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Question Paper Code : 11039

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015

Fifth Semester

Electrical and Electronics Engineering

EC 65 — DIGITAL SIGNAL PROCESSING

(Common to Sixth Semester Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulations 2008)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given a continuous time signal $x(t) = 2\cos 500\pi t$. What is the Nyquist rate and fundamental frequency of the signal?

2. Determine whether $x[n] = u[n]$ is a power signal or an energy signal.

3. Determine the z-transform and ROC for the signal $x(n) = \delta(n-k) + \delta(n+k)$.

4. Prove the convolution property of z-transform.

5. Draw the basic butterfly of DIF-FFT.

6. What is the relationship between DFT and Z transform?

7. Define pre-warping effect. Why it is employed?

8. Give Hamming window function.

9. Define periodogram.

10. Define Gibbs phenomena.

PART B — (5 × 16 = 80 marks)

11. (a) Compute the convolution for the signals (16)

$x(n) = \alpha^n, \quad -3 \le n \le 5$
0, elsewhere

$h(n) = 1, \quad 0 \le n \le 4$
0, elsewhere.

Or

(b) Consider the analog signal

$x_a(t) = 3\cos 2000\pi t + 5\sin 6000\pi t = 10\cos 12{,}000\pi t.$

(i) What is the Nyquist rate for this signal? (4)

(ii) Assume now that we sample this signal using a sampling rate $F_S = 5000$ Samples/sec. What is the discrete time signal obtained after sampling? (6)

(iii) What is the analog signal $y_a(t)$ that we can reconstruct from the samples if we use ideal interpolation. (6)

12. (a) (i) Find the Z – Transform and ROC of $x(n) = r^2 \cos(n\theta)u(n)$. (8)

(ii) Find Inverse Z — Transform of $X(z) = z/[3z^2 - 4z + 1]$, ROC $|z| > 1$. (8)

Or

(b) (i) Determine the DTFT of the given sequence $x[n] = a^n(u(n) - u(n-8)), |a| < 1$. (8)

(ii) Prove the linearity and frequency shifting theorem of the Discrete Time Fourier Transform. (8)

13. (a) (i) The first five points of the eight point DFT of a real valued sequence are {0.25, 0.125 – j0.3018, 0,0.125 – j0.0518, 0}. Determine the remaining three points. (4)

(ii) Compute the eight point DFT of the sequence $x = [1,1,1,1,1,1,1,1]$, using Decimation-in-Frequency FFT algorithm. (12)

Or

(b) Consider the sequences:

$x_1(n) = \{0, 1, 2, 3, 4\}, x_2(n) = \{0, 1, 0, 0, 0\}$

$s(n) = \{1, 0, 0, 0, 0\}$

(i) Determine a sequence $y(n)$ so that $Y(k) = X_1(k)X_2(k)$ (8)

(ii) Is there a sequence $x_3(n)$ such that $S(k) = X_1(k)X_3(k)$? (8)

14. (a) Design a low pass Chebychev filter with an acceptable passband ripple of 2 dB, cut off frequency of 1 rad/sec. and stop band attenuation of 20 dB or greater beyond 1.3 rad/sec. (16)

Or

(b) Design a low pass FIR filter using the Hanning window for which the desired frequency response is

$$H_d(w) = \begin{cases} e^{-jw\alpha}, & |w| = w_c \\ 0, & \text{elsewhere} \end{cases}$$

The length of filter is 7 and $w_c = 1$ rad/sec. (16)

15. (a) Explain various addressing modes of a digital signal processor. (16)

Or

(b) Draw the functional block diagram of a digital signal processor and explain. (16)
