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**Question Paper Code : 40495**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth/Eighth Semester

Electrical and Electronics Engineering

EE 8591 — DIGITAL SIGNAL PROCESSING

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

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is meant by Nyquist rate? Comment on aliasing effect.

2. When is a system said to be causal and stable?

3. State convolution theorem wrt Z-transform.

4. List any two properties of DTFT, with relevant expression.

5. Compare DFT and FFT based on computational complexity.

6. Draw the basic DIT butterfuly diagram marking input and output with twiddle factor.

7. Write the windowing function due to Blackmann for FIR filter design.

8. What is meant by prewarping? Give remedial measure to prevent this.

9. Differentiate Von Numann and Harvard architecture

10. Give the different addressing formats of digital signal processors.

PART B — ($5 \times 13 = 65$ marks)

11. (a) For the system described by $y(n) = x(n)x(n-2)$, check whether it is static/dynamic, causal/non-casual, linear/non-linear and time invariant/time variant. (13)

Or

(b) (i) Represent the sequence $x(n) = (3,1,-2,1,4,2,5,1)$ for $n = -3,-2,-1,0,1,2,3,4$ as weighted sum of unit impulses. (6)

(ii) Check whether the signal $x(n) = u(n) - u(n-6)$ is an energy signal or power signal. (7)

12. (a) Find the linear convolution of the two signals represented by (13)

$$x(n) = \begin{cases} 2 & for \quad n = -2, 0,1 \\ -1, & for \quad n = -1 \\ 0 & elsewhere \end{cases}$$

and $h(n) = \delta(n) - 2\delta(n-1) + 3\delta(n-2) - \delta(n-3)$.

Or

(b) Find all possible inverse Z-transforms of $X(z) = [z(z^2 - 4z + 5)]/(z^3 - 6z^2 + 11z - 6)$. (13)

13. (a) (i) Find the frequency response, magnitude response and phase response of $y(n) = x(n) + 0.81x(n-1) + 0.81x(n-2) - 0.45x(n-3)$. (6)

(ii) Find the 4 point DFT using matrix method if $x(n) = \{1,-2,3,2\}$. (7)

Or

(b) Compute $X(k)$ of $x(n) = \{1,-1,-1,-1,1,1,1,-1\}$ using radix-2 DIT FFT. Also plot amplitude and frequency spectra. (13)

14. (a) Convert the analog filter with transfer function $H_a(S) = s + 0.1/(s + 0.1)^2 + 9$ into digital filter by impulse invariant transformation. (13)

Or

(b) Design a low pass Butterworth digital filter to give response of 3dB or less for frequencies upto 2kHz and an attenuation of 20 dB or more beyond 4kHz. Use the bilinear transformation technique and obtain H(z) of the desired filter. (13)

15. (a) Explain in detail with a neat diagram the architecture of any one of the latest digital signal processors. (13)

Or

(b) (i) Write a brief technical note on commercial digital signal processors. (6)

(ii) Describe in detail any four addressing formats of digital signal processor. (7)

PART C — (1 × 15 = 15 marks)

16. (a) Design an FIR low pass filter satisfying the following specifications :

$(\alpha_p \leq 0.1 dB, a_s \geq 38\ dB)$

$w_p = 15\ rad/\text{sec},\ w_s = 25\ rad/\text{sec},\ w_{sf} = 80\ rad/\text{sec}$. Use Kaiser window.

Or

(b) The desired frequency response of a low pass filter is

$$H_d(e^{jw}) = \begin{cases} 1; & -\pi/2 \leq w \leq \pi/2 \\ 0; & \pi/2 \leq w \leq \pi \end{cases}$$

Determine $h_d(n)$ for M=7 using rectangular window.