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Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Sixth Semester B.Tech Degree (S,FE) Examination May 2022 (2015 Scheme)

**Course Code: EC302**

**Course Name: Digital Communication**

Max. Marks: 100 Duration: 3 Hours

**PART A**

***Answer any two full questions, each carries 15 marks*** Marks

1 a) Find the mean value and the variance of a random variable X, which is uniformly distributed between x = a to x = b (5)

b) Derive Interpolation formula for reconstructing an analog signal from its sampled version. (10)

2 a) State and prove Nyquist criteria for distortionless transmission (10)

b) Derive an expression for mean square value of output random process if a stationary random process X(t) is given as input to an LTI system. (5)

3 a) Derive the impulse response and frequency response of Duobinary encoder (8)

b) A sinusoidal signal is applied to an DM transmitter having a step size of 0.5V. If the sampling frequency is 15 times the Nyquist rate, then determine the minimum allowed amplitude of the input signal so as to avoid slope overload distortion. (5)

c) How can you overcome the practical limitation of using ideal Nyquist channel? (2)

**PART B**

***Answer any two full questions, each carries 15 marks***

4 a) Explain Gram schmidt orthogonalization procedure to find the orthonormal basis function for the set of M signals. (10)

b) Draw synthesizer for generating the signal waveform from signal vector and analyser for generating the signal vector from the waveform with relevant equations. (5)

5 a) Derive the Bit Error Probability for QPSK. (10)

b) Draw the block diagram for QPSK generation and detection with relevant equations (5)

6 a) Derive mean and variance of received signal x(t) at the output of $k^{th}$ correlator, if $x(t) = s_i(t) + w(t)$ (5)

b) Determine the bit error probability for BPSK system having a bit rate of 1Mbps. The receiver receives the waveforms, $s_1(t) = A\cos(2\pi f_c t)$ and $s_2(t) = -A\cos(2\pi f_c t)$, $0 \le t \le T_b$. The received signals are coherently detected using matched filter. If A=10mV and single sided noise spectral density, $N_0 = 10^{-11}$ W/Hz. Assume signal power and energy per bit are normalised. {erfc(2.24) = 0.001536, erfc(1.06) = 0.133856, erfc(1.78) = 0.011826} (5)

c) Explain ML decoding. (5)

## PART C

***Answer any two full questions, each carries 20 marks***

7 a) Check the balance property and run property for the following PN sequence, (5)

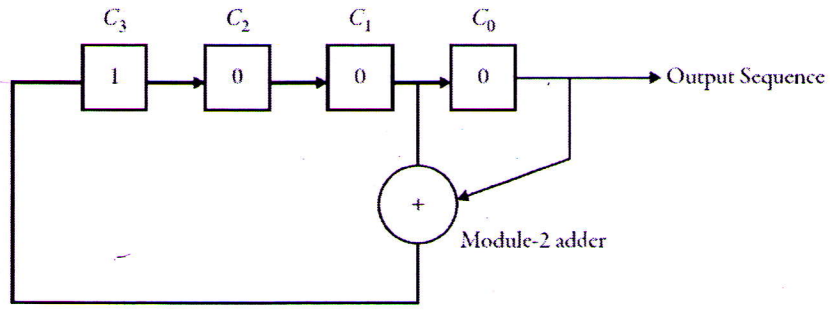
111101011001000

b) Explain the block diagram for DSSS and show that DSSS is immune to interference (10)

c) Write a short note on FDMA technique. (5)

8 a) A PN sequence is generated using 4-stage linear feedback SR, shown in Figure below, with initial condition ( $C_3C_2C_1C_0$) = (1000 ) . This sequence is used in a slow FH/MFSK system. The FH/MFSK signal has the following parameters. (15)

Number of bits per MFSK symbol $k = 2$
Number of MFSK tones $M = 2^k = 4$
Length of PN segment per hop $n = 3$
Total number of frequency hops $2^n = 8$




Find (i) period of PN sequence (ii) PN sequence for one period length (iii) Illustrate the hopping pattern for one period of PN sequence if two symbols are transmitted in one frequency hop. Assume the data sequence as: 10001101000111111001

b) Distinguish between Coherence bandwidth and Coherence time. Give its significance (5)

9 a) Explain the block diagram for OFDM (10)

b) What is PN sequence? How it is generated (5)

c) In a DSSS modulation, it is required to have a jamming margin greater than 26dB. The ratio $E_b/N_0$ is set at 10. Determine the minimum processing gain and the minimum number of stages required to generate the ML sequence. (5)

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