GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022-2023

ADVANCED DIGITAL COMMUNICATION

MCE101

TIME ALLOTTED: 3 Hours **FULL MARKS: 70**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: 10×1=10

			Marks	CO No
1.	i)	The distribution function of random variable is a) P(X less than or equal to x) b) P(X greater than or equal to x) c) P(X less than x) d) P(X greater than x)	1	CO3
	ii)	If the number of bits per sample in a PCM system is increased from a n to $n + 1$, the improvement in signal to quantization noise ratio will be a) 3 dB b) 6 dB c) $2n$ dB d) n dB	1	CO5
	iii)	At a given probability of error, binary coherent FSK is inferior to binary coherent to binary coherent PSK by a) 6 dB b) 3 dB c) 2 dB d) 0 dB	1	CO4
	iv)	For a bit-rate of 8 Kbps, the best possible values of the transmitted frequencies in a coherent binary FSK system are a) 16 kHz and 20 kHz b) 20 kHz and 32 kHz c) 20 kHz and 40 kHz d) 32 kHz and 40 kHz	1	CO2
	v)	PN sequence converts _____ signal to _____ signal. a) Narrowband, wideband b) Wideband, narrowband c) Unmodulated, modulated d) Low frequency, high frequency	1	CO4

vi) Eye pattern is — 1 — CO2
- a) Is used to study ISI
- b) May be seen on CRO
- c) Resembles the shape of human eye
- d) All of the above

vii) QPSK is a modulation scheme where each symbol consists of — 1 — CO3
- a) 4 bits
- b) 2 bits
- c) 1 bits
- d) M number of bits, depending upon the requirement

viii) _____ is a digital multiple access system in which carrier frequencies is varied in pseudorandom order. — 1 — CO1
- a) CDMA
- b) FCDMA
- c) FHMA
- d) SDMA

ix) The use of non-uniform quantization leads to — 1 — CO4
- a) Reduction of transmission bandwidth
- b) Increase in maximum SNR
- c) Increase in SNR for low bend signal
- d) Simplification of quantization process

x) The spectral density of white noise is — 1 — CO2
- a) Exponential
- b) Uniform
- c) Poisson
- d) Gaussian

xi) Which FSK has no phase discontinuity? — 1 — CO5
- a) Continuous FSK
- b) Discrete FSK
- c) Uniform FSK
- d) None of the mentioned

xii) Which system uses QAM? — 1 — CO1
- a) Digital microwave relay
- b) Dial up modem
- c) Digital microwave relay & Dial up modem
- d) None of the mentioned

GROUP – B
(Short Answer Type Questions)
(Answer any *three* of the following) — **3 x 5 = 15**

		Marks	CO No
2. a.	A box contains 3 red, 4 white and 5 black balls. One ball is drawn at random. Find the probability that it is (i) red (ii) not Black (iii) black or white.	3	CO2
b.	Two dies are thrown simultaneously. Find the probability of getting a 5.	2	CO5

3. a	What are the advantages and disadvantages of bipolar signaling format?	2	CO2
b.	Sketch the PSD of PNRZ and PRZ and determine its bandwidth.	3	CO1
4. a.	Draw the signal space representation of BFSK and find the distance between symbols.	3	CO2
b.	Find the probability of error in Phase Shift Keying (PSK).	2	CO3
5. a	What is an Integrate and Dump filter?	2	CO3
b.	Derive the expression of its Signal to noise Ratio.	3	CO3
6. a.	Why PN sequence is called pseudo noise?	2	CO4
b.	What is jamming margin and how is it related to processing gain?	3	CO4

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

		Marks	CO No.
7. a.	Show that the squared length of any signal vector is equal to the energy of the signal.	5	CO1
b.	A pair of signals $s_i(t)$ and $s_k(t)$ have a common duration T, show that the inner product of this pair of signals is given by $$\int_0^T s_i(t)\, s_k(t)dt = \boldsymbol{s}_i^T \boldsymbol{s}_k$$ Where $\boldsymbol{s}_i$ and $\boldsymbol{s}_k$ denote the vector representations of the signals $s_i(t)$ and $s_k(t)$ respectively.	5	CO3
c.	A pair of signals $s_i(t)$ and $s_k(t)$ have a common duration T, show that $$\int_0^T \big(s_i(t) - s_k(t)\big)^2 dt = \|\boldsymbol{s}_i - \boldsymbol{s}_k\|^2$$ Where $\boldsymbol{s}_i$ and $\boldsymbol{s}_k$ denote the vector representations of the signals $s_i(t)$ and $s_k(t)$ respectively.	5	CO3
8. a.	How does decision region in signal space offer a technique for finding minimum error probability in symbol detection?	5	CO4
b.	A speech signal has a total duration of 10 s. It is sampled at the rate of 8 kHz and then encoded. The signal-to-(quantization) noise ratio is required to be 40 dB. Calculate the minimum storage capacity needed to accommodate this digitized speech signal.	5	CO1
c.	Consider a sine wave of frequency f_m and amplitude A_m, which is applied to a delta modulator of step size Δ. Show that slope-overload distortion will occur if $A_m > \frac{\Delta}{2\pi f_m T_s}$ where T_s is the sampling period.	5	CO2
9. a.	Draw the constellation diagram of QPSK modulation scheme. Justify use of Grey encoding in QPSK modulation.	7	CO5
b.	Compare QPSK and BPSK modulation schemes in terms of bandwidth efficiency and bit error rate.	4	CO4
c.	Derive an expression of bit error rate in BFSK modulation scheme considering the presence of additive white Gaussian noise.	4	CO4

10.	a.	Discuss about the properties of PN sequence and the applications of spread spectrum modulation.	7	CO3
	b.	What is processing gain (PG)? Explain its importance in narrowband interference rejection in DSSS modulation.	8	CO1
11.		Write short notes on any *three* of the following:	3x5=15	
	a.	Nyquist Criterion for Zero ISI	5	CO4
	b.	Non-Uniform quantization and Companding	5	CO1
	c.	Matched filter	5	CO2
	d.	Gaussian Process	5	CO4
	e.	CSMA-CA	5	CO3