Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2018
SUBJECT: DIGITAL COMMUNICATION (ECE - 3201)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. For the signals shown in FIG 1A, Find
   i. The orthonormal basis functions and plot the signal constellation.
   ii. Euclidian distance between vectors
   iii. Energy of each vector.

1B. Show that doubling the channel bandwidth permits twice the number of bits in a code word.

1C. For the signal shown in FIG 1C, Sketch the impulse response of a filter matched to this signal and sketch it as a function of time. Determine the peak output of the matched filter

(5+3+2)

2A. With neat sketches, explain Differential pulse code modulation (DPCM) and obtain the expression for $(SNR)_P$.

2B. Define entropy. Explain the properties of entropy.

2C. Obtain an expression for the decision rule in the case of a Maximum Likelihood detector assuming AWGN channel

(5+3+2)

3A. Define and derive the expression for average probability of error for the quadri-phase shift keying (QPSK) modulation scheme. Also give the signal constellation diagram

3B. A discrete memoryless source has an alphabet of symbols with probabilities for its output, as described in the table below:

Symbol	s_0	s_1	s_2	s_3	s_4
Probability	0.4	0.2	0.2	0.1	0.1

Compute the Shannan Fano code for this source. Find code efficiency and code redundancy.

3C. Define the NRZ Bipolar format for binary data representation. Assuming that the input binary bits are equally likely, calculate the autocorrelation function $R_A(n)$.

(5+3+2)

4A. The binary data 011100101 are applied to the input of a modified duo-binary system. (i) Construct the modified duo-binary encoder output and the corresponding receiver output without a pre-coder. (ii) Suppose that due to error during the transmission, the level produced by the third digit is reduced to zero. Construct the new receiver output.

4B. Show that the energy of a strictly bandlimited signal $g(t)$ may be expressed in terms of the sample

values of $g(t)$ taken at the Nyquist rate.

4C. A binary data is transmitted over an AWGN channel using phase shift keying at the rate of 1 M bits/sec. It is desired to have average probability of error < 10^{-4}. Noise power spectral density is 10^{-12} watts/Hz. Determine the average carrier power required. Hint: Refer error function table.

(5+3+2)

5A. Develop interpolation formula for reconstructing the original signal $g(t)$, sampled at the Nyquist rate. Also develop the signal space interpretation for the same.

5B. Draw the block diagram of a frequency hop spread spectrum communication system using M-ary Frequency Shift Keying and differentiate between slow hop and fast hop.

5C. The input bit pattern is 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 1 0 0 0. Draw the PCM wave with amplitude levels +1 volt and – 1 volt for bits 1 and 0 respectively. The code word used consists of three bits. Find the sampled version of an analog signal from which this PCM wave is derived.

(5+3+2)

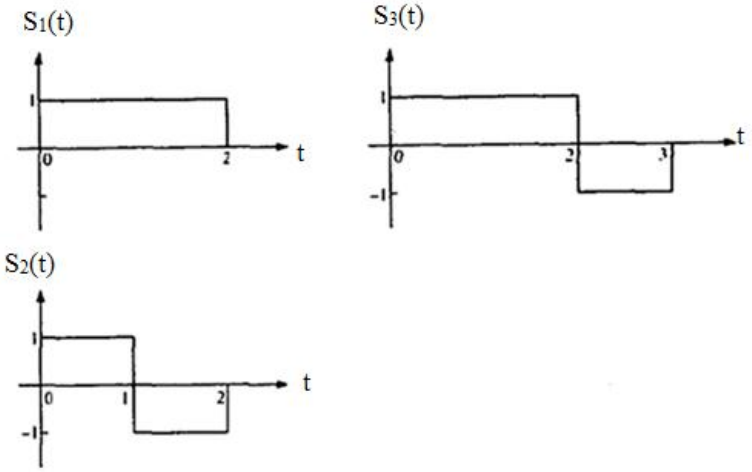

FIG 1 A

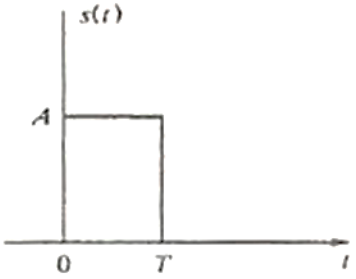

FIG 1 C

Table E.1 Error Function

u	erf(u)	u	erf(u)
0.00	0.00000	1.10	0.88021
0.05	0.05637	1.15	0.89612
0.10	0.11246	1.20	0.91031
0.15	0.16800	1.25	0.92290
0.20	0.22270	1.30	0.93401
0.25	0.27633	1.35	0.94376
0.30	0.32863	1.40	0.95229
0.35	0.37938	1.45	0.95970
0.40	0.42839	1.50	0.96611
0.45	0.47548	1.55	0.97162
0.50	0.52050	1.60	0.97635
0.55	0.56332	1.65	0.98038
0.60	0.60386	1.70	0.98379
0.65	0.64203	1.75	0.98667
0.70	0.67780	1.80	0.98909
0.75	0.71116	1.85	0.99111
0.80	0.74210	1.90	0.99279
0.85	0.77067	1.95	0.99418
0.90	0.79691	2.00	0.99532
0.95	0.82089	2.50	0.99959
1.00	0.84270	3.00	0.99998
1.05	0.86244	3.30	0.999998