Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SECOND SEMESTER M Tech. (DEAC & MICROELECTRONICS) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: SPREAD SPECTRUM COMMUNICATION (ECE - 549)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Demonstrate any three properties of m-sequences using a sequence generated by the polynomial $[23]_8$.

1B. Draw the schematics of an optimum DPSK receiver and explain its working.

1C. Consider a finite set of integers {0, 1, 2, 3}. With the help of $1+D+D^2$, define addition and multiplication tables which together with this set will define a field of four elements.

(5+3+2)

2A. With relevant diagrams, give a spectral domain explanation on how a DSSS system reduces the impacts of a single tone jammer.

2B. Consider a BPSK direct sequence spread spectrum system using differential binary PSK data modulation. Suppose that this system is jammed by a narrowband pulse noise jammer having a total average power of J and duty factor p. Assume that the spreading code chip rate is 20 times the data bit rate. Find the optimum jammer duty factor and the probability of error when the jammer operates at this optimum duty factor

2C. Invert the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 0 \end{bmatrix}$ defined over GF(3) formed with the set S={0,1,2}. Express the inverse such that it contains only the elements from S.

(5+3+2)

3A. A Fibonacci sequence generator is described by $g(D) = 1+D+D^2$.
i. Draw the schematic diagram of this sequence generator
ii. Write the state transition matrix of this sequence generator and hence, obtain the output of this sequence generator if the initial state is $a(D)=1+D$
iii. Apply any five properties of m-sequences on this sequence. Is this an m-sequence?

3B. Suppose -1 1 -1 1 -1 -1 1 1 -1 is a strip of a received m-sequence. If spectral estimate of the received m-sequence is as given in Fig Q.3, obtain the most likely generator polynomial used by the transmitter.

3C. Two separate maximum length sequence generators run by the same clock employ polynomials $1+D^2+D^3$ and $1+D+D^5$ for their feedback connections. What will be the period of the sequence generated through modulo-2 addition of these two maximum length sequences

(5+3+2)

4A. What are preferred maximum length sequences? Generate the entire set of Gold code from a pair of preferred, length 7, maximum length sequences.

4B. Consider a *phase shift keying with carrier component* signal $s(t) = A\sin\left[\omega_0 t + d(t)\cos^{-1} a\right]$ where $d(t)$ takes on values +1 or -1 within the signalling interval T and a is a parameter called as the modulation index. Show that $s(t)$ can be written as the sum of a carrier plus modulated signal component. Use the expression for probability of error in coherent binary signalling schemes and obtain the probability of error as a function of bit energy to noise density ratio and the modulation index.

4C. A direct sequence spread spectrum system is used to communicate between a base station and a mobile station separated by a distance which yields a propagation delay of 0.15μs. The spreading code is a m-sequence specified by $g(D)=1+D^3+D^{10}$ and the code generator clock is 100 MHz. Determine a set of initial conditions for the transmitter and receiver code generators such that, if the generators are started simultaneously, the received signal will be despread.

(5+3+2)

5A. Determine the output of a Galois sequence generator defined by $1+D+D^2+D^3$ with $1+D^2$ as initial state using polynomial division method. Determine the equivalent initial state of a Fibonacci sequence generator defined by the same polynomial as above so that the output of the two sequence generators would be the same.

5B. Derive an expression for average probability of error of a DSSS/BPSK system in the presence of a barrage noise jammer.

5C. Factorize the polynomial $1+D+D^3+D^4$ defined over GF(2)

(5+3+2)

6A. Explain a FHSS system with the help of schematic diagrams. With sample time-frequency diagrams, differentiate clearly between fast and slow hopping

6B. Generate the entire set of length 15 Kasami sequences.

6C. Draw the constellation for $\pi/4$ shifted QPSK and list down its advantages

(5+3+2)

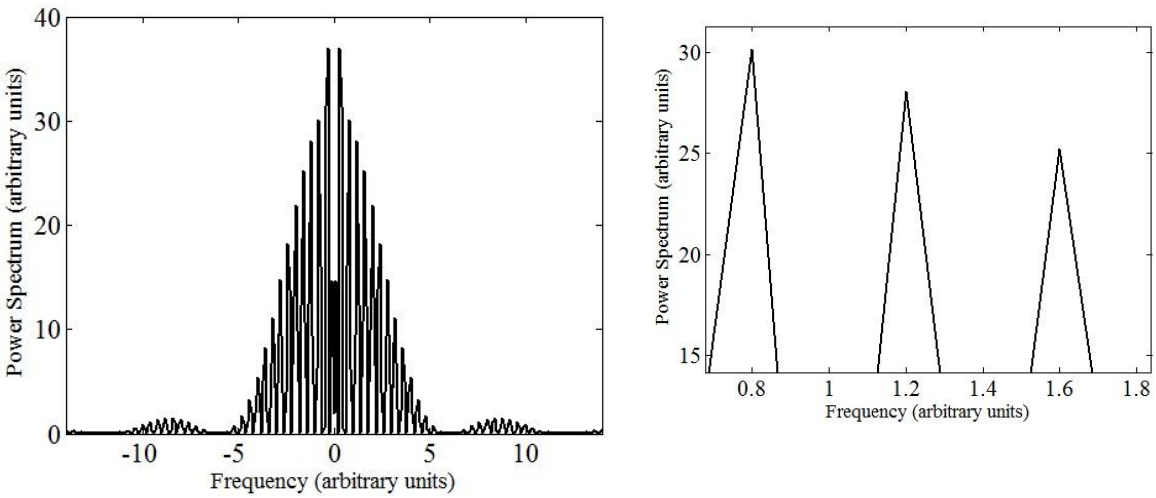

Figure Q.3