Total No. of Questions : 12]

SEAT No. :

P835

[Total No. of Pages : 3

[4659]-94
B.E. (E & TC)
b - JOINT TIME FREQUENCY ANALYSIS
(2008 Pattern) (Elective - II) (Semester - I)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer 3 questions from Section I and 3 questions from Section II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Verify Parsevals theorem for the given signal

$x(t) = e^{-15t} \cdot u(t)$. **[8]**

b) Find the time bandwidth product of $f(t) = e^{-|t|}$. **[10]**

OR

Q2) a) Explain with example that signal cannot be timelimited and bandlimited Simoltaneously. **[6]**

b) Discuss the concept of Hilbert Spaces. **[6]**

c) If $f_1(n) = \{1, 2, -1, 1\}$ **[6]**
$\uparrow$

$f_2(n) = \{2, 1, 3, 1\}$
$\uparrow$

Find

i) $\langle f_1(n), f_2(n) \rangle$

ii) $\langle f_1(n), f_1(n) \rangle$

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Q3) a) Explain with tiling diagram difference between Fourier, STFT & wavelet transform. **[8]**

b) Explain the importance of Analytic signal. Also find instantaneous frequency of $x(t) = \cos 100t . \cos 50t$. **[8]**

OR

Q4) Given

$x[n] = \{2, 1, 3, 2, 1, 5, 2, 4\} \in V_3$.

Develop complete wavelet Packet tree till V_0 and calculate the coefficients along with the corresponding bases. Prove perfect reconstruction. **[16]**

Q5) a) Discuss the MRA axioms. **[8]**

b) Explain Wavelet delation equation in time and frequency domain. **[8]**

OR

Q6) Find out the projection of signal $x(t)$ shown in figure 1 on subspace V_0 & V_1. Prove that $V_1 = V_0 \oplus W_0$. Sketch the projection on V_0, V_1 & W_0 subspace. **[16]**

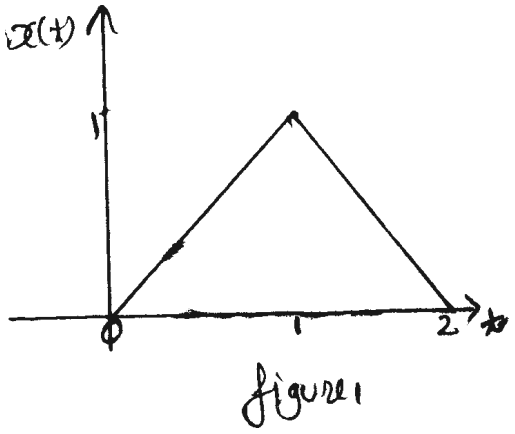

figure 1

SECTION - II

Q7) a) Discuss the properties of wavelet function. **[6]**

b) Show that convolution of two Harr Scaling functions produces a hat function (triangular function). Show that the scaling functioning $\phi(t) \in V_0$ follow the relation $\hat{\phi}(w) = H(w/2)\hat{\phi}(w/2)$. **[10]**

OR

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Q8) a) If $\phi(t)$ is a Harr scaling function and

$x(t) = 4\phi(2t) + 3\phi(2t-1) + 6\phi(2t-2)$

$+ 5\phi(2t-3) + 4\phi(2t-4) + 6\phi(2t-5)$

$+7\phi(2t-6) + 4\phi(2t-7)$.

Project $x(t)$ down the ladder and show that

$V_j = V_{j-1} \oplus W_{j-1}$

Sketch the projections on the corresponding V & W subspaces. **[16]**

Q9) Given $x[n] = \{6, 3, 2, 1\} \in V_2$. Develop wavelet lifting scheme. Decompose $x[n]$ upto V_0 subspace. Clearly show 'split'. 'Update' and 'predict'stages. show perfect reconstruction. **[16]**

OR

Q10) Given $x[n] \in V_3$. Derive and sketch wavelet packet tree till O^{th} subspace. **[16]**

Q11) Write notes on (any two): **[18]**

a) Image Compression using JPEG.

b) Speech Compression.

c) Nested Subspaces.

OR

Q12) Given $x[n] = \{16, 5, 20, 8, 36, 5, 13, 0\} \in V_3$ perform MRA using Harr filters. Clearly find out projections in V2, W2, V1, W1, V0 & W0. Reconstruct after suppressing (making zero) coefficients in Wj subspaces, and show denoising (smoothening) effect on reconstructed signal $x_d[n]$ when compared with $x[n]$. **[18]**

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