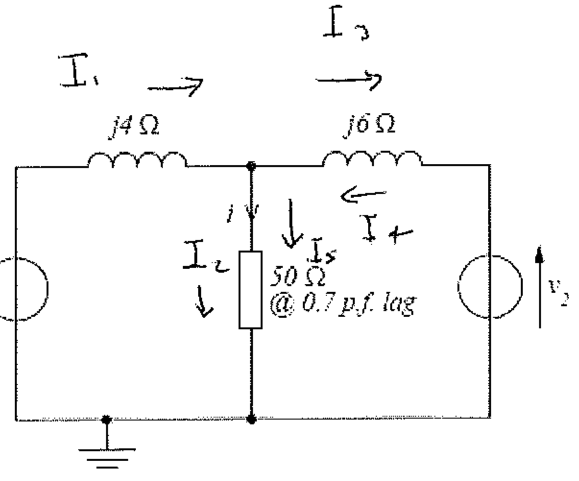
1. FIGURE 1 shows a 50 Ω load being fed from two voltage sources via their associated reactances. Determine the current i flowing in the load by:

(a) applying Thévenin's theorem

(b) applying the superposition theorem

(c) by transforming the two voltage sources and their associated reactances into current sources (and thus form a pair of Norton generators).

Superposition



$$v_1 = \sqrt{2} \times 415 \cos(100\pi t) \quad \text{volts}$$
$$v_2 = \sqrt{2} \times 415 \sin(100\pi t) \quad \text{volts}$$

FIG. 1

1b)

Removing V_2

~~Resistance~~ Z =

$$J4 + \frac{(35 + J35.71) \times J6}{35 + J35.71 + J6}$$

$$= \frac{J210 - 214.26}{35 + J41.71} + J4$$

$$(J210 - 214.26) \times (35 - J41.71) =$$

$$J350 + 8759.1 - 7499.1 + J8936.7846$$

$$= J9286.78 \text{ to 2.d.p} + 1260$$

$$(35 + J41.71) \times (35 - J41.71)$$

$$= 1225 + 1739.7241$$

So

$$\frac{J9286.78 + 1260}{2964.7241}$$

$$= J3.132 \text{ to 3.dp} + 0.4249 \text{ or } 0.425 \text{ to 3.dp}$$

2

Z total

$Z = J7.132 + 0.425$

$I_1 = \frac{V}{Z}$

$\frac{J415}{J7.132 + 0.425}$

$= \frac{J176.375 + 2959.78}{\cancel{0.180}\ 0.181 \text{ to 3.dp} + 50.865424}$

$= \frac{J176.375 + 2959.78}{51.046 \text{ to 3.dp}}$

$J3.455 + 59.14119011 = I_1$

$I_2 = \left(\frac{J6}{35 + J41.71}\right) I_1$

$J6(35 - J41.71) = J210 + 250.26$

$(35 + J41.71) \times (35 - J41.71)$

$= 1225 + 1739.7241$

$= 2964.7241$

$$\frac{J210 + 250.26}{2964.7241} = J0.71 \text{ to 2.dp} + 0.84 \text{ to 2.dp}$$

So

$$(J3.455 + 59.141 \text{ to 3.dp})(J0.71 + 0.84) = I_2$$

$$-2.45 \text{ to 2.dp} + J41.99 \text{ to 2.dp}$$

$$+ 49.67844 + J2.90 \text{ to 2.dp}$$

$$I_2 = 47.2284 + J44.89$$

Removing V_1

$$Z = \frac{J4(35 + J35.71)}{J4 + J35.71 + 35} + J6$$

So

$$\frac{J140 - 142.84}{J39.71 + 35} + J6$$

Removing (V_1)

V_2 415 + J0

parrallel = ①

$$\frac{J4(35 + J35.71)}{J4 + 35 + J35.7}$$

②

$$\frac{J140 - 142.84}{35 + J39.7}$$

③

$(J140 - 142.84) \times (35 - J39.7)$

$= J4900 - 4999.4 + 5558 + J5670.748$

So

$J10570.748 + 558.6$ Top

$(35 + J39.7) \times (35 - J39.7)$

$1225 + 1576.09 = 2801.09$ bottom

$$\frac{J10570.748 + 558.6}{2801.09}$$

Total resistance to V_2 =
$= J3.77$ to 2dp + 0.2 to 1dp + J6

$= J9.77 + 0.2$

5

$\underline{470}$

$0.2 + J9.77$

$= 470(0.2 - J9.77)$

$94 - J4591.9 = I4$

So $I_s = \frac{I4}{35 + J39.7} \times I_4$

$J4(35 - J39.7)$

$= J140 + 158.8$ Top

$1225 + 1576.09 = 2801.09$

So

$\frac{J140 + 158.8}{2801.09}$

$= J0.05$ to 2.dp $+ 0.0567$ to 4.dp

$(94 - J4591.9)(J0.05 + 0.0567) = I_5$

$J4.7 + 229.595 + 5.3298 - J260$

$I_s = J255.7$ to 1.dp $+ 234.923$ to 3.dp