TE / EXTC / SEM-V / C-2019 / NOV. 2023

Duration : 3Hrs **Marks: 80**

N B. :- Questions no. 1 is Compulsory.
Attempt any 3 out of the remaining five
All questions carry equal marks
Assume suitable data if required & state it clearly

Q. 1 Attempt any Four (5 Marks Each)
a) Write a note on Correlator Receiver.
b) Compare MSK & QPSK
c) For a binary bit stream 11010110, Draw the Line codes for Unipolar RZ, Bipolar NRZ, Bipolar RZ, Polar RZ & Manchester.
d) What is Inter Symbol Interference? Explain in brief.
e) State Shannon Hartley Theorem. Derive the condition for upper limit of channel capacity

Q. 2a A discrete memory less source generates symbols every one millisecond as given below:

S	S1	S2	S3	S4	S5	S6	S7	S8
P	1 /2	1/8	1/8	1/16	1/16	1/16	1/32	1/32

Construct Shannon-Fano code. Also find the source entropy, information rate and code efficiency & redundancy (10)

Q. 2b Why is MSK called Minimum. Derive this condition for Fh & Fl. Draw MSK waveforms for (m=7) with 101010101 (10)

Q.3a For (7,4) cyclic code, $g(x) = x3+x2+1$. Design Encoder for 1110 & Decoder for 1010111. (10)

Q.3b Find Convolutional Code for g1(101), g2(110), g3(111). Draw State Table, State Diagram, & Trellis Diagram. Find code word for 1101101 (10)

Q.4a State the difference between BASK, BFSK and BPSK Modulation Systems based on following parameters:
a. Bandwidth requirement & Spectral Efficiency
b. Type of Geometrical representation & Euclidian Distance
c. Modulated waveforms
d. Noise Immunity
e. Line Coding technique used for binary signal conversion (10)

Q.4b Draw & Explain M-ary PSK transmitter & Receiver. Draw its spectrum & find BW (10)

Q.5a Discrete Memoryless Source has an alphabet of five symbols with their probabilities as shown.

Symbol	S1	S2	S3	S4	S5
Probability	0.16	0.23	0.35	0.10	0.16

Construct a Huffman Code for each symbol and determine following parameters.
a. Entropy
b. Average code word Length
c. Code efficiency
d. Redundancy of the code. (10)

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Q.5b Illustrate 16-QAM & derive its Euclidean distance

Q.6a State the Nyquist's criteria for ISI & the practical solutions to overcome ISI

Q.6b Draw the Transmitter & Receiver for BFSK and BPSK Modulation Systems.

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1 Attempt any **FOUR** [20]

a Sketch the frequency response and identify the following filters based on their pass band:

i). $h(n) = \left\{1, -\frac{1}{2}\right\}$ ii). $H(z) = \frac{z^{-1} - a}{1 - az^{-1}}$

b Find the IDIF-FFT for a given sequence X(k)= {26, -2+2j, -2, -2-2j}.

c Explain the effects of coefficient quantization in FIR filters.

d Explain frequency warping in bilinear transformation

e Compare IIM and BLT.

2 a Design FIR filter using frequency sampling technique for the following specifications: [10]

$$H(e^{j\omega}) = \begin{cases} e^{-j3\omega} & 0 \le |\omega| \le \frac{\pi}{2} \\ 0 & \text{otherwise} \end{cases}$$

b Design a Butterworth low pass filter using BLT for the following specifications (Assume T=1sec) [10]

$$0.9 \le |H(e^{j\omega})| \le 1 \quad for \quad 0 \le \omega \le \frac{\pi}{2}$$

$$|H(e^{j\omega})| \le 0.1 \quad for \quad \frac{3\pi}{4} \le \omega \le \pi$$

3 a If x(n) = {1, 2, 3, 4, 5, 6, 7, 8}, Find X(k) using DIT-FFT algorithm. Compare the computational complexity of above algorithm with DFT. [10]

b The transfer function of digital causal system is given as follows: [10]

$$H(z) = \frac{1 - z^{-1}}{1 - 0.2z^{-1} - 0.15z^{-2}}$$

(i) Find the difference equation.

(ii) Draw cascade form, parallel form realization.

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4 a $x(n) = \begin{cases} 1, & 0 \le n \le 3 \\ 0, & 4 \le n \le 7 \end{cases}$ [10]

i). Determine the DIF-FFT of the sequence x(n)

ii). Also find the DFT of the following sequences using the result obtained in (i)

$$x_1(n) = \begin{cases} 1, & n = 0 \\ 0, & 1 \le n \le 4 \\ 1, & 5 \le n \le 7 \end{cases}$$

$$x_2(n) = \begin{cases} 0, & 0 \le n \le 1 \\ 1, & 2 \le n \le 5 \\ 0, & 6 \le n \le 7 \end{cases}$$

b Design a FIR filter using window method for following specification. [10]

$$H(e^{j\omega}) = \begin{cases} e^{-j2\omega} & for \ -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0 & for \ \frac{\pi}{4} \le |\omega| \le \pi \end{cases}$$

Determine the filter coefficient h(n) if the window function is defined as

$$w[n] = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & otherwise \end{cases}$$

Also determine the frequency response of the designed filter.

5 a An analog filter has transfer function [10]

$$H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$$

Determine the transfer function of digital filter using bilinear transformation.

The digital filter should have specification $\omega_r = \frac{\pi}{2}$

b The unit sample response of a system is h(n) = {1, 2} use overlap-save method of linear filtering to determine output sequence for the repeating input sequence, x(n) = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. Take N=5 [10]

6 a Explain application of DSP in ECG and EEG signal analysis. [10]

b Obtain lattice realization for FIR filter given by [10]

$$H(z) = 1 + \frac{3}{4}z^{-1} + \frac{1}{2}z^{-2} + \frac{1}{4}z^{-3}$$

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Time: 3hrs **[Total Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
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1 Attempt any FOUR [20]

a State Working of TG logic with proper diagram [10]

b Explain Flash memory in brief.

c For n-channel MOSFET $V_T = 1.75$ V, $V_{GS}=5V$, $V_{DS} = 2V$, $I_D = 120A$, $COX=51.72$ nF/CM^2, $\mu n =400$ CM^2/S. Find the region of operation and W/L ratio. [10]

d Explain MOSFET electrical characteristics.

e Write short note on clock distribution.

2 a Explain P-MOS fabrication with neat and clean diagram. [10]

b Consider a CMOS inverter with following parameters: [10]

nMOS VTN = 0.6 V Kn = 200 µA/V2

pMOS VTp = -0.7 V Kp = 80 µA/V2 Kr = 2.5

Calculate noise margin. The power supply voltage is VDD = 3.3 V.

3 a Design SR Latch using CMOS logic and draw its layout [10]

b i) Explain short channel effects in VLSI [10]

ii) Implement carry circuit of 4 bit carry lookahead adder.

4 a Realize the expression for AND gate using the following logic style. [10]

1. Clocked CMOS logic
2. Pseudo NMOS
3. Dynamic PMOS
4. Domino Logic

b Draw and explain 6-T SRAM with neat and clean diagram. Explain read and write condition with equations. [10]

5 a Implement using CMOS logic 1) 1-Bit full adder 2) DFF using TG. [10]

b State and explain different types of ROM memory. Draw 4 *4 bit NAND based array to store the following data in respective memory locations. [10]

Memory address	Data
1000	1101
0100	1001
0010	1010
0001	1001

6 a Illustrate RTL design of 3 TAP Serial FIR filter with HLSM,FSM and datapath. Calculate hardware required for 100 TAP filter. [10]

b Draw and explain VTC characteristics of CMOS inverter in detail. [10]

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e: 3 hours

Max. Marks: 80

N.B. : 1) Question no. 1 is compulsory
2) Answer any 3 questions from remaining five questions

1 Answer any four questions

a. Define mathematical, statistical, and axiomatic definitions of probability. **05**
b. Define PDF and CDF of random variables with properties. **05**
c. Define Autocorrelation Function. List the properties. **05**
d. Explain the central limit theorem **05**
e. Define n^{th} order stationary process. When will it become a WSS process? **05**

2 a. For a certain binary, communication channel, the probability that a transmitted '0' is received as a '0' is 0.95 and the probability that a transmitted '1' is received as '1' is 0.90. if the probability that a '0' is transmitted is 0.4, find the probability that **10**
i) '1' is received ii) a '1' was transmitted given that a '1' was received iii) Error Probability
b. Find mean and variance of binomial distribution using characteristic function **10**

3 a. If the probability of success is 0.2, how many trials are necessary in order that probability of at least one success is greater than 0.5? **10**
b. The joint pdf of the random variables (X, Y) is given by **10**

$$f(x,y) = kxye^{-(x^2+y^2)},\ x>0,\ y>0$$
$$= 0\ ,\ \text{elsewhere}$$

Find the value of k and prove that X and Y are independent.

4 a. Prove that for a linear time invariant system, if the input is a WSS process, then output is also WSS Process. **10**
b. Find the equation of the regression line from the following data. Calculate MSE. **10**

X	1	3	5	7	9	10
Y	9	8	10	12	11	13

5 a. If the WSS process X (t) is given by X (t) = 10 cos (100t+ θ), where θ is uniformly distributed over (-π, π). Prove that X (t) is correlation ergodic. **10**
b. If two random variables X and Y are independent, find the pdf of Z=X+Y if $f(X)=5e^{-5x}$ and $f(Y)=2e^{-2y}$, x > 0 and y > 0 **10**

6 a. Find the correlation coefficient for the bivariate random variable (x, y) having the joint probability function. **10**

$$f(x, y) = \frac{3}{2}(x^2 + y^2)\ ;\ 0 \le x \le 1;\ 0 \le y \le 1$$
$$= 0\ ;\ \text{elsewhere}$$

b. Write a note on **10**
i) Bayes Theorem ii) Gaussian process

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Paper / Subject Code: 32229 / Department Level Optional Course-1: Sensor Technology

TE | Sem - V | EXTC | C-2019 | NOV-2023

Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR **[20]**
a Explain the components of MEMS and their functions.
b Discuss applications of Humidity sensors with an example.
c Explain in brief about UWB.
d Discuss the role of sensors in biomedical applications
e Discuss the factors that leads to need of signal conditioning.

2 a Describe the components of RFID? Discuss types of tags in RFID with its diagram. **[10]**
b Categorize different types of Proximity sensors with their applications. **[10]**

3 a List various sensors used in Onboard Automobile sensing system. Explain any one sensor in detail. **[10]**
b Distinguish between Analog and Digital sensors based on signal representation, B.W., Noise immunity, memory, and applications. **[10]**

4 a Explain in detail with block diagram working of Smart sensors. **[10]**
b Illustrate the working principle and applications of Thermocouple. **[10]**

5 a Explain Data logger with the help of block diagram and its functions. **[10]**
b Illustrate the working of MEMS Pressure Sensors and its applications. **[10]**

6 a Discuss the role of different types of sensors used in underwater sensing **[10]**
b Describe with a block diagram working of 3-bit Flash ADC **[10]**

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