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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2025 - 2026)

Subject: Analog and Digital Signal Processing & Communication

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

- | | | |
|-------|---|---|
| (1.1) | Linear convolution of $[1, 1]$ and $[1, -1]$ is: (CO1,K3) | 1 |
| | (a) $\{1, 0, -1\}$ | |
| | (b) $\{1, 2, -1\}$ | |
| | (c) $\{1, 0, 1\}$ | |
| | (d) $\{0, 1, 0\}$ | |
| (1.2) | Which property of DFT is used to compute linear convolution efficiently? (CO1,K1) | 1 |
| | (a) Linearity | |
| | (b) Circular convolution property | |
| | (c) Time shift | |
| | (d) Parseval's theorem | |
| (1.3) | Stopband attenuation depends on (CO2,K1) | 1 |
| | (a) Window type | |
| | (b) Sampling | |
| | (c) Gain | |
| | (d) Delay | |
| (1.4) | The number of multipliers in FIR filter equals: (CO2,K1) | 1 |
| | (a) Length | |
| | (b) Order | |
| | (c) Length-1 | |
| | (d) Twice Length | |

- (1.5) If carrier amplitude doubles, AM power (CO3,K2) 1
- (a) Remains same
 - (b) Doubles
 - (c) Quadruples
 - (d) Halves
- (1.6) The process of extracting information from modulated signal is (CO3,K1) 1
- (a) Modulation
 - (b) Detection
 - (c) Filtering
 - (d) Amplification
- (1.7) Symbol duration in QPSK is (CO4,K1) 1
- (a) T_b
 - (b) $T_b/2$
 - (c) $2T_b$
 - (d) $4T_b$
- (1.8) In DPSK, information is carried in (CO4,K1) 1
- (a) Absolute phase
 - (b) Phase difference
 - (c) Frequency
 - (d) Amplitude
- (1.9) Encapsulation in networking refers to (CO5,K2) 1
- (a) Encryption of data
 - (b) Removing noise
 - (c) Adding headers at each layer
 - (d) Signal amplification
- (1.10) Which OSI layer uses MAC addressing? (CO5,K1) 1
- (a) Network
 - (b) Transport
 - (c) Physical
 - (d) Data Link

2. Attempt all parts:-

- (2.1) Draw the time-reversed version of the unit step signal $u(t)$. (CO1,K3) 2
- (2.2) Explain why aliasing occurs in impulse invariant method? (CO2,K2) 2
- (2.3) Analyze why modulation reduces antenna height requirement? (CO3,K4) 2
- (2.4) Sketch the waveform of polar RZ for a given binary sequence 010101. (CO4,K3) 2
- (2.5) Define IP address. (CO5,K1) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) Find the response of an FIR filter with impulse response $h(n) = \{1, 2, 4\}$ to the input sequence $x(n) = \{1, 2\}$ using Matrix multiplication method. (CO1,K3) 6

- (3.2) Analyze the limitations of circular convolution in real-world systems. (CO1,K4) 6
 Answer any one of the following:-
- (3.3) Apply Bilinear transformation to $H(s)$ with $T=0.1s$. (CO2,K3) 6

$$H(s) = \frac{2}{(s+1)(s+3)}$$
- (3.4) Examine how coefficient quantization affects digital filter performance? (CO2,K4) 6
 Answer any one of the following:-
- (3.5) Draw and label the block diagram of a basic communication system, showing the main functional blocks from source to destination and the flow of information through the system. (CO3,K2) 6
- (3.6) Discuss Frequency Division Multiplexing Technique with example in detail. (CO3,K2) 6
 Answer any one of the following:-
- (3.7) Describe the working principle of Pulse Code Modulation (PCM) with block diagram explanation. (CO4,K2) 6
- (3.8) Compare ASK, FSK, and PSK in terms of bandwidth efficiency and noise immunity. (CO4,K4) 6
 Answer any one of the following:-
- (3.9) Describe the operation of HTTP protocol in web communication. (CO5,K2) 6
- (3.10) Compare LoRaWAN and NB-IoT in terms of range, power consumption, and applications. (CO5,K4) 6
- SECTION-C** 50
4. Answer any one of the following:-
- (4.1) Find the output response of a Finite Impulse Response (FIR) filter whose impulse response is $h(n)=\{2,1,3\}$ when the input signal is $x(n)=\{1,0,2\}$. (CO1,K3) 10
- (4.2) Given $x(n)=\{1,2,3,4,4,3,2,1\}$, find $X(k)$ using DIT FFT algorithm. (CO1,K3) 10
5. Answer any one of the following:-
- (5.1) Explain the process of filter transformation by using impulse invariant method for designing of digital IIR filter. Also write down the limitations of this filter transformation method. (CO2,K2) 10
- (5.2) Design a digital low pass Butterworth IIR filter using impulse invariant method for the following specification. (Assume $T=1$ sec). (CO2,K5) 10
- Passband:** $0.8 \leq |H(e^{j\omega})| \leq 1 \quad |\omega| \leq 0.2\pi$
Stopband: $|H(e^{j\omega})| \leq 0.2 \quad 0.6\pi \leq |\omega| \leq \pi$
6. Answer any one of the following:-
- (6.1) A sinusoidal carrier of 20V, 2 MHz is frequency modulated by a sinusoidal message signal of 5V, 25 KHz with $k_f = 50$ KHz/volt. Find; i) Δf , β , BW, and power. ii) Repeat the above if message signal amplitude is doubled. (CO3,K3) 10
- (6.2) Compare between Frequency modulation and Phase Modulation. (CO3,K4) 10
7. Answer any one of the following:-

- (7.1) A signal is bandlimited to 5 kHz. Determine the minimum sampling frequency. If quantized using 10 bits/sample, calculate the bit rate. (CO4,K3) 10
- (7.2) A binary data stream 0011010010 is transmitted using DPSK show the reconstruction of the DPSK signal. (CO4,K3) 10
8. Answer any one of the following:-
- (8.1) Describe the TCP/IP model architecture and explain how it differs from the OSI model with suitable examples. (CO5,K2) 10
- (8.2) Compare MQTT, CoAP, and HTTP protocols for IoT applications in terms of efficiency and overhead. (CO5,K4) 10

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