**Homework 6**



**P16.2.6** The periodic voltages *vSRC*1 and *vSRC*2 are applied to the circuit shown in Figure P16.2.6. Determine the voltage across the capacitor.



**Solution:** When Two lines of opposite slopes as shown are added, the sum is a constant: *kt* + (*k* – *kt)* = *k*. It follows that *vSRC*1 and *vSRC*2 = 1, which is a dc voltage. The capacitor behaves as an open circuit for dc voltages, so that the voltage across the capacitor is 1 V.

**P16.2.8** The triangular pulse train of Figure 16.3.4 is applied as the input  to the circuit of Figure P16.2.8. Determine  Show that if   and  becomes the square pulse train of Figure 16.2.10a with an appropriate amplitude.



**Solution:** From Equation 16.4.20, *vI* = . In terms of phasors: , where *ω* = *nω*0. Any given term in this expansion is many be denoted as: *vI* = *A*cos*ωt*, where *A* = . Then:  =  , where tan*α* =*ωCR*. It follows that:

  If *ωCR* << 1, then *α* → 0, and *vO* = .

*dvI*/*dt* is a square wave of amplitude 2*Am*/(*T*/2) = 4*Am*/*T* = 2*Amω*0/*π.* From Equation 16.2.39, the FSE of a square wave of amplitude 4*Am*/*T* is:

. It is seen *vO* is the derivative of the input multiplied by CR. The interpretation is that is If *ωCR* << 1, then  and vO(*t*) = *Ri* = *CR*.

**P16.3.22** The periodic voltage shown is applied across a



10 Ω resistor, Determine the average power dissipated in the resistor.

**Solution:** The area under the square of the half cycle is: 100×2 + 64×1 = 264. The mean square is 264/3 = 88 V2. The power dissipated in the 10 Ω resistor is V2/10 = 88/10 = 8.8 W.



**P16.3.24** *f*2(*t*) in Figure P16.3.24 is the same function *f*1(*t*) lowered by 1 unit. Which function has the larger rms value?

**Solution:** = + 

= + 

where =  and

< . It follows that

> .



**P16.3.27** The half-wave rectified waveform of Figure

16.4.1a, with *A* = 10 V and *f* = 50 Hz is applied to the circuit of Figure P16.3.27. Determine the average power dissipated in the circuit.

**Solution:** The half-wave rectified waveform has a dc value of

10/*π* and an ac component of rms value 3.8559 V. The ac component appears across the 10 Ω resistor, and the dc component appears across a 30 Ω resistor. It follows that the average power dissipated is 1.487 + 0.338 = 1.83 W.

**P17.1.7** The capacitor in the circuit of Figure P17.1.7 absorbs -200 VAR. Determine the power dissipated in the 5 Ω resistor.



**Solution:** ; ; `; 400 V2; power dissipated in the 5 Ω resistor is 400/5 = 80 W.



**P17.1.15** A load that absorbs 15 kVA at 0.6 p.f. lagging is connected in parallel with a load that absorbs 4.8 kW at 0.8 p.f. leading, across a source of voltage 200∠0° V rms and 50 Hz frequency. Determine the capacitance that should be connected in parallel with the loads so as to have a maximum magnitude of current supplied by the source.

**Solution:** The reactive power absorbed by the first load is 15×0.8 = 12 kVAR, and the reactive power absorbed by the second load is -4.8×0.6/0.8 = -3.6 kVAR. For maximum magnitude of source current, the p.f. should be unity. The capacitor must add a reactive power -(12 – 3.6) = -8400 VAR. Hence, -8400 =

-100*πC*(200)2; *C* = = 0.6684 mF.

**Simulation:** The reactive power absorbed by the first load is 15×0.8 = 12 kVAR, and the real power is 15×0.6 = 9 kW. The load can be represented by a resistance *R* =  == 40/9 = 4.4444 Ω in parallel with an inductance ≡  mH. The second load can be represented by a resistance *R* = = 25/3 = 8.3333 in parallel with a capacitance ≡ 0.2865 mF.

**P17.1.21** Determine the complex power delivered



by the independent current source in Figure P17.1.21 and verify that it equals the complex power absorbed in the rest of the circuit.

**Solution:** The dependent source is transformed to a voltage source, as shown. **I** = . The



impedance in parallel with the inductor is Ω. In parallel with *j* Ω, the effective parallel impedance is: = Ω. The magnitude of the current is 5 A. The real power delivered by the source is 25(-3/10) = -7.5 W, and the reactive power delivered is 25(4/10) =10 VAR. The complex power delivered by the source is therefore -7.5 + *j*10 VA.



**Vx** = ; |**Vx**| = = 2.5 V, and reactive power absorbed by the inductor = = (2.5)2 = 6.25 VAR.



**I** = == ; |**I**| = , and the reactive power absorbed by the capacitor = = = -11.25 VAR.



The voltage **Vy** across the parallel combination of the dependent source and the 2 Ω resistor is **Vx** – (-*j***I)** = **Vx** + *j***I** = ; |**Vy**| = |**Vx**| = V; the real power absorbed by the resistor is 25/2 = 12.5 W.



The complex power delivered by dependent current source = **VY**(2**Vx**)**\*** = 2**VY**(**Vx**)**\*** = VA. The independent source absorbs (7.5 – *j*10) VA. The complex power absorbed by the passive elements is 12.5 W + (6.25 – 11.25) VAR = 12.5 – *j*5 VA. Adding this to the power absorbed by dependent source is 20 – *j*15 VA, as that delivered by the dependent source.