

**ADVANCED DSP AND APPLICATIONS
(ECEN 5202)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following is done to convert a continuous time signal into discrete time signal?
(a) Modulating (b) Sampling
(c) Differentiating (d) Integrating.
- (ii) What are the important block(s) required to process an input analog signal to get an output analog signal?
(a) A/D converter (b) Digital signal processor
(c) D/A converter (d) All of (a), (b) & (c).
- (iii) If $x(n)=Ae^{j\omega n}$ is the input of an LTI system and $h(n)$ is the impulse response of the system, then what is the output $y(n)$ of the system?
(a) $H(-\omega)x(n)$ (b) $-H(\omega)x(n)$
(c) $H(\omega)x(n)$ (d) None of (a), (b) & (c).
- (iv) What is the set of all values of z for which $X(z)$ attains a finite value?
(a) Radius of convergence (b) Radius of divergence
(c) Feasible solution (d) None of (a), (b) & (c).
- (v) If $x(n)=(0,1,2,3,3,0,0,0)$ then $x(2n)$ is?
(a) $(0,2,4,6,6,0,0,0)$ (b) $(0,1,2,3,3,0,0,0)$
(c) $(0,2,3,0,)$ (d) None of (a), (b) & (c).
- (vi) The main lobe width of length M rectangular window is
(a) $\frac{4\pi}{M}$ (b) $\frac{8\pi}{M}$
(c) $\frac{12\pi}{M}$ (d) variable.

- (vii) What is the output $y(n)$ when a signal $x(n)=n*u(n)$ is passed through an accumulator system under the conditions that it is initially relaxed?
(a) n^2+n+12 (b) $n(n+1)2$
(c) n^2+n+22 (d) None of (a), (b) & (c).
- (viii) What is the value of chebyshev polynomial of degree 1?
(a) 1 (b) x
(c) -1 (d) $-x$.
- (ix) What is the process of converting a signal from a given sampling rate to a different sampling rate?
(a) Sampling (b) Normalizing
(c) Sampling rate conversion (d) None of (a), (b) & (c).
- (x) Convolution of impulse function $\delta(t-7)$ with $x(t+5)$ is equal to
(a) $x(t-12)$ (b) $x(t+12)$
(c) $x(t-2)$ (d) $x(t+2)$.

Group-B

2. (a) Explain the role of Fourier series & Fourier transform in signal processing. What is the main disadvantage of Fourier transform regarding analysis of signal?
[[CO1(Understand/LOCQ)]]
- (b) What is Short Time Fourier transform (STFT)? Explain how the windowing method can be applied to analyze the signals in frequency domain and also explain that the main disadvantage of Fourier transform can be removed up to a certain level using it.
[[CO1(Understand/Remember/IOCQ)]]
5 + 7 = 12
3. (a) An analog signal $x_a(t)=2\cos(280 \pi t) +3\sin(720 \pi t)$ is sampled with sampling rate 600 samples per second
(i) Determine the nyquist sampling rate for $x_a(t)$.
(ii) Determine the folding frequency.
(iii) What are the frequencies, in radian in the resulting discrete time signal $x(n)$?
[[CO2(Evaluate/HOCQ)]]
- (b) If $x(n)$ is passed through an ideal D/A converter, what is the reconstructed signal $y_a(t)$?
[[CO2(Apply/IOCQ)]]
(2 + 1 + 4) + 5 = 12

Group-C

4. (a) Derive the expression of DFT of a discrete time signal.
[[CO4(Understand/Remember/IOCQ)]]
- (b) Prove the periodicity property of twiddle factor.
[[CO4(Understand/Remember/IOCQ)]]
- (c) Find out 4 point DFT of $x(n)=\{0,1,2,3\}$.
[[CO4(Evaluate/LOCQ)]]
4 + 4 + 4 = 12

5. (a) Using radix-2 DIF-FFT algorithm, evaluate the DFT of the sequence $x(n) = \{-2, 1, 2, 3\}$. [[CO4](Apply/IOCQ)]
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- (b) Find out IDFT if the given DFT $X(k) = \{6, -2, -2+2j, -2-2j\}$. Use matrix method. [[CO4](Evaluate/HOCQ)]
- (c) Evaluate the Fourier series coefficient C_k for the discrete time signal $x(n) = \cos\left(\frac{\pi}{3}n\right)$. [[CO4](Evaluate/IOCQ)]
- 5 + 5 + 2 = 12**

Group – D

6. (a) Explain
(i) Adaptive filter
(ii) Applications of adaptive filter
(iii) Different algorithms for adaptive filters? [[CO2](Understand/LOCQ)]
- (b) Develop the LMS algorithms and explain its application. [[CO2](Understand/LOCQ)]
- (1 + 2 + 2) + 7 = 12**
7. (a) State some advantage & disadvantage of IIR & FIR filter. [[CO5](Understand/Remember/LOCQ)]
- (b) What is Gibbs phenomenon? Explain with diagram. [[CO5](Understand/Remember/IOCQ)]
- (c) Design a digital filter to find out $H(z)$ for the following specifications:
 $\alpha_p=6$; $\alpha_s=30$; $f_p=300$ Hz and $f_s=500$ Hz. Where α_p and α_s are pass band and stop band attenuations at the cut off frequencies at f_p and f_s respectively. Use Bilinear Transformation technique. [[CO2](Evaluate/IOCQ)]
- 2 + 2 + 8 = 12**

Group – E

8. (a) Explain the terms
(i) Decimation (ii) Interpolation. [[CO3](Understand/IOCQ)]
- (b) Explain multirate signal processing and its utility. [[CO3](Understand/IOCQ)]
- (c) Illustrate a simple model of sampling rate conversion using basic building blocks and explain it. [[CO3](Apply/IOCQ)]
- 3 + 3 + 6 = 12**
9. (a) What are the different parameters of wavelet transform? Show the general mathematical expression of wavelet transform and explain the role of different parameters appear in it. [[CO3](Understand/Remember/IOCQ)]
- (b) Describe Haar Wavelet with a diagram. [[CO6](Understand/Remember/IOCQ)]
- (c) Explain how wavelet coefficients are determined of a signal and also explain that the disadvantages of Fourier transform can be removed using wavelet transform. [[CO1&6](Apply/HOCQ)]
- (1 + 2) + 3 + 6 = 12**

<i>Cognition Level</i>	<i>LOCQ</i>	<i>IOCQ</i>	<i>HOCQ</i>
<i>Percentage Distribution</i>	<i>23.95</i>	<i>57.30</i>	<i>18.75</i>

Course Outcomes (CO):

1. Students will know about the different transforms applied in signal processing.
2. They will have knowledge about LTI systems, Digital filters.
3. The students will know about multi- rate processing, wavelet transforms.
4. They will solve problems on FFT and DFT.
5. The students will know about the comparison of filters.
6. They will be able to apply the knowledge of wavelets.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*