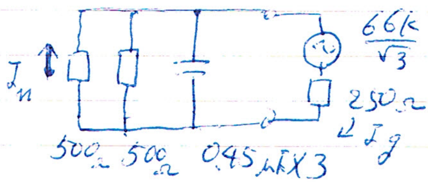
問題1

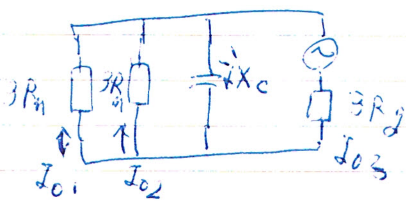


I_{n1}, I_{n2}, I_g を求める.

テブナンの定理を使って,



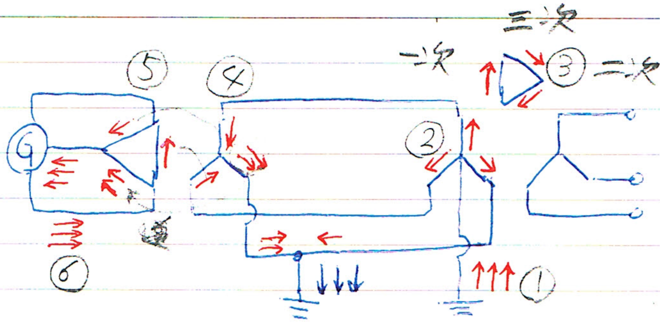
零相電流で表わすと.



実回路から零相等価回路を描く方法は？

$I_g = 3I_{03}$

$I_n = 3I_{01} = 3I_{02}$


三次
一次
二次
G
1
2
3
4
5
6

$$\mathcal{L}[f(t)'] = sF(s) + f(0)$$

$$\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$\sin(\alpha+\beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$$