

University of Mumbai
Examination First Half 2022

Examinations Commencing from 17th May 2022 to 15th June 2022

Program: Electronics and Telecommunication Engg.

Curriculum Scheme: Rev2019

Examination: TE Semester V

Paper Code 32221 Course Code: ECC 501 and Course Name: Digital Communication

Time: 2 hour 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Entropy is maximum when
Option A:	Symbols with equal probability
Option B:	Symbols with unequal probability
Option C:	Less no. of symbols
Option D:	None of the above
2.	For a (6, 3) block code, 6 is the ----- and 3 is the number of redundant bits
Option A:	Information bits
Option B:	Redundant bits
Option C:	Information rate
Option D:	Total number of bits
3.	If a source generates symbols with the rate of 500 symbols/sec and entropy of the source is 5 bits/symbol, the information rate will be
Option A:	1520bps
Option B:	1220bps
Option C:	1250 bps
Option D:	2000bps
4.	If SNR is 20dB and channel BW is 2.4 KHz, the channel capacity will be
Option A:	16 kbps

Option B:	20 kbps
Option C:	32 kbps
Option D:	40 kbps
5.	BW requirement for QPSK is
Option A:	F_b
Option B:	$F_b/2$
Option C:	$4f_b$
Option D:	$2f_b$
6.	For M equally likely messages, the average amount of information H is
Option A:	$H = 2\log_2 M$
Option B:	$H = 10\log_{10} M$
Option C:	$H = 2\log_{10} M$
Option D:	$H = \log_2 M$
7.	The Euclidean distance for QPSK is
Option A:	$\sqrt{2Eb}$
Option B:	$\sqrt{1.5Eb}$
Option C:	\sqrt{Eb}
Option D:	$2\sqrt{Eb}$
8.	In a digital communication system, the input data rate is 1Mbps and carrier frequency is 500kHz, BW required for 16 PSK system is
Option A:	1 Mbps
Option B:	1.5 Mbps
Option C:	2 Mbps
Option D:	0.5 Mbps
9.	In (n, k) linear block code, the parity bits are defined as $m = n - k$, the number of message bits are

Option A:	$k = 2^m - 1 - m$
Option B:	$k = 2^n - 1 - m$
Option C:	$k = 2^m - 1 - n$
Option D:	$k = n - 1 - m$
10.	ISI can be reduced by
Option A:	Differential coding
Option B:	Polar NRZ
Option C:	Manchester coding
Option D:	Unipolar RZ

Q2	
A	Solve any Two 5 marks each
i.	Explain coherent and non-coherent detection.
ii.	Define code rate, code efficiency, systematic and non-systematic code in context with linear block code.
iii.	Why is MSK called shaped QPSK?
B	Solve any One 10 marks each
i.	Explain working of 16-ary PSK transmitter and receiver and plot spectrum and calculate BW.
ii.	What is an eye diagram? With the help of a suitable diagram explain the parameters observed from the diagram.

Q3	
A	Solve any Two 5 marks each
i.	Define entropy and when entropy is maximum.
ii.	Explain characteristics of line codes.
iii.	Compare OQPSK and non-OQPSK.
B	Solve any One 10 mark each
i.	A DMS generates symbols A(0.4), B(0.2), C(0.1), D(0.1), E(0.1), F(0.1) Calculate Entropy of the source, obtain Huffman code and its code efficiency.
ii	Explain OQPSK transmitter with block diagram and draw the modulated output waveform for the given input sequence $b(t) = 1001110$

Q4.	
A	Solve any Two 5 marks each
i.	Compare FEC and ARQ system
ii.	Justify that the probability of error in a matched filter does not depend on the shape of the input signal.
iii.	Explain soft decision and hard decision decoding.
B	Solve any One 10 marks each
i.	<p>The parity check bits of a (8,4) block codes are generated by</p> $C_5 = d_1 + d_2 + d_4$ $C_6 = d_1 + d_2 + d_3$ $C_7 = d_1 + d_3 + d_4$ $C_8 = d_2 + d_3 + d_4$ <p>Where d_1, d_2, d_3, d_4 are message bits.</p> <p>Find (1) Generator matrix and Parity check matrix (2) Minimum weight of the code (3) Obtain code vector for message bits (1) 1100 and (2) 1001</p>
ii.	Explain Viterbi decoding algorithm for convolutional code.

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Examination First Half 2022

Program: Electronics and Telecommunication Engineering

Curriculum Scheme: (R- 19) (C Scheme)

Examination: TE Semester V

Course Code: ECC502 and Course Name: Discrete Time Signal Processing

Time: 2 hour 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	If discrete time signal $x[n]$ is real with its N-point DFT as $X(k)$, what is the DFT of $x[-n]$?
Option A:	$X(-k)$
Option B:	$-X(k)$
Option C:	$X(k)$
Option D:	$NX(k)$
2.	An FIR filter which has the following property $ \angle H(0) - \angle H(\pi) = 0$ behaves like an
Option A:	Maximum phase system
Option B:	Minimum phase system
Option C:	Mixed phase system
Option D:	Zero phase system
3.	The filter with difference equation $y(n) = x(n) + x(n-1)$ is defined as
Option A:	FIR Low pass filter
Option B:	FIR High Pass filter
Option C:	IIR Low pass filter
Option D:	IIR High Pass filter
4.	Round off error for sign magnitude and 2's complement binary number representation with b number of bits is given by
Option A:	$-\left(\frac{2^{-b}}{2}\right) \leq \epsilon_R \leq \left(\frac{2^{-b}}{2}\right)$
Option B:	$-(2^{-b}) \leq \epsilon_R \leq 0$
Option C:	$-(2^{-b}) \leq \epsilon_R \leq (2^{-b})$
Option D:	$-(2^{+b}) \leq \epsilon_R \leq 0$
5.	The magnitude response of Butterworth filter has
Option A:	monotonous stop-band and pass-band with ripples
Option B:	monotonous pass band and stop-band with ripples
Option C:	monotonous stop band and monotounous pass band
Option D:	pass-band with ripples and stop-band with ripples
6.	Coefficient symmetry is important in FIR filters to provide
Option A:	less stopband attenuation
Option B:	less passband ripple
Option C:	a smaller transition bandwidth
Option D:	a linear phase response

7.	The DFT of discrete time sequence $x[n] = \delta[n] + 3\delta[n - 1] - 2\delta[n - 2] + 4\delta[n - 3]$ is
Option A:	{6, -1+3j, 8, -1-3j}
Option B:	{6, 1-3j, 8, 1+3j}
Option C:	{6, 3-j, -8, 3+j}
Option D:	{6, 3+j, -8, 3-j}
8.	The abrupt spike present in EEG provides
Option A:	Information about abnormal heart rate
Option B:	Information about EEG rhythms
Option C:	Information about epilepsy condition
Option D:	Information about unconscious state of patient
9.	The anti-symmetric linear phase filter is given by {1 -2 0 2 -1}. Which type of linear phase FIR filter is it?
Option A:	Type 1
Option B:	Type 2
Option C:	Type 3
Option D:	Type 4
10.	Parallel realization is useful for
Option A:	reducing the number of multipliers and adders
Option B:	high speed filtering operation
Option C:	practical implementation of filter
Option D:	achieving a better efficiency of the filter

Q2	Solve any Two Questions out of Three 10 marks each
A	Find the DFT of sequence $x[n]=\{5, 2, 1, 3\}$. Using answer and not otherwise, Find i) $x_1[n]=\{5, -2, 1, -3\}$ ii) $x_2[n]=\{2, 1, 3, 5\}$ iii) $x_3[n]=\{5, 3, 1, 2\}$
B	The desired response of the low pass filter is $H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & -3\pi/4 \leq \omega \leq 3\pi/4 \\ 0 & \text{Otherwise} \end{cases}$ Design the filter using hamming window for M=5
C	Explain the concept of Lattice Ladder realization structure.

Q3	Solve any Two Questions out of Three 10 marks each
A	Design a Butterworth low pass filter using Bilinear transformation for the following constraints (Assume T=1sec): $0.85 \leq H(e^{j\omega}) \leq 1$ for $0 \leq \omega \leq 0.2\pi$ $ H(e^{j\omega}) \leq 0.2$ for $0.6\pi \leq \omega \leq \pi$
B	Find the DFT of the following sequence using DIF-FFT $x[n] = \{1, 2, 3, 4, 0, 0, 0, 0\}$
C	Draw the realization structure for following transfer function using parallel and cascade form? $H(z) = \frac{16z^{-2} + 8z^{-1} + 1}{(4z^{-2} + 4z^{-1} + 1)(2z^{-1} + 1)}$

Q4	Solve any Four out of Six	5 marks each
A	Explain overlap save method of linear filtering using DFT with neat diagram.	
B	Design a digital resonator for a frequency of 50 Hz.	
C	One of the zeros of an asymmetric linear phase FIR filter is at 0.5. Find the location of other zeros. Determine transfer function.	
D	Write a short note on DSP application for ECG signal.	
E	For analog transfer function $H(s) = \frac{1}{(s+1)(s+2)}$ Determine H(z) using impulse invariant method. Assume T=1 sec.	
F	What is Quantization? Explain the different types of quantization error in FIR and IIR filtering?	

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Examinations summer 2022

Program: **Electronics and Telecommunication Engineering**

Curriculum Scheme: Rev2019

Examination: TE Semester V

Course Code: ECC503 and Course Name: Digital VLSI

Time: 2 hour 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	In CMOS logic circuit the n-MOS transistor acts as:
Option A:	Load
Option B:	Pull up network
Option C:	Pull down network
Option D:	Not used in CMOS circuits
2.	In CMOS inverter if VDD and VSS is swapped then circuit is called as
Option A:	Weak Buffer
Option B:	Inverter
Option C:	Invalid circuit
Option D:	Buffer
3.	CMOS domino logic is same as one of the following circuit with inverter at the output line.
Option A:	Clocked CMOS logic
Option B:	Gate logic
Option C:	Dynamic CMOS logic
Option D:	switch logic
4.	Which of the following is not property of Dynamic CMOS logic
Option A:	No static power consumption
Option B:	Requires clock
Option C:	Ratio-ed logic
Option D:	Ratio less logic
5.	In dynamic CMOS during pre-charge the load capacitor is
Option A:	Discharged to Zero.
Option B:	Charged to V_{DD}
Option C:	Charged to $V_{DD}/2$
Option D:	Disconnected.
6.	In FSM, any bit output not explicitly assigned any value in a state is implicitly assigned
Option A:	Zero
Option B:	One
Option C:	Invalid
Option D:	Error
7.	For a NOR based ROM Array which of the following is true
Option A:	If active transistor exist at a crosspoint of column and selected row then the column voltage is never affected
Option B:	If active transistor exist at a crosspoint of column and selected row then the column voltage is pulled up to logic high level by the transistor
Option C:	Logic-1 bit is stored as the presence of an active transistor
Option D:	Logic-0 bit is stored as the presence of an active transistor

8.	Which flip-flop is usually used in the implementation of the registers?
Option A:	D flip-flop
Option B:	S-R flip-flop
Option C:	T flip-flop
Option D:	J-K flip-flop
9.	Sense amplifier produces full logic swing at
Option A:	Input terminal
Option B:	Output terminal
Option C:	Ground
Option D:	Voltage supply
10.	Which method of physical clocking is a recursive structure where the memory elements are grouped together to make the use of nearby or same distribution points?
Option A:	H tree
Option B:	Balanced tree clock network
Option C:	Clock skew
Option D:	Single phase two level clocking

Q2.	Solve any Two	10 marks each
A	Describe with neat diagram CMOS fabrication process	
B	Realize 3 input NAND Gate using CMOS logic. Draw CMOS inverter equivalent circuit and find equivalent W/L for NMOS and PMOS, if $(W/L)_p = 10$ and $(W/L)_n = 20$. Draw its layout.	
C	Implement the 4-bit CLA carry using following design styles 1. Dynamic PMOS 2. Domino	

Q3.	Solve any Two	10 marks each
A	Implement the following 1. DFF using Tristate 2. NAND-NOR-NAND chain Using NORA 3. 1-bit 5 stage shift register using pass transistor 4. Inverter using clocked CMOS	
B	Describe the operation of 6T SRAM cell with proper diagram and waveforms	
C	Implement the following 1. 4-bit array Multiplier 2. 4-bit carry save multiplier	

Q4.	Solve any Two	10 marks each
A	Explain any 2 of the following 1. Clock generation and distribution 2. Carry skip adder 3. Scaling	
B	Solve any 2 of the following 1. MOSFET Capacitance 2. CNTFET 3. Derive equation for Current, power, power density for Full scaling and constant voltage scaling	
C	Design soda dispenser machine using the RTL design process. Draw Datapath, FSM, HLSM	

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Program: **Electronics and Telecommunication Engineering**

Curriculum Scheme: **Rev2019**

Examination: **Third Year Semester V**

Course Code: **ECC504** and Course Name: **Random Signal Analysis**

Time: 3 hours

Max. Marks: 80

Q1. (20 Marks)	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks. 2 marks each
1.	Which of the following is not equally likely event?
Option A:	Tossing a dice
Option B:	Tossing a coin
Option C:	Picking a ball containing many balls of different colors
Option D:	All of the above
2.	If F(x) is a Cumulative distribution function of a random variable X, then F(x)=?
Option A:	1
Option B:	$df(x)/dx$
Option C:	$\int_{-\infty}^x f(x)dx$
Option D:	$\int_{-\infty}^{\infty} f(x)dx$
3.	If X is a Poisson random variable with $P(X=1) = P(X=2)$, find mean and Variance.
Option A:	1 and 2
Option B:	2 and 2
Option C:	3 and 3
Option D:	0 and 1
4.	A random variable X has a uniform distribution over (-3,3) Compute $P(X < 2)$?
Option A:	5/6
Option B:	1/6
Option C:	2/3
Option D:	1/2
5.	Which of the following theorem states that the probability distribution function of the sum of a large number variables of random with arbitrary distribution approaches a Gaussian Distribution?
Option A:	Central Limit Theorem
Option B:	Probability Theorem
Option C:	Central Moment theorem
Option D:	Chebyshev inequality
6.	If the correlation between two random variables X and Y is zero then they are said to be _____.
Option A:	Orthogonal
Option B:	Independent
Option C:	Correlated
Option D:	Uncorrelated

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7.	A random process becomes a random variable when _____ is fixed at some particular value.
Option A:	Time
Option B:	Frequency
Option C:	sample,
Option D:	Amplitude
8.	Which of the following is incorrect statement about the mean value of a Random process?
Option A:	It is an ensemble average of the random process X(t).
Option B:	It is time average of the random process X(t).
Option C:	It is a function of time and is denoted by $\mu_X(t) = E[X(t)]$, where $E[X(t)]$ is the expected value of X(t).
Option D:	It depends upon probability density function of a random process $f_X(x, t)$.
9.	With reference to the mean square value of a random process X(t) which of the following is true?
Option A:	It is also known as total power of random process X(t).
Option B:	It is also known as average power of random variable X.
Option C:	It is calculated by Autocorrelation function at time $t=0$.
Option D:	This parameter is not defined for random process.
10.	Two lines of regression coincide if and only if
Option A:	$\rho_{xy} = 0$
Option B:	$\rho_{xy} = \pm \frac{1}{\sqrt{2}}$
Option C:	$\rho_{xy} = \pm 1$
Option D:	$\rho_{xy} = \pm \frac{1}{2}$

Q2. (20 Marks)	Solve any Two Questions out of Three	10 marks each
A	<p>A company producing electric relays has three manufacturing plants producing 50, 30, and 20 percent, respectively, of its product. Suppose that the probabilities that a relay manufactured by these plants is defective are 0.02, 0.05, and 0.01, respectively.</p> <p>(a) If a relay is selected at random from the output of the company, what is the probability that it is defective?</p> <p>(b) If a relay selected at random is found to be defective, what is the probability that it was manufactured by plant 2?</p>	
B	<p>If the probability mass function of a random variable X is given by, $P(X=r)=kr^3$; $r=1,2,3,4$.</p> <p>Find i) the value of k,</p> <p>ii) $P(1/2 < X < 5/2) / (X > 1)$,</p> <p>iii) the mean and variance of X,</p> <p>iv) the distribution function of X.</p>	
C	<p>Suppose X and Y are two random variables. Define Covariance and correlation of X and Y. When do you say that X and Y are</p> <p>i) Orthogonal</p> <p>ii) Independent</p>	

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	iii) Uncorrelated Are uncorrelated variables independent?
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Q3. (20 Marks)	Solve any Two Questions out of Three. 10 marks each
A	Define discrete and continuous random variables by giving examples. Discuss the properties of distribution function.
B	Write a short note on the following special distributions: 1) Poisson Distribution 2) Gaussian Distribution
C	A Random process is given by $X(t) = 10 \cos(50t + Y)$ where ω is constant and Y is a Random variable that is uniformly distributed in the interval $(0, 2\pi)$. Show that $X(t)$ is a WSS process and it is Correlation ergodic.

Q4. (20 Marks)	Solve any Two Questions out of Three. 10 marks each												
A	The random variables X and Y have joint pdf given by $f_{X,Y}(x,y) = 4xy ; 0 < x < 1, 0 < y < 1$ $= 0 ; \text{otherwise.}$ Find the joint pdf of $V = X^2$ and $W = XY$.												
B	Explain Power spectral density function. State its important properties and prove any two of the properties. Explain Power spectral density function. State its important properties and prove any two of the properties.												
C	The following table gives the data on rainfall and discharge in a certain river. Obtain the line of regression of y and x . <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 5px;">Rainfall (inches) X</td> <td style="padding: 5px;">1.53</td> <td style="padding: 5px;">1.78</td> <td style="padding: 5px;">2.60</td> <td style="padding: 5px;">2.95</td> <td style="padding: 5px;">3.42</td> </tr> <tr> <td style="padding: 5px;">Discharge 100 c.c. Y</td> <td style="padding: 5px;">33.5</td> <td style="padding: 5px;">36.3</td> <td style="padding: 5px;">40.0</td> <td style="padding: 5px;">45.8</td> <td style="padding: 5px;">53.5</td> </tr> </table>	Rainfall (inches) X	1.53	1.78	2.60	2.95	3.42	Discharge 100 c.c. Y	33.5	36.3	40.0	45.8	53.5
Rainfall (inches) X	1.53	1.78	2.60	2.95	3.42								
Discharge 100 c.c. Y	33.5	36.3	40.0	45.8	53.5								

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Examinations Summer 2022

Time: 02 hours 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Which of the following is lossless Text compression technique?
Option A:	MPEG
Option B:	JPEG
Option C:	Arithmetic Coding
Option D:	JBIG
2.	In a public-key system using RSA, you intercept the cipher text $C = 256$ sent to a user whose public key is $e = 17$, $n = 341$. What is the plain text M ? _____.
Option A:	786
Option B:	28
Option C:	07
Option D:	16
3.	Cryptographic hash function takes an arbitrary block of data and returns _____.
Option A:	fixed size bit string
Option B:	variable size bit string
Option C:	both fixed size bit string and variable size bit string
Option D:	variable sized byte string
4.	Data Encryption standard, DES encoder uses a key generator to generate sixteen _____ round keys.
Option A:	32 bits
Option B:	64 bits
Option C:	48 bits
Option D:	42 bits
5.	The _____ method provides a one-time session key for two parties.
Option A:	Diffie-Hellman
Option B:	RSA
Option C:	DES
Option D:	AES
6.	Choosing a discrete value that is near but not exactly at the analog signal level leads to _____.
Option A:	PCM error
Option B:	Quantization error
Option C:	PAM error
Option D:	Sampling error
7.	In JPEG and JPEG 2000 standards, compression of still images is based on _____ and _____ respectively.
Option A:	Cosine Transform, Hadamard Transform,
Option B:	DCT, Walsh Transform

Option C:	IDCT, Discrete Wavelet Transform (DWT)
Option D:	DCT, Discrete Wavelet Transform (DWT)
8.	In digital signature algorithm, the responsibility of a certification authority is to authenticate the _____.
Option A:	private keys of subscribers
Option B:	public keys of subscribers
Option C:	key used in DES
Option D:	hash function used
9.	Which of the following is not a type of symmetric-key cryptography technique?
Option A:	Diffie Hellman cipher
Option B:	Data Encryption Standard (DES)
Option C:	Caesar cipher
Option D:	Playfair cipher
10.	In Data Encryption Standard, Triple DES used by the operator _____.
Option A:	can be broken only if the algorithm is known using even slow computer.
Option B:	is impossible to break ever.
Option C:	cannot be broken in reasonable time using presently available computers.
Option D:	can be broken with presently available high-performance computers.

Q2.	Solve any Four out of Six questions.	05 marks each
A	Explain Authentication, Data Integrity and Authorization in cryptography.	
B	Write a short note on DPCM.	
C	Solve the following. 1. $17^{-1} \pmod{23}$ 2. $23^{-1} \pmod{29}$	
D	List advantages of AES over DES.	
E	What is the importance of Ethical Hacking?	
F	Write a short note on H.264 encoder and decoder.	
Q3.	Solve any Two Questions out of Three.	10 marks each
A	Consider a source with alphabet $A = \{a_1, a_2, a_3\}$ with probability model of $\{0.6, 0.02, 0.38\}$ respectively. Perform Arithmetic Coding and generate a decimal tag for the sequence $a_1 a_2 a_3 a_2 a_1$.	
B	Convert plain text "HIDE THE GOLD IN THE TREE STUMP" using Playfair Cipher technique. Use encryption key as "PLAYFAIR EXAMPLE".	
C	Discuss various types of Block Ciphers with examples.	
Q4.	Solve any Two Questions out of Three.	05 marks each
A		
i.	State the advantages of JPEG-2000 over JPEG-LS.	
ii.	What is the significance of HASH functions in message integrity and authentication?	
iii.	How firewall is design to provide security.	
B	Solve any One	10 marks each
i.	Explain RSA algorithm to encrypt the plain text message, $M=2$ for prime numbers $p=17$ and $q=31$, public key $e=7$. Verify that the decrypted text is the same as plain text.	
ii.	Illustrate Diffie-Hellman key exchange algorithm with example.	

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, logN],
Option C:	[1, logN + 1],
Option D:	(0, logN)
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 <ol style="list-style-type: none"> 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

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:	$N\log_2N$
Option B:	$(N/2)\log_2N$
Option C:	$2N\log_2N$
Option D:	$(N/2)\log N$
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 $x_1[n]$ is $X_1(k) = \{-2, -2-2j, 10, -2+2j\}$?
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 $T=1$ sec. $H(s) = \frac{1}{(s+1)(s+2)}$	
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 $h_d(n)$ for the desired frequency response of low pass filter given by $H(e^{jw}) = e^{-3jw} \quad \begin{matrix} -\pi \\ 2 \end{matrix} \leq w \leq \begin{matrix} \pi \\ 2 \end{matrix}$ $= 0 \quad \begin{matrix} \pi \\ 2 \end{matrix} \leq w \leq \pi$ 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 $0.8 \leq H(e^{jw}) \leq 1 \quad 0 \leq w \leq 0.2\pi$ $ H(e^{jw}) \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 $H_2(z) = \frac{1}{1-0.8z^{-1}}$. Determine the overall o/p noise power.	
iii	Write a short note on frequency sampling realization of FIR filters.	