Dokuz Eylül University

Department of Electrical and Electronics Engineering

EE 5150–Transform Theory and Its Applications

Final Exam, Fall 2009

January 18th, 2010; 10:00 AM-17:00 PM

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Student No:
Student Name:

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10

TOTAL:	

Q1) Consider a discrete time system described by the linear shift invariant difference equation of second order given below.

$$y(n) = 0.3y(n-1) - 0.02y(n-2) + x(n) - 0.1x(n-1)$$

where $x(n) = (-0.2)^2 u(n)$, $y(-1) = 1.0$ and $y(-2) = 0.6$. Find the output response of the system in time domain.

Q2) The correlation matrix of a vector is given by

$$R_x = \begin{bmatrix} 0.3 & 0.1 & 0.1 \\ 0.1 & 0.3 & -0.1 \\ 0.1 & -0.1 & 0.3 \end{bmatrix}$$

Calculate the Karhunen-Loewe transform of the input vector.

Q3) Find the Hilbert transform of $g(t)=1/t$.

Q4) If $\emptyset_1(t)$ and $\emptyset_2(t)$ satisfy dilation equation,

(a) Does their product $P(t) = \emptyset_1(t)\emptyset_2(t)$ satisfy a dilation equation? Justify your answer.

(b) Does their convolution $P(t) = \emptyset_1(t) * \emptyset_2(t)$ satisfy a dilation equation? Justify your answer.

Q5) Consider $\mathrm{h(n)} = \left(\frac{2}{5\sqrt{2}}, \frac{6}{5\sqrt{2}}, \frac{3}{5\sqrt{2}}, \frac{-1}{5\sqrt{2}}\right)$. Find the corresponding wavelet filter for an orthogonal wavelet system.

Q6) The discrete cosine transform of type III is given by

$$\mathrm{DCT}_{\mathrm{N}}^{\mathrm{III}} = \frac{\sqrt{2}}{\mathrm{N}} \sum_{\mathrm{k}} \mathrm{a}_{\mathrm{k}} \cos\left[\frac{(2\mathrm{n}+1)\mathrm{k}\pi}{2\mathrm{N}}\right]; \quad \mathrm{k}, \mathrm{n} = 0, 1, \cdots, \mathrm{N}$$

Find the DCT matrix for N=6, and skecth it.

Q7) Find the Laplace transform of

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} - 3x = e^t$$

where x(0)=1 and $\frac{dx(0)}{dt} = -1$.

Q8) Find the inverse Laplace transform of $\frac{s}{(s^2+\omega^2)^2}$ using convolution property of the Laplace transform.

Q9) Compute the inverse Fourier transform of

$$F(\omega) = (1 + \omega^2)^{-1}$$

Q10) Compute the N-point DFTs of the following signal.

$$x(n) = \cos\left(\frac{2\pi}{N} k_0 n\right), \qquad 0 \leq n \leq N-1$$

ALL QUESTIONS ARE THE SAME POINTS. GOOD LUCK!