**Homework 7**

**P17.2.3** *RL* in Figure P17.2.3 is restricted to the range 1 to 5 Ω. Determine the value of *RL* that results in maximum power transfer to it and calculate the value of this power.



**Solution:** On open circuit, and using superposition, *VTh* = 24 + 4 – 6×3 = 10 V. The resistance seen between the terminals, with the sources set to zero, is 6 Ω. Hence, *RL* for maximum power transfer is 5 Ω, and the power transferred is  W.



**P17.2.20** Determine  in

Figure P17.2.20 for maximum power transfer and calculate this power.

**Solution:** When the output is short circuited,



**Iφ** = 100/1 kΩ = 0.1 A. Hence, **Isc** = 0.1 A. When a test source **VT** is applied, with the independent source set to zero, **Iφ** = -4**VT**/1000 =



-**VT**/250 A. KCL gives: ,  S; NEC will be a shown. = 1/50 S, so that *RL*max = 50 Ω. The current in

*GL*max is  = 0.0527∠18.4°A. Power dissipated in *RL*max is (0.0527)2×50 = 0.139 W.



**P17.2.23** Determine  in Figure

P17.2.23 for maximum power transfer and calculate this power.

**Solution:** On open circuit, the circuit is a shown. Taking KVL around the outer loop, 10 – 5**I2** + 5**I2** – **VTh** = 0, which gives **VTh** = 10∠0° V.



On short circuit, the circuit is as shown. From KVL, 10 – 5(**ISC** + **I2**) – 5(**ISC** + **I2**) = 0. This gives **ISC** = 1∠0° A, so that *Rmax* = *RTh* = 10 Ω. The power transferred is =  W.



**P17.2.32** (a) Determine *ZL* in Figure P17.2.32 that



results in maximum power absorption in

**** and calculate this power. (b) If **** consists of a resistor in parallel

with a capacitor, determine the values of these elements will result

in maximum power absorption in

****, and calculate this power.

**Solution:** (a) The primary circuit is reflected to the secondary side by multiplying the voltage by 1.5 and the impedances by (1.5)2 = 2.25. **VTh** = = 12 – *j*6 = V. *ZTh* = = Ω. *ZLm* = 3.6 + *j*1.8 Ω; maximum power dissipated in *ZL* is  W.



(b) A parallel *RC* circuit for *ZL* introduces a negative reactance *XL* having the same sign as the reactance *XTh* of *ZTh*. Hence, for maximum power transfer, *XL* must be as small as possible, which in this case would be zero. This leaves *RL* = |*ZTh*| = Ω; |**ILm**|2 =  A, and power delivered is |**ILm**|2 = 11.8 W.

**P18.1.3** The voltage drop across a device is  V and the current through it, in the direction of voltage drop, is Determine the instantaneous power and energy delivered to the device.

**Solution:** *p* = *vi* == W; 

J.

**P18.1.4** Evaluate the following integrals involving impulse functions:

(a) ;

(b) .

(c) 

**Solution:** (a) 

.

(b)  

.

(c) Substituting *ω* = 0 makes the integrand zero. The integral is therefore 0.



**P18.2.5** Determine *iC* a*t* = 0+ in Figure P18.2.5, given *iSRC* = 10*δ*(*t*) A and assuming that the capacitor is initially uncharged.

**Solution:** For the capacitor *iC* = *CdvC*/*dt*. Multiplying both sides by 4 gives: 4*iC* = 4*CdvC*/*dt*, so that the dependent source is equivalent to a capacitance of 4 F; *Ceqp* = 5 F. The impulse deposits a charge of 10 C on *Ceqp*, resulting in a voltage of 2 V. The total current delivered by *Ceqp* is 2×5 = 10 A, one fifth of which is due to the given capacitor. It follows that *iC*(0+) = -2 A.

**P18.2.7** Determine *vO*(*t*) in Figure P18.2.7 assuming the capacitor to be initially charged to 1 V.



**Solution:** Assuming the capacitor to be initially uncharged, the initial value of *vC* and hence *vO* is zero. The final value of *vO* is, from voltage division, 15×3/9 = 5 V. The time constant is

2×10-3×(3||6 kΩ) = 4 s. Hence, **. With the initially charged capacitor acting alone, *vO* is initially 0.5 V, and the final value is zero. Hence, **. It follows that **V, *t* is in s.