

EEE 391 Homework

① Using Euler's formula $re^{j\theta} = r\cos\theta + jr\sin\theta$, derive the following relationships:

a) $\cos^2\theta = \frac{1}{2}(1 + \cos 2\theta)$

b) $\sin\theta \cdot \sin\phi = \frac{1}{2}\cos(\theta - \phi) - \frac{1}{2}\cos(\theta + \phi)$

c) $\sin(\theta + \phi) = \sin\theta \cos\phi + \cos\theta \sin\phi$

② Determine whether or not each of the following continuous-time signals is periodic. If the signal is periodic, determine its fundamental period.

a) $x(t) = \cos^2(2t - \frac{\pi}{3})$

b) $x(t) = -2 + 4\cos(5t + 1) - 2\sin(12t + \frac{\pi}{3})$

c) $x(t) = 1 - 3\sin(6\sqrt{3}t - \frac{\pi}{4}) + \cos(18t + 7)$

d) $x(t) = 40\sin(5\pi t + \frac{\pi}{6}) - 12\cos(2t - 10)$

③ A continuous-time periodic signal $x(t)$ is real valued and has a fundamental period $T=8$. The nonzero Fourier series coefficients for $x(t)$ are specified as

$$a_1 = a_{-1}^* = j \quad a_5 = a_{-5} = 2 \quad a_7 = a_{-7}^* = 3 - 4j$$

Express $x(t)$ in the form $x(t) = \sum_{k=0}^{\infty} A_k \cos(\omega_k t + \phi_k)$

④ Find the Fourier series coefficients of the following signal. Identify the fundamental frequency and the harmonics that exist in the spectrum.

$$x(t) = -2 + 5\sin^2(2t - \frac{\pi}{3}) + 16\cos(14t + 1) - 4\sin(8t + \frac{\pi}{7})$$

Hint: You do not need to take any difficult integrals to solve this question.

⑤ Determine the Fourier series representations of the following signals:

