University of Mumbai
Examination Second Half 2022

Program: **BE EXTC**

Curriculum Scheme: Rev2016

Examination: TE Semester V

Paper Code: 32202 Course Code: ECC 501 and Course Name: Digital Communication

Time: 2hour 30 minutes Max. Marks: 80

Q1(20 Marks)	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	What is the range of values that entropy of a source can take? Assume that the source can transmit N possible messages.
Option A:	[0, 1],
Option B:	[0, log*N*],
Option C:	[1, log*N* + 1],
Option D:	(0, log*N*)
2.	Consider 16-QPSK modulation system. How many bits per symbol and number of symbols exist, respectively, in this system?
Option A:	16, 4
Option B:	4, 16
Option C:	16, 2
Option D:	2, 16
3.	What is the relationship between the PDF and CDF of any random variable?
Option A:	PDF is the integral of CDF
Option B:	PDF is the derivative of CDF
Option C:	PDF is CDF multiplied by a constant
Option D:	PDF is CDF raised to a constant
4.	Consider a (7, 4) cyclic code with the generator polynomial $G(x) = x^3 + x^2 + 1$. Determine the systematic cyclic codeword for the data 1110.
Option A:	1110010
Option B:	1101110
Option C:	1110111
Option D:	1110101
5.	By grouping longer sequences and proper source coding, it is possible to
Option A:	Reduce delay in the transmission
Option B:	Increase code efficiency
Option C:	Equate entropy with channel capacity.
Option D:	Reduce transmission errors.
6.	For the (n, k) systematic cyclic code, how many bits are present in the syndrome at the receiver?
Option A:	k
Option B:	n
Option C:	n – k
Option D:	n – k + 1
7.	The phase difference between symbols for a QPSK modulator is
Option A:	0 degree
Option B:	45 degrees

Option C:	90 degrees
Option D:	180 degrees
8.	In the eye diagram, what does the squinted (i.e. asymmetric) eye pattern represent?
Option A:	linear distortion
Option B:	fading
Option C:	non-linear distortion
Option D:	no distortion
9.	What is the expression for the maximum SNR of the matched filter, where E is the symbol energy and N0 is the noise PSD?
Option A:	E/N0,
Option B:	2E/N0,
Option C:	E/(2N0),
Option D:	4E/N0
10.	Which of the following inequalities is used to determine the maximum SNR for the matched filter?
Option A:	Cauchy
Option B:	Cauchy-Schwarz
Option C:	Schwarz
Option D:	Euclidean

Q2 (20 Marks)	
A	**Solve any Two** **5 marks each**
i.	Define QAM. Explain the relationship between the minimum bandwidth required and the bitrate for 16-QAM system.
ii.	Define channel capacity. What are the key factors which effect the channel capacity?
iii.	Distinguish between continuous and discrete random variables.
B	**Solve any One** **10 marks each**
i.	Differentiate QPSK and OQPSK. Sketch the QPSK wave form for the sequence 0110100.
ii.	Using the generator polynomials, $g_{1(x)} = 1 + x + x^2$, and $g_{2(x)} = 1 + x^2$, Write the convolutional code for the data sequence 101011.

Q3 (20 Marks)	
A	**Solve any Two** **5 marks each**
i.	What is matched filter? State its important properties.
ii.	What is the difference between source coding, line coding and error control coding?
iii.	Write a brief note on Inter Symbol Interference (ISI).
B	**Solve any One** **10 marks each**
i.	Justify that probability of error in matched filter does not depend upon shape of input signal. Derive the relevant expression.
ii.	Describe the coherent detection method of binary FSK signal. Also draw power spectra for BFSK modulated signal.

Q4 (20 Marks)	
A	**Solve any Two** **5 mark each**
i.	Explain the steps involved in digital transmission of analog signal.
ii.	State Central Limit Theorem. What is the significance of Central Limit Theorem?
iii.	Define entropy and state its properties.
B	**Solve any One** **10 mark each**
i.	Design a cyclic code encoder using shift registers using the generator polynomial $g(x) = 1 + x + x^2 + x^4$
ii.	Consider an alphabet of DMS having five different source symbols with their respective probabilities as 0.1,0.2,0.4,0.1 and 0.2 a) Create a Huffman tree by placing the combined probability lower than that of other similar probability in the reduced list. b) Tabulate the codeword and the length of codeword for each source symbols. c) Determine the average codeword length of specified DMS. d) Comment on the results obtained.

University of Mumbai

Examination First Half 2022

Program: Electronics and Telecommunication Engineering

Curriculum Scheme: (R- 16) (C Scheme)

Examination: TE Semester V

Course Code: ECC504 and Course Name: Discrete Time Signal Processing

Time: 2 hour 30 minutes Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	Consider two real sequences $x_1(n)$ and $x_2(n)$ with their DFTs $X_1[k]$ & $X_2[K]$ respectively. If $x[n]=ax_1[n]+bx_2[n]$ then what is X(k)
Option A:	$[X_1(k)+ X_2(k)]$
Option B:	$[aX_1(k)+ bX_2(k)]$
Option C:	$[X_1(k)/a+ X_2(k)/b]$
Option D:	$[aX_1(k)-bX_2(k)]$
2.	Find the IDFT of the given sequence X (k) = {10.-2+2j, -2, -2-2j}
Option A:	[1,2,3,4]
Option B:	[3,4,2,1]
Option C:	[4,3,2,1]
Option D:	[0,1,0,3]
3.	For mapping from analog domain to digital domain i. e. $s=\sigma+j\Omega$ and $z=re^{j\omega}$, then what is the condition on σ if r>1?
Option A:	$\sigma > 0$
Option B:	$\sigma < 0$
Option C:	$\sigma > 1$
Option D:	$\sigma > 1$
4.	The nonlinear relation between the analog and digital frequencies is called
Option A:	Aliasing
Option B:	Anti- aliasing
Option C:	Frequency Warping
Option D:	Mapping
5.	The number of complex additions that we need to perform in the linear filtering of any sequence using the FFT algorithm would be:
Option A:	$N\log_2 N$
Option B:	$(N/2)\log_2 N$
Option C:	$2N\log_2 N$
Option D:	(N/2)logN
6.	If DFT of x[n] = {1, 2, 3, 4}is X(k)= {10, -2+2j, -2, -2-2j}. Which property of DFT will result into DFT of x1[n] is X1(k) = {-2, -2-2j, 10, -2+2j}?
Option A:	Time Reversal
Option B:	Complex Conjugate

Option C:	Frequency shifting
Option D:	Time shifting
7.	The location of compulsory zero in a Type II linear phase FIR filter is at_____ and in Type IV is at _____
Option A:	$z = -1,\ z = +1$
Option B:	$z = +1,\ z = -1$
Option C:	$z = \pm 1$, No compulsory zeros
Option D:	No compulsory zeros, $z = \pm 1$
8.	_____is a method where the speech signal is subdivided into several frequency bands and each band is digitally encoded separately with different number of bits.
Option A:	Quantization
Option B:	Sub band Coding
Option C:	Filtering
Option D:	Truncation
9.	Why rounding is preferred than truncation for quantization.
Option A:	Quantization error will be more in rounding than in truncation
Option B:	Quantization error will be less in rounding than in truncation
Option C:	Rounding is easy
Option D:	Rounding required less time.
10.	In the cascaded form of realization, the polynomials are factored into
Option A:	a product of 1st-order and 2nd-order polynomials
Option B:	a product of 2nd-order and 3rd-order polynomials
Option C:	sum of 1st-order and 2nd-order polynomials
Option D:	sum of 2nd-order and 3rd-order polynomials

For Q2 to Q4 Each 20 Marks, Use any of the Following Format

Q2	**Solve any Four out of Six** **5 marks each**
A	Determine circular convolution of the sequences $x_1(n)$ and $x_2(n)$ using DFT/IDFT only $x_1(n)$= [1, 2, 3, 1] and $x_2(n)$= [4, 3, 2, 2]
B	What are linear phase filters? What conditions are to be satisfied by the impulse response in order to have LP? Define phase delay and group delay.
C	For the analog transfer function H(S), Determine H(z) using impulse invariance method. Assume T=1sec. $H(s) = \frac{1}{(s+1)+(s+2)}$
D	For the given transfer function of discrete time causal system $H(z) = \frac{1 - z^{-1}}{1 - 0.2z^{-1} - 0.15z^{-2}}$ Draw cascade and parallel realization.
E	Explain Application of DSP for ECG signals analysis.
F	Short note on finite word length effect in digital filters.

Q3	**Solve any One Questions out of Two** **10 marks each**
A	Find linear convolution using overlap add and overlap-save method x(n)=[1,2,-1,2,3,-2,-3,-1,1,1,1,2,1] and h(n)=[1,2,3].
B	Determine the filter coefficient hd(n) for the desired frequency response of low pass filter given by $H(e^{jw}) = e^{-3jw} \quad \frac{-\pi}{2} \leq w \leq \frac{\pi}{2}$ $= 0 \quad \frac{\pi}{2} \leq w \leq \pi$ Also find transfer function using hanning window.

Q4 A	**Solve any One Questions out of Two** **10 marks each**
i	Find the order and cut off frequency of Butterworth digital filter with $0.8 \leq \lvert H(e^{jw}) \rvert \leq 1 \quad 0 \leq w \leq 0.2\pi$ $\lvert H(e^{jw}) \rvert \leq 0.2 \quad 0.6\pi \leq w \leq \pi$ using IIM and BLT method.
ii	An eight-point sequence x_1(n)= [1,2,3,4,5,6,7,8] a) Find the DFT of x_1(n) i.e. $X_1(k)$using DIT FFT technique. b) Let x_2(n)=[5,6,7,8,1,2,3,4] using appropriate DFT property and answer of part a determine $X_2(k)$.
Q4 B	**Solve any Two Questions out of Three** **5 Marks each**
i	One of the zeros of causal LP FIR filter is at $0.5e^{j\pi/3}$. Show the locations of other zeros and hence find the transfer function and impulse response of the filter.
ii	A cascade realization of two first order digital filters are $H_1(z) = \frac{1}{1-0.9z^{-1}}$ and $H_1(z) = \frac{1}{1-0.8z^{-1}}$. Determine the overall o/p noise power.
iii	Write a short note on frequency sampling realization of FIR filters.