

Total No. of Questions : 12]

SEAT No. : **P835****[4659]-94**

[Total No. of Pages : 3

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**

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

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]**

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

↑

Find

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

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

P.T.O.

- 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 $x(t) = \cos 100t \cdot \cos 50t$. [8]

OR

Q4) Given

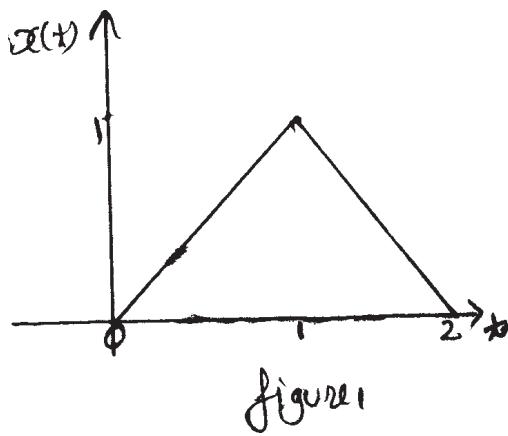
$$x[n] = \{2, 1, 3, 2, 1, 5, 2, 4\} \in V_3.$$

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]



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

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

$$\begin{aligned}x(t) = & 4\phi(2t) + 3\phi(2t-1) + 6\phi(2t-2) \\& + 5\phi(2t-3) + 4\phi(2t-4) + 6\phi(2t-5) \\& + 7\phi(2t-6) + 4\phi(2t-7).\end{aligned}$$

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 V_2, W_2, V_1, W_1, V_0 & W_0 . Reconstruct after suppressing (making zero) coefficients in W_j subspaces, and show denoising (smoothening) effect on reconstructed signal $x_d[n]$ when compared with $x[n]$. [18]

