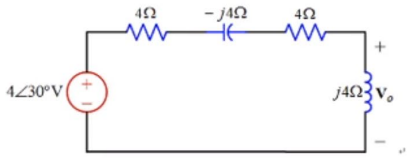
電路學（二）期中考解答

1.(a) $\mathbf{I}_{2\Omega} = \dfrac{4\angle 0^\circ}{2} = 2\angle 0^\circ \text{ A}$， $P_{2\Omega} = \dfrac{(2)^2}{2} \times 2 = 4\text{ W}$ (5%)

(b)(c) $P_{j2\Omega} = 0\text{ W}$， $P_{-j4\Omega} = 0\text{ W}$ (10%)

2. 將電路參考至二次側(也可以參考至一次側，但答案相同) (9%)



$$\mathbf{V}_o = 4\angle 30^\circ \times \frac{j4}{4 - j4 + 4 + j4} = -1 + j1.732 = 2\angle 120^\circ \text{V}$$ (6%)

3.(a) $\mathbf{Z}_Y = 3 + j2\Omega$, $\mathbf{V}_{AN} = 220\angle 0^\circ \times \dfrac{3 + j2}{4 + j3} = 158.6\angle -3.2^\circ \text{ Vrms}$, $\mathbf{V}_{AB} = 274.8\angle 26.8^\circ \text{ Vrms}$ (6%)

$$\mathbf{V}_o = 4\angle 30^\circ \times \frac{j4}{4 - j4 + 4 + j4} = -1 + j1.732 = 2\angle 120^\circ \text{V}$$ (6%)

3.(a) $\mathbf{Z}_Y = 3 + j2\Omega$, $\mathbf{V}_{AN} = 220\angle 0^\circ \times \dfrac{3 + j2}{4 + j3} = 158.6\angle -3.2^\circ \text{ Vrms}$, $\mathbf{V}_{AB} = 274.8\angle 26.8^\circ \text{ Vrms}$ (6%)

$\mathbf{V}_{BC} = 274.8\angle -93.2^\circ \text{Vrms}$， $\mathbf{V}_{CA} = 274.8\angle 146.8^\circ \text{ Vrms}$ (4%)

(b) $\mathbf{I}_{AB} = \mathbf{V}_{AB} \div (9 + j6) = 25.4\angle -6.9^\circ \text{ Arms}$， (6%)

$\mathbf{I}_{BC} = 25.4\angle -126.9^\circ \text{ Arms}$， $\mathbf{I}_{CA} = 25.4\angle 113.1^\circ \text{ Arms}$ (4%)

(c) $\mathbf{S} = 3\mathbf{V}_{AB}\mathbf{I}_{AB}^* = 3(274.8\angle 26.8^\circ)(25.4\angle 6.9^\circ) = 17421 + j11618\text{VA}$ (8%)

(d) $P_{old} = 1742\text{ W}$, $Q_{old} = 11618\text{var}$

$\theta_{new} = -\cos^{-1} 0.98 = -11.5^\circ$

$Q_{new} = P_{old} \tan\theta_{new} = -3537\text{var}$

$\Delta Q = Q_{new} - Q_{old} = -15155\text{var}$

$$Q_C = \frac{1}{3}\Delta Q = -5051.7\text{var} = -(274.8)^2 \times 377 \times C$$

$C = 1.77 \times 10^{-4} = 177\,\mu\text{F}$ (12%)

4.(a) $\mathbf{G}_V(0) = 0$, $\mathbf{G}_V(\infty) = 0 \Rightarrow$ band-pass filer (5%)

3.(a) $\mathbf{Z}_Y = 3 + j\,2\Omega$, $\mathbf{V}_{AN} = 220\angle 0° \times \frac{3}{4+j3} = 158.0\angle -53.2°$ Vrms, $\mathbf{V}_{AB} = 274.8\angle 26.8°$ Vrms (6%)

$\mathbf{V}_{BC} = 274.8\angle -93.2°$ Vrms, $\mathbf{V}_{CA} = 274.8\angle 146.8°$ Vrms (4%)

(b) $\mathbf{I}_{AB} = \mathbf{V}_{AB} \div (9 + j6) = 25.4\angle -6.9°$ Arms, (6%)

$\mathbf{I}_{BC} = 25.4\angle -126.9°$ Arms, $\mathbf{I}_{CA} = 25.4\angle 113.1°$ Arms (4%)

(c) $\mathbf{S} = 3\mathbf{V}_{AB}\mathbf{I}_{AB}^{*} = 3(274.8\angle 26.8°)(25.4\angle 6.9°) = 17421 + j11618$VA (8%)

(d) $P_{old} = 17421$W, $Q_{old} = 11618$var

$\theta_{new} = -\cos^{-1} 0.98 = -11.5°$

$Q_{new} = P_{old} \tan\theta_{new} = -3537$var

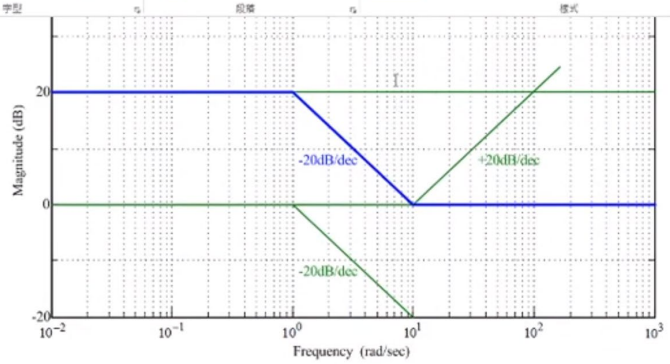
$\Delta Q = Q_{new} - Q_{old} = -15155$var

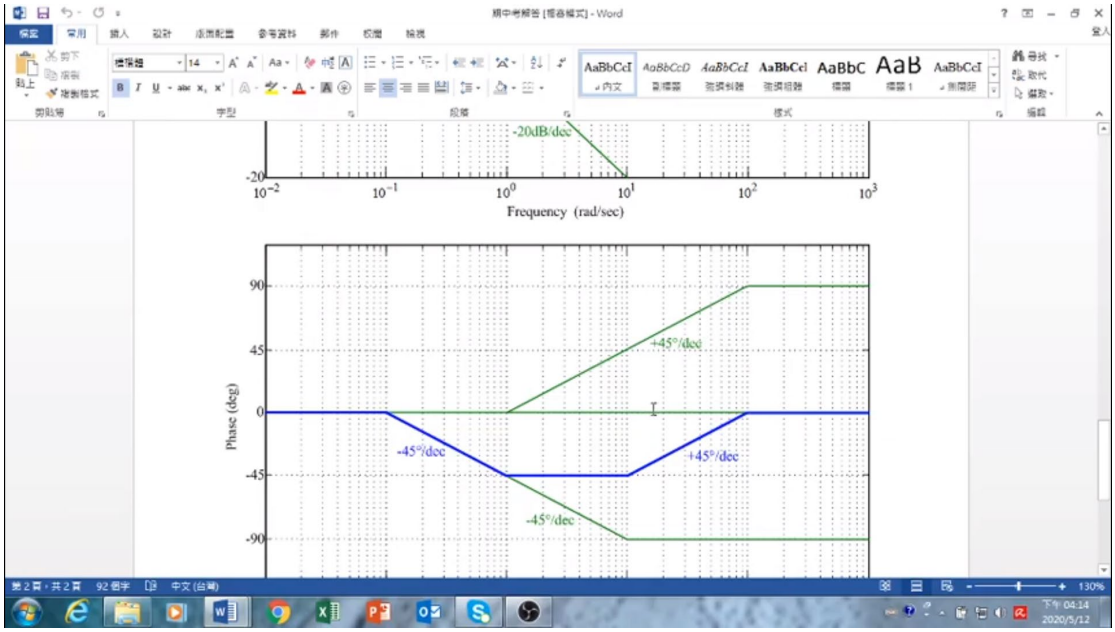
$Q_C = \frac{1}{3}\Delta Q = -5051.7\text{var} = -(274.8)^2 \times 377 \times C$

$C = 1.77 \times 10^{-4} = 177\,\mu$F (12%)

4.(a) $\mathbf{G}_v(0) = 0, \mathbf{G}_v(\infty) = 0 \Rightarrow$ band-pass filer (5%)

(b) $\mathbf{G}_v(0) = 0, \mathbf{G}_v(\infty) = 1 \Rightarrow$ high-pass filter (5%)




-20dB/dec
-20
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (rad/sec)
90
45
0
-45
-90
Phase (deg)
+45°/dec
-45°/dec
+45°/dec
-45°/dec