53 (EC 603) DISP

2019

DIGITAL SIGNAL PROCESSING

Paper : EC 603

Full Marks : 100

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

*Answer **any ten** questions.*

1. Determine the output sequence of
    the system with impulse response
    $h(n) = \left(\dfrac{1}{4}\right)^n u(n)$ and input
    $x(n) = 4 \times e^{j\pi n/2}$; $\quad -\infty < n < \infty$. State the
    necessary theory.   10

2. Calculate the circular convolution of two
    sequences $x_1(n) = \{1, -1, -2, 3, -1\}$ and
    $x_2(n) = \{1, 2, 3\}$ using graphical method.
    Hence discuss the need for circular
    convolution.   8+2

3. (a) Deduce the relationship between analog and digital frequencies. Write their corresponding units. 5

(b) Find the z-transform of $x(n) = (0 \cdot 8)^n$. 5

4. Consider three signals $g_1(t) = \cos(6\pi t)$, $g_2(t) = \cos(14\pi t)$ and $g_3(t) = \cos(26\pi t)$. If sampling frequency is $10 Hz$, show that it is not possible to get back original signal. Explain. 10

5. The following transfer function

$$H(z) = \sum_{n=0}^{N-1} h(n) \cdot z^{-n}, \quad N = 11$$

Determine the magnitude response of the following transfer function and show that phase and group delay are constant. 10

6. (a) What are the characteristics of linear phase FIR system? What is the need of a system to be linear phase? 3+4

3. (b) Why some system are called FIR and IIR? 3

7. Determine the output sequence using radix-2 FFT-DIT algorithm when the input sequence is given by $\{1, 2, 3, 4, 4, 3, 2, 1\}$. 10

8. Obtain cascade and parallel structure of the transfer function

$$H(z) = \frac{2(z+2)}{(z-1)(z+2)(z+3)}$$

10

9. Determine the direct form II and transposed direct form II for the given system

$$y(n) = 0 \cdot 5y(n-1) - 0 \cdot 25y(n-2) + x(n) + x(n-1).$$

10

10. Digital system with the difference equation with and initial condition. Explain zero input limit cycle effect. 10

11. Consider the transfer function of an analog

   filter is $H(s) = \dfrac{s+3}{s^2+4s+13}$.

   Now design the digital filter using impulse invariance method. Consider the sampling interval $T = 0.1s$. **10**

12. (a) Draw the block diagram of linear convolution using DFT. **5**

   (b) Write advantage of digital filter over analog filter. **5**

13. Write short notes on *any two* of the following : **5×2**

   (a) Gibb's phenomenon

   (b) Overlap-add method

   (c) Overlap-save method

   (d) Design of FIR filter using window method.

14. A LPP should have the following frequency response characteristics

   $$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & ; \quad -\omega_c \le \omega \le \omega_c \\ 0 & ; \quad \omega_c < |\omega| \le \pi \end{cases}$$

   Find the filter coefficients $H_d(n)$ and also find a condition on τ, such that $h_d(n) = h_d(-n)$. **10**

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