

Öğrenci adı-soyadı:  
Öğrenci no :

**Dokuz Eylül Üniversitesi**  
**Elektrik-Elektronik Mühendisliği**  
**Bölümü**  
**EE 5150–Dönüşüm Kuramı ve**  
**Uygulamaları**  
**Ödev3, Güz 2009**  
**2 Ekim 2009, 9:30-12:15**  
**Öğretim Üyesi: Dr. Gülden Köktürk**

**Dokuz Eylül University**  
**Department of Electrical and**  
**Electronics Engineering**  
**EE 5150–Transform Theory and Its**  
**Applications**  
**Homework3, Fall 2009**  
**October 2th, 2009, 9:30-12:15 AM**  
**Instructor: Dr. Gülden Köktürk**

**S1)** Aşağıdaki özelliği kanıtlayın.

$$X_c(\omega + \beta) = F_c[x(t)\cos(\beta t)] - F_s[x(t)\sin(\beta t)]$$

**S2)** Aşağıdaki özelliği kanıtlayın.

$$\int_{-\infty}^{\infty} X_c(\beta) d\beta = \left[-\frac{1}{t}x(t)\right]$$

**S3)** Aşağıdaki ifadeyi doğrulayın.

$$F_s = F_s^{-1}$$

**S4)** Aşağıdaki ifadeyi doğrulayın.

$$F_s[x(at)] = a^{-1}X_s\left(\frac{\omega}{a}\right), \quad \text{for real } a > 0$$

**S5)** AFD-II için

$$(u_k)_l = \cos\left[\left(1 + \frac{1}{2}\right)k\pi/N\right]$$

ifadesinin

$$(C_N^{II})_{lk} = \sqrt{\frac{2}{k}}\sigma_k \cos\left[\frac{\left(1 + \frac{1}{2}\right)k\pi}{N}\right],$$

$$k, l = 0, 1, \dots, N-1$$

ifadesindeki k'inci öz değerin l'inci elemanı olduğunu gösterin. Burada  $\lambda_k = 2 - 2\cos\left[\frac{k\pi}{N}\right]$  ilintili özdeğerdir.

**S6)** Aşağıda verilen ifadeleri kullanarak sırasıyla  $A_3$  ve  $A_4$ 'nin öz değerlerini bulun.

$$(C_N^{III})_{lk} = \sqrt{\frac{2}{N}}\sigma_1 \cos\left[l\left(k + \frac{1}{2}\right)\frac{\pi}{N}\right]$$

$$(C_N^{IV})_{lk} = \sqrt{\frac{2}{N}}\cos\left[\left(1 + \frac{1}{2}\right)\left(k + \frac{1}{2}\right)\frac{\pi}{N}\right],$$
$$k, l = 0, 1, \dots, N-1$$

**Q1)** Derive the property:

$$X_c(\omega + \beta) = F_c[x(t)\cos(\beta t)] - F_s[x(t)\sin(\beta t)]$$

**Q2)** Derive the property:

$$\int_{-\infty}^{\infty} X_c(\beta) d\beta = \left[-\frac{1}{t}x(t)\right]$$

**Q3)** Verify that

$$F_s = F_s^{-1}$$

is true.

**Q4)** Verify that

$$F_s[x(at)] = a^{-1}X_s\left(\frac{\omega}{a}\right), \quad \text{for real } a > 0$$

is true.

**Q5)** For DCT-II, show that

$$(u_k)_l = \cos\left[\left(1 + \frac{1}{2}\right)k\pi/N\right]$$

is the l-th element of the k-th eigenvector in

$$(C_N^{II})_{lk} = \sqrt{\frac{2}{k}}\sigma_k \cos\left[\frac{\left(1 + \frac{1}{2}\right)k\pi}{N}\right],$$

$$k, l = 0, 1, \dots, N-1$$

with  $\lambda_k = 2 - 2\cos\left[\frac{k\pi}{N}\right]$  as the corresponding eigenvalue.

**Q6)** Based on the information given in

$$(C_N^{III})_{lk} = \sqrt{\frac{2}{N}}\sigma_1 \cos\left[l\left(k + \frac{1}{2}\right)\frac{\pi}{N}\right]$$

and

$$(C_N^{IV})_{lk} = \sqrt{\frac{2}{N}}\cos\left[\left(1 + \frac{1}{2}\right)\left(k + \frac{1}{2}\right)\frac{\pi}{N}\right],$$
$$k, l = 0, 1, \dots, N-1$$

Determine the eigenvalues of the  $A_3$  and  $A_4$ , respectively.