U.G. 6th Semester Examination-2022

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHY-H-DSE-T-03

(Digital Signal Processing)

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **five** questions : 2×5=10

a) State the methods to find inverse z-transform.

b) Define ROC and explain its significance.

c) What is the meaning of radix-2?

d) What is FFT? Is it a transform?

e) Draw the signal flow graph for N = 4 radix-2 DIT-FFT algorithm.

f) Compare DIT and DIF-FFT algorithms.

g) Draw the signal flow graph for 4-point DIF-FFT algorithm.

h) What are various methods to design IIR filters?

GROUP-B

2. Answer any **two** questions: 5×2=10

a) Compute the DFT of the following sequence:

$$x(n) = \begin{cases} \frac{1}{4}, & 0 \le n \le 2 \\ 0, & otherwise \end{cases}$$

State Parseval's theorem. 3+2

b) What are the advantages of z-transform? What is DFT? 3+2

c) A discrete-time signal is expressed as $x(n) = \delta(n+1)2\delta(n) + 5\delta(n-3) - 2\delta(n-4)$.

Find its z-transform.

What is the difference between circular convolution and linear convolution? 3+2

d) Find the inverse z-transform of $X(z) = \frac{3}{z-2}$ $|z| > 2$.

What are the applications of circular convolution? 3+2

GROUP-C

3. Answer any **two** questions: 10×2=20

a) Compute the convolution *y(n)* of the following signals:

$$x(n)=\begin{cases}\frac{1}{3}n & 0\le n\le 6\\ 0 & otherwise\end{cases} \quad and \quad h(n)=\begin{cases}1, & -2\le n\le 2\\ 0, & otherwise\end{cases}$$

Examine whether the following signal: $x(n)=\cos\left(\frac{n}{10}\right)\cos\left(\frac{n\pi}{10}\right)$ is a periodic signal or not. A digital filter has the following impulse response: $h(n)=\{-3,2,1,-2,3\}$. If it is a linear phase filter, justify. 5+3+2

b) Determine the circular convolution of the following sequences:

$x(n)$ = {1,0.5, 1, 0.5, l, 0,5}

$h(n)=\{0,1,2,3\}$

Sketch the following signal

$x(t)=A\sin t$ for $-\infty<t<\infty$.

Also check whether the signal is a power signal or an energy signal or neither. What are Energy and Power Signals? Explain. 5+3+2

c) Explain the different properties of region of convergence (ROC) of z-transform. Test the system $y(n) = x(n).u(n)$ for Linearity, Causality and Time invariance. Define region of convergence (ROC). 5+4+1

d) State the advantages and disadvantages of digital filters. Use the rectangular window to design a linear FIR filter of order N = 24 to approximate the following frequency response magnitude.

$$|H_d(e^{j\omega})| = \begin{matrix}1 & for & |\omega|\le 0.2\pi\\ 0 & for & 0.2\pi\le|\omega|\le\pi\end{matrix}$$

What is DIF-FFT algorithm? 5+4+1

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