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
	    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.