



B.E/B.TECH DEGREE EXAMINATIONS: APRIL /MAY 2024

(Regulation 2018)

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

U18EII6202: Digital Signal Processing and Deep Learning

COURSE OUTCOMES

- CO1:** Understand the characteristics of discrete-time signals and discrete systems.
CO2: Analyze signal / system properties using mathematical tools.
CO3: Apply and develop algorithms for digital systems.
CO4: Illustrate efficient computation of DFT.
CO5: Discuss advanced features and architecture of generic P-DSP.
CO6: Design FIR and IIR filters.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

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|---|-----|-------------------|
| 1. State the properties of Discrete time signal. | CO1 | [K ₁] |
| 2. Find the linear convolution of the two sequences $x(n) = \{3, 2, 1, 2\}$, $h(n) = \{1, 2, 1, 2\}$ | CO1 | [K ₂] |
| 3. Calculate the DTFT of $x(n) = \{1, -1, 1, -1\}$ | CO2 | [K ₂] |
| 4. Calculate the Z - transform of the signal
$x(n) = na^n u(n)$ | CO2 | [K ₂] |
| 5. Compute the DFT of $x(n) = a^n$. | CO3 | [K ₂] |
| 6. Calculate the speed improvement factor in calculating 64 point DFT using FFT algorithm | CO3 | [K ₃] |
| 7. Justify why impulse invariant method is not preferred in the design of IIR filter other than lowpass filter. | CO4 | [K ₄] |
| 8. Determine the frequency response of FIR filter defined by
$Y(n) = 0.5x(n) + x(n-1) + 0.5x(n-2)$. Calculate phase delay and Group delay | CO4 | [K ₃] |
| 9. Differentiate Harvard & Modified Harvard architecture. | CO5 | [K ₃] |
| 10. List the factors that influence selection of DSP, Processor. | CO5 | [K ₃] |

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) Discuss the implications of violating the Nyquist-Shannon sampling theorem in the context of signal reconstruction. Consider a scenario where a continuous-time signal is sampled at a rate lower than the Nyquist frequency. How does undersampling lead to aliasing, and what are the consequences for signal reconstruction? Additionally, propose potential strategies for mitigating aliasing effects and reconstructing the original signal accurately despite undersampling. 8 CO1 [K₂]
- b) Examine the system $y[n] = nx(n)$ and find the properties of the system. 8 CO1 [K₃]
12. a) A causal system is represented by the following difference equation

$$y(n) = 0.2y(n-1) + x(n)$$
Find the transfer function $H(Z)$ and ROC 8 CO2 [K₃]
- b) Calculate the inverse Z transform of the following

$$X(z) = 1 / [(1-2z^{-1})(1-z^{-1})^2]$$
 8 CO2 [K₃]
13. a) Calculate the 8-point DFT of the sequence $x[n]=n+1$ for $n=0,1,\dots,7$ using radix-2 DIF-FFT algorithm. What are the total number of complex additions and multiplication needed for this computation. 12 CO4 [K₃]
- b) List the properties of DFT. 4 CO3 [K₂]
14. a) Design a digital Butterworth filter satisfying the constraints

$$0.707 \leq H(e^{j\omega}) \leq 1 \quad \text{for } 0 \leq \omega \leq \pi/2$$

$$H(e^{j\omega}) \leq 0.2 \quad \text{for } 3\pi/4 \leq \omega \leq \pi$$
With $T=1$ sec using bilinear transformation. Realize the filter using the most convenient realization form. 12 CO6 [K₄]
- b) Convert the analog filter with system transfer function

$$H(S) = 10 / (S^2+7S+10)$$
into a digital IIR filter means of the impulse invariant method for $T=0.2S$. 4 CO6 [K₄]

15. a) Design an ideal band reject filter with a frequency response 12 CO6 [K₄]

$$H_d(e^{j\omega}) = \begin{cases} 1 & \pi/4 \leq |\omega| \leq \pi \\ 0 & \text{otherwise} \end{cases}$$

Find the values of $h(n)$ for $N=11$ using Hanning window. Find $H(Z)$. Plot the magnitude response.

- b) Obtain the cascade form realizations of FIR systems 4 CO6 [K₄]

$$H(z) = 1 + 2.5z^{-1} + 2z^{-2} + 2z^{-3}$$

16. a) Explain down sampling employed in multirate signal processing with example 10 CO5 [K₂]

- b) Discuss the importance of pipelining in DSP architecture. 6 CO5 [K₃]
