Answer

• 17.10

The instrument for displaying the spectrum of a signal is known as:

○ (a) oscilloscope

○ (b) spectrogram

○ (c) spectrum analyzer

○ (d) Fourier spectrometer

Answer

Problems
Section 17.2 Trigonometric Fourier Series

• 17.1

Evaluate each of the following functions and see if it is periodic. If periodic, find its period.

○ (a)

\[ f(t) = \cos \pi t + 2 \cos 3\pi t + 3 \cos 5\pi t \]

○ (b)

\[ y(t) = \sin t + 4 \cos 2\pi t \]

○ (c)

\[ g(t) = \sin 3t \cos 4t \]

○ (d)

\[ h(t) = \cos^2 t \]

○ (e)

\[ z(t) = 4.2 \sin(0.4\pi t + 10^\circ) + 0.8 \sin(0.6\pi t + 50^\circ) \]
- (f) 
  \[ p(t) = 10 \]
- (g) 
  \[ q(t) = e^{-\pi t} \]

Answer

- 17.2

Using MATLAB, synthesize the periodic waveform for which the Fourier trigonometric Fourier series is

\[ f(t) = \frac{1}{2} - \frac{4}{\pi^2} \left( \cos t + \frac{1}{9} \cos 3t + \frac{1}{25} \cos 5t + \cdots \right) \]

- 17.3

Give the Fourier coefficients \( a_0, a_n, \) and \( b_n \) of the waveform in Fig. 17.47. Plot the amplitude and phase spectra.

Figure 17.47
For Prob. 17.3.

Answer

- 17.4

Find the Fourier series expansion of the backward sawtooth waveform of Fig. 17.48. Obtain the amplitude and phase spectra.

Figure 17.48
For Probs. 17.4 and 17.66.
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For Prob. 17.8.

- 17.9

Determine the Fourier coefficients \(a_n\) and \(b_n\) of the first three harmonic terms of the rectified cosine wave in Fig. 17.52.

![Figure 17.52](image1)

For Prob. 17.9.

- Answer

- 17.10

Find the exponential Fourier series for the waveform in Fig. 17.53.

![Figure 17.53](image2)

For Prob. 17.10.

- 17.11

Obtain the exponential Fourier series for the signal in Fig. 17.54.

![Figure 17.54](image3)

For Prob. 17.11.

- Answer

- *17.12

A voltage source has a periodic waveform defined over its period as

\[ v(t) = 120t(2\pi - t) \text{ V}, \quad 0 < t < 2\pi \]

Find the Fourier series for this voltage.

- 17.13
Design a problem to help other students better understand obtaining the Fourier series from a periodic function.

- Answer

- 17.14
  
  Find the quadrature (cosine and sine) form of the Fourier series
  
  \[ f(t) = 7.5 + \sum_{n=1}^{\infty} \frac{37.5}{n^3 + 1} \cos \left(2nt + \frac{n\pi}{4}\right) \]

- 17.15
  
  Express the Fourier series
  
  \[ f(t) = 10 + \sum_{n=1}^{\infty} \frac{4}{n^2 + 1} \cos 10nt + \frac{1}{n^3} \sin 10nt \]
  
  - (a) in a cosine and angle form,
  
  - (b) in a sine and angle form.

- Answer

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- 17.16
  
  The waveform in Fig. 17.55(a) has the following Fourier series:
  
  \[ v_1(t) = \frac{1}{2} - \frac{4}{\pi^2} \left( \cos \pi t + \frac{1}{9} \cos 3\pi t \right. \]
  
  \[ \left. + \frac{1}{25} \cos 5\pi t + \cdots \right) \text{ V} \]

  Obtain the Fourier series of \( v_2(t) \) in Fig. 17.55(b).