

**LAHORE UNIVERSITY OF MANAGEMENT SCIENCES**  
**Department of Electrical Engineering**

**EE310 Signals and Systems**  
**Quiz 5**

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**Name:** \_\_\_\_\_

**Campus ID:** \_\_\_\_\_

**Total Marks:** 10

**Time Duration:** 20 minutes

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**Question 1** (2 marks)

The **duality property** of the CTFT states: if

$$x(t) \xleftrightarrow{\mathcal{F}} X(j\omega),$$

then

$$X(jt) \xleftrightarrow{\mathcal{F}} 2\pi x(-\omega).$$

Prove the duality property.

**Question 2** (8 marks)

Consider the signal  $x(t) = e^{-a|t|}$  for constant  $a > 0$ .

(a) [3 marks] Compute the CTFT  $X(j\omega)$  directly from the analysis equation

$$X(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt.$$

(b) [3 marks] Using the result of part (a) and the duality property proved in Question 1, determine the CTFT of

$$g(t) = \frac{1}{a^2 + t^2}.$$

(c) [2 marks] Using **Parseval's theorem** applied to  $g(t)$ , evaluate the integral

$$I = \int_{-\infty}^{\infty} \frac{1}{(a^2 + t^2)^2} dt.$$

Express your answer in terms of  $a$ .