

MAT 321

Quiz 5

Spring 2026

1. Let $f(t)$ be a periodic function in SPW2 with Fourier series coefficients c_k , and let $g(t) = f(t - a)$. Assume f has period T and fundamental frequency $\omega_0 = 2\pi/T$. Using the “shift \leftrightarrow multiply by complex exponential” time-frequency correspondence, find an expression for the Fourier series coefficients for g .

a) $e^{-ik\omega_0 a} c_k$ b) $e^{ik\omega_0 a} c_k$ c) $e^{iaT} c_k$ d) e^{iac_k} e) e^{-iac_k}

Correct Answer: $e^{-ik\omega_0 a} c_k$

2. Let \mathbf{x} be a time domain signal in SPW3, with frequency content $X(\omega)$. Using the “shift \leftrightarrow multiply by complex exponential” time-frequency correspondence, find an expression for the values y_t of a time domain signal \mathbf{y} that has frequency content $X(\omega - \alpha)$.

a) $e^{i\alpha t} x_t$ b) $e^{i\omega t} x_t$ c) $e^{i(\omega - \alpha)t} x_t$ d) $e^{i\alpha x_t}$ e) e^{ix_t}

Correct Answer: $e^{i\alpha t} x_t$

3. Fill in the blanks in this sentence: The Z -transform of a filter’s “_____” is the same as the filter’s _____.

a) transfer function, impulse response b) transfer function, frequency response c) impulse response, transfer function d) frequency response, transfer function e) frequency response, impulse response

Correct Answer: impulse response, transfer function

4. Suppose that a continuous domain function f is real-valued and even. Which of the following expressions are equivalent to the Fourier Transform of f ?

i) $\mathcal{F}f^-$ ii) $\mathcal{F}^{-1}f$ iii) $(\mathcal{F}f)^-$

a) all of them b) none of them c) ii) and iii) only d) i) and ii) only e) i) and iii) only

Correct Answer: all of them

5. Suppose f is a finite domain signal with values in \mathbb{C}^N . Which of the following expressions are equivalent to the Fourier Transform (DFT) of f^- , or $\mathcal{F}f^-$?

i) $N\mathcal{F}^{-1}f$ ii) $\frac{1}{N}\mathcal{F}f$ iii) $(\mathcal{F}f)^-$

a) all of them b) none of them c) ii) and iii) only d) i) and ii) only e) i) and iii) only

Correct Answer: i) and iii) only

6. Suppose f is a finite domain signal with values in \mathbb{C}^N . Which of the following expressions are equivalent to $\mathcal{F}^4 f = \mathcal{F}\mathcal{F}\mathcal{F}\mathcal{F}f$?

i) $N^2 f$ ii) $-\frac{1}{N^2} \mathcal{F}^{-1} f$ iii) $\mathcal{F}(N^2 \mathcal{F}^{-1} f)$

a) all of them b) none of them c) ii) and iii) only d) i) and ii) only e) i) and iii) only

Correct Answer: i) and iii) only

7. Suppose $f(t)$ is a time domain signal in SPW2 with period 2π and with Fourier coefficients c_k with $c_{-1} = -\frac{1}{2}$, $c_1 = \frac{1}{2}$, and all other $c_k = 0$. Find f :

a) $\sin(t)$ b) $i \sin(t)$ c) $\cos(t)$ d) $i \cos(t)$ e) $\sin(t) + \cos(t)$

Correct Answer: $i \sin(t)$

8. Same f and c_k as in the previous problem. What property of f can be deduced from the Fourier coefficients c_k . (As usual: r. means real, i. means imaginary, v. means valued, e. means even, o. means odd.)

a) r.v.e. b) r.v.o. c) i.v.o. d) i.v.e. e) none of these

Correct Answer: i.v.o.