

Total number of printed pages-4

53 (EC 712) SSCM

2017

**SPREAD SPECTRUM  
COMMUNICATION**

Paper : EC 712

Full Marks : 100

Time : Three hours

**The figures in the margin indicate  
full marks for the questions.**

Answer **any five** questions.

1. (a) Show that for digital baseband signalling technique using uni-polar NRZ, the error probability decreases as the input SNR to the receiver increases. 15
- (b) What are the criterion for a spread spectrum communication systems to be satisfied? 3

Contd.

(c) Name *two* communication systems which are wide-band, but not spread spectrum communication system. 2

2. Find an expression for the maximum bit error probability in case of a pulse noise jamming. Hence show that this optimised pulse noise jammer can cause a degradation of approximately  $31.5\text{dB}$  relative to a continuous jamming at a BER of  $10^{-5}$ . What methods can mitigate this effect? 17+3

3. (a) Show that a BPSK communication system using DSSS will suppress the effect of narrow-band noise ' $n(t)$ '; you may assume that the noise arises because of a narrow band interfering signal. 10

(b) Show that a BPSK communication system using DSSS can reduce the effect of multipath signal propagation and the effect of a jamming signal using a different spreading code. 8

(c) What is the advantage of using BPSK modulation technique in a DSSS? 2

4. (a) Calculate the power spectrum of the DSSS transmitted signal when BPSK is used for both the data modulation and the spreading code modulation. Assume that the spreading code is 100 times that of the data rate and the period of the spreading code is infinite.

12

(b) Calculate the power spectra for the data modulated carrier and the transmitted signal when BPSK is used for data modulation. Assume that  $T_C = T/3$  ; where 'T' is the data time period and ' $T_C$ ' is the chip duration.

8

5. Suppose that BPSK is used for data modulation and the interference is a single tone having power ' $J$ '. Also assume that the jammer places the jamming tone directly in the centre of the modem's transmission bandwidth. Show that the magnitude of the jammer power that will be passed by an IF filter with transfer function  $H(f)$  is given by  $J_0 = J(T_C/T)$  ; where the symbols have their usual meaning.

20

6. (a) An FHSS/BFSK is used for transmitting binary data coming at the rate of  $20\text{kbs}$ . The unspread BFSK signal occupies a bandwidth of  $25\text{kHz}$ . The received signal power is  $(-15\text{dBm})$ . A jammer which can produce a received power of at the most  $(-20\text{dBm})$  either has a narrowband signal of  $25\text{kHz}$  bandwidth or as a broadband signal occupying the full bandwidth of the FHSS system, is trying to jam the FHSS signal. If the spreading factor 'L' of the FHSS/BFSK system is 25, find the improvements in SNR (dB) under broadband jamming as compared to narrowband jamming. Assume the one-sided Psd of the Awan channel to be  $10^{-11}\text{ W/Hz}$ . 16

(b) A DSSS system is used for range measurement. It gives a range resolution of  $0.01\text{km}$ . Find the value of the chip rate that is required for this purpose. 4