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 2019
SUBJECT: DIGITAL COMMUNICATIONS (ECE - 3201)

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

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

1A. A discrete memory-less source X has eight symbols x1, x2, x3, x4, x5, x6, x7 and x8 with probabilities $P(x_1) = 0.01$, $P(x_2) = 0.01$, $P(x_3) = 0.15$, $P(x_4) = 0.1$, $P(x_5) = 0.05$, $P(x_6) = 0.03$, $P(x_7) = 0.4$, $P(x_8) = 0.25$. Perform source encoding using Shannon-Fanon and Huffman encoding techniques. Also, calculate and compare the efficiencies of both techniques.

1B. A convolutional encoder has a single stage (i.e., one flip-flop with constraint length K=2), one modulo-2 adder and an output multiplexer. The generator sequences of the encoder are: $g^{(1)} = (1, 1)$, $g^{(2)} = (1, 0)$. Draw the block diagram of the encoder. Find the encoder output produced by the message sequence 10111.

1C. The PN sequence generator has 3 flip-flops with outputs x_1, x_2 and x_3 respectively. The feedback has a modulo-2 adder with x_2 and x_3 inputs and the feedback is given to the input of first flip-flop. The initial state of flip-flop is 100. Obtain the PN sequence.

(4+3+3)

2A. Determine and plot the power spectral density of a Manchester data format. Assume statistically independent and equally likely message bits.

2B. With a neat diagram explain Generalized correlative coding. Construct a correlative coder which has tap weights $w_0 = +1, w_1 = 0$ and $w_2 = -1$. Encode the binary sequence 001011010 using the same coder.

2C. With a neat diagram of transmitter and the receiver, derive the expression for the probability of error of the coherent Binary Frequency Shift Keying.

(4+3+3)

3A. Derive the maximum likelihood detection rule for the detection of the known equiprobable M-ary signals in noise. Also obtain the expression for the probability of error for the same.

3B. Consider the functions $s_1(t) = e^{-|t|}$ and $s_2(t) = 1 - Ae^{-2|t|}$. Determine the constant, A, such that $s_1(t)$ and $s_2(t)$ are orthogonal over the interval $(-\infty, \infty)$.

3C. Derive the impulse response of a matched filter that gives maximum value of output SNR.

(4+3+3)

4A. Prove that a wide sense stationary message process X(t) that contains 'W' Hertz as highest frequency component can be reconstructed from its samples which are spaced at 1/2W secs apart with zero error power.

4B. Derive the expression for aliasing error while reconstructing the signal from its sampled version. Also mention its maximum value.

4C. Design a TDM PCM system that will accommodate four 300 bps (synchronous) digital inputs and one analog input that has a bandwidth of 500 Hz. Assume that the analog samples will be encoded into 4-bit PCM words.

(4+3+3)

5A. Determine the output SNR in a DM system for a 1 kHz sinusoid, sampled at 32 kHz without slope overload and followed by a 4 kHz post reconstruction filter.

5B. Determine the ratio of minimum to maximum step size in the case of A-law compander.

5C. A binary channel with a bit rate $R_b = 36kbps$ is available for PCM voice transmission. Find appropriate values of the sampling rate, Number of quantization levels and the number of bits per sample if the maximum frequency component is f_m =3.2 kHz

(4+3+3)