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C 3255

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Sixth Semester

Electrical and Electronics Engineering

EC 1361 — DIGITAL SIGNAL PROCESSING

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

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A discrete time signal $x[n]$ is defined as

$$x[n] = \frac{n^2}{2} + |n|; \quad -2 \le n \le 2$$
$$= 0; \qquad \text{elsewhere}$$

Plot $x[n]$.

2. Distinguish between a causal and a non causal system.

3. Determine the Z-transform of $x[n] = \delta[n-3]$.

4. Define discrete time fourier transform pair for discrete time signal $x[n]$.

5. Distinguish between DTFT and DFT.

6. A discrete time system is described by the transfer function

$$H(Z) = \frac{Z^3 - 2Z^2 + Z}{Z^2 + \frac{1}{4}Z + 8}$$

Is this system causal?

7. Enumerate the significant differences between FIR and IIR filters.

8. What is Gibb's phenomenon?

9. State the important features of TMS320C54 digital signal processor.

10. State the errors encountered in digital filters due to the finite word length of registers.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Define energy and power signals. Determine whether a discrete time unit step signal $x[n] = u[n]$ is an energy signal or a power signal. (8)

(ii) A discrete time system is described by its impulse response

$$h[n] = \alpha^n u[n+2].$$

Determine if this system is causal and memoryless.

Determine the condition for this system to be stable. (8)

Or

(b) (i) Describe the different types of discrete time signal representation. (6)

(ii) What is Nyquist rate? Explain its significance while sampling the analog signals. (6)

(iii) The relationship between the input and output of a discrete time system is described by $y[n] = r^n x[n]$. Determine if this system is time-invariant. (4)

12. (a) A Linear Time Invariant (LTI) system is characterized by the system function $H(Z) = \dfrac{3 - 4Z^{-1}}{1 - 3.5Z^{-1} + 1.5Z^{-2}}$

Specify the ROC of $H(Z)$ and determine $h[n]$ for the following conditions :

(i) The system is stable

(ii) The system is causal

(iii) The system is anticausal. (16)

Or

(b) A discrete time LTI system having impulse response $h[n] = \alpha^n [u[n] - u[n-7]]$ is excited by an input signal $x[n] = u[n] - u[n-5]$. Determine the output $y[n]$ by convolution. (16)

13. (a) Describe the Decimation In Time (DIT) radix - 2 FFT algorithm to determine N-point DFT. (16)

Or

(b) An 8-point discrete time sequence is given by $x[n] = \{2, 2, 2, 2, 1, 1, 1, 1\}$. Compute the 8-point DFT of $x[n]$ using radix-2 FFT algorithm. (16)

14. (a) Design a linear phase FIR Bandpass filter to pass frequencies in the range 1 to 2 rad/sec using Hanning window with N = 5. (16)

Or

(b) Describe the Impulse Invariance and Bilinear transformation methods used for designing digital IIR filters. (16)

15. (a) Describe in detail the architectural aspects of TMS 320C54 digital signal processor using an illustrative block diagram. (16)

Or

(b) A second order IIR filter is described by its transfer function

$$H(Z) = \frac{1}{(1 - 0.5Z^{-1})(1 - 0.45Z^{-1})}$$

Determine the effects of coefficient quantisation due to truncation with 3-bit word length registers in (i) direct form and (ii) cascade form. (16)
