

LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE310 Signals and Systems
Quiz 4

Name: _____

Campus ID: _____

Total Marks: 10

Time Duration: 15 minutes

Question 1 (4 marks)

Consider two continuous-time periodic signals, $x(t)$ and $y(t)$, that share the same fundamental period T . Let their respective Fourier series representations be: $x(t) \xleftrightarrow{FS} a_k$ and $y(t) \xleftrightarrow{FS} b_k$. The multiplication property states that the Fourier series coefficients c_k of the product signal $z(t) = x(t)y(t)$ are given by the discrete convolution of a_k and b_k :

$$c_k = \sum_{m=-\infty}^{\infty} a_m b_{k-m}$$

Prove the multiplication property stated above. **Hint:** To start your proof, express both $x(t)$ and $y(t)$ using the Fourier series synthesis equation:

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t}$$

Make sure to use different dummy summation indices (for example, use m for $x(t)$ and n for $y(t)$) before multiplying the two series together.

Question 2 (6 marks)

Consider the following continuous-time signals with fundamental period $T = 6$:

$$x(t) = e^{j\frac{2\pi}{6}t}, \quad y(t) = \cos\left(\frac{4\pi}{6}t\right)$$

- (a) [3 marks] Determine the Fourier series coefficients of $x(t)$ and $y(t)$.
- (b) [1 mark] Sketch the Fourier series coefficients of $x(t)$ and $y(t)$.
- (c) [2 marks] Using the multiplication property (Question 1) or otherwise, find the Fourier series coefficients of $z(t) = x(t) \cdot y(t)$.