EEEN 202 Electrical and Electronic Circuits II
Homework 03

Due: 10-May-2019
Friday 17:00

Problem 1)

Consider the filter shown in Figure P1.

a) Show that the circuit behaves as a band-pass filter. (Hint: Find the transfer for this circuit and show that it has the same form as the transfer function for a band-pass filter.)
b) Find the center frequency, bandwidth and gain for this band-pass filter.
c) Find the cutoff frequencies and the quality factor for this band-pass filter.

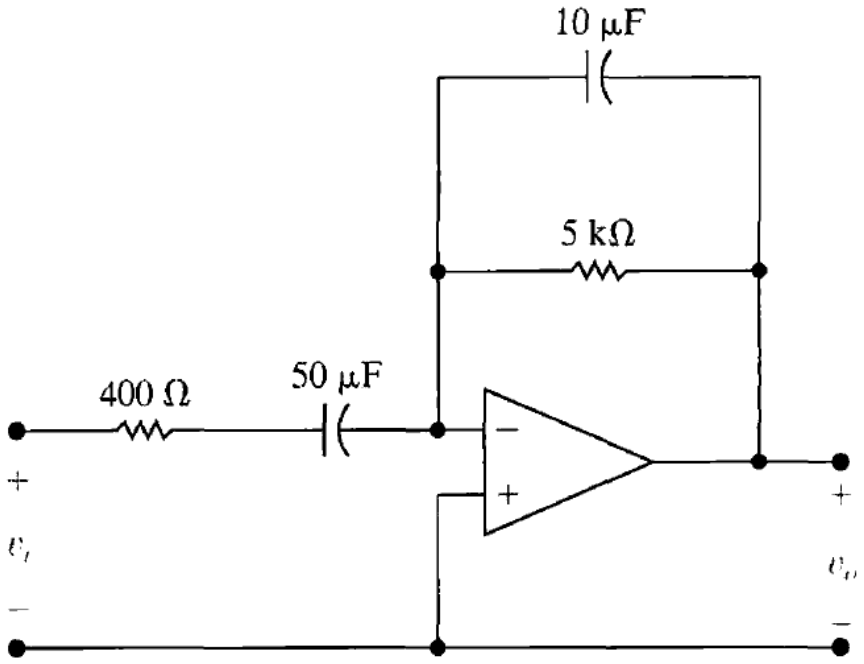


Figure P1

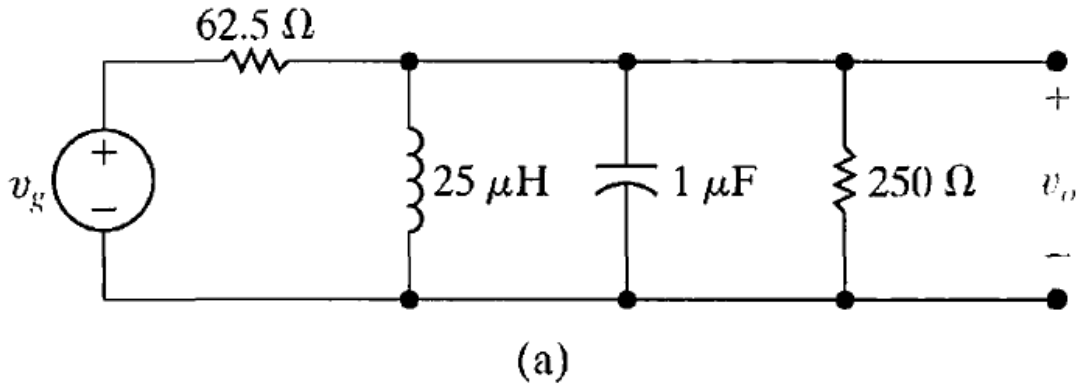
Problem 2)

a) Using 1 kΩ resistors and ideal op amps, design a low-pass unity-gain Butterworth filter that has a cutoff frequency of 8 kHz and is down at least 48 dB at 32 kHz.
b) Draw a circuit diagram of the filter and label all the components.

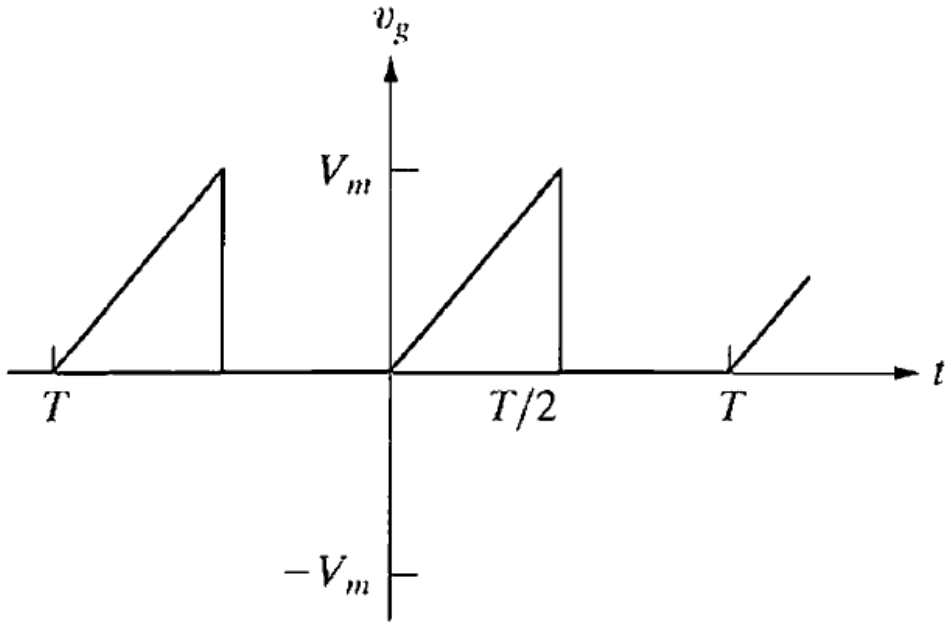
Problem 3)

The periodic voltage source in the circuit shown in Figure P3 (a) has the waveform shown in Figure P3 (b).

- **a)** Derive the expression for C_n.
- **b)** Find the values of the complex coefficients C_0, C_{-1}, C_1, C_{-2}, C_2, C_{-3}, C_3, C_{-4}, and C_4 for the input voltage v_g, if V_m = 54 V and $T = 10\pi$ μs.
- **c)** Repeat **b)** for v_o.
- **d)** Use the complex coefficients found in **c)** to estimate the average power delivered to the 250 kΩ resistor.



(a)

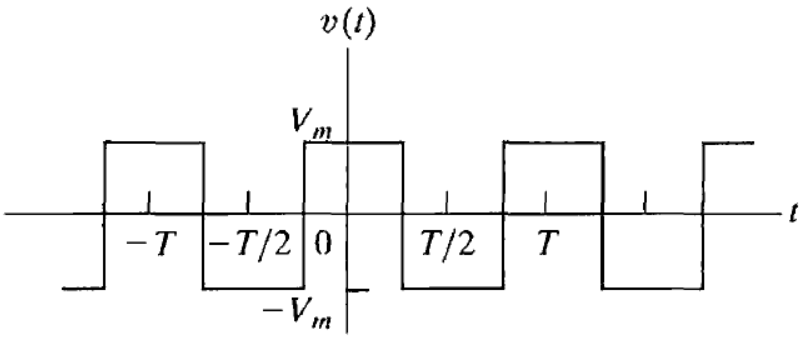


(b)

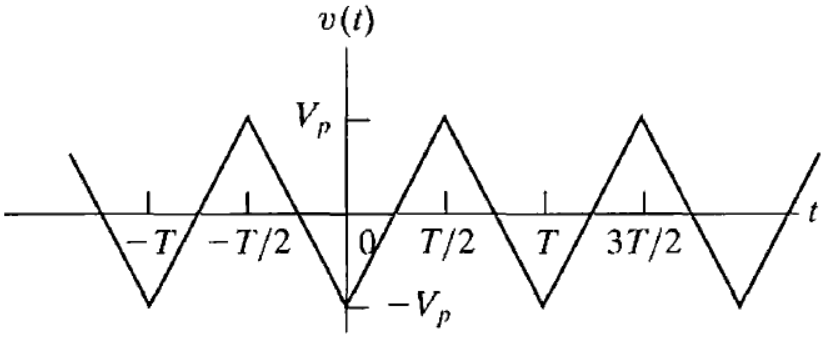
Figure P3

Problem 4)

Find the Fourier series of the periodic functions shown in Figure P4 (a) and (b).



(a)



(b)

Figure P4

Problem 5)

The voltage and current at the terminals of a network are

$$v = 15 + 400 \cos 500t + 100 \sin 1500t \text{ V},$$

$$i = 2 + 5 \sin (500t + 60°) + 3 \cos (1500t - 15°) \text{ A}.$$

The current is in the direction of the voltage drop across the terminals.

a) What is the average power at the terminals?
b) What is the rms value of the voltage?
c) What is the rms value of the current?