53 (EC 712) SSCM

2018

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)* What are the criteria for a Spread Spectrum Communication system to be satisfied ? 3

   (b) Show that for digital baseband signalling technique using uni-polar NRZ, the error probability decreases as the input SNR to the receiver increases. 17

2. *(a)* Consider a binary optimum system with source probabilities $P_1 \triangleq P(m_1)$ and $P_2 \triangleq P(m_2)$ for messages 'm_1' and 'm_2' respectively. Deduce the optimization criterion for detecting the message 'm_2'. 10

(b) For the given binary optimum system with source probabilities given in Q.2 (a), show that the threshold voltage for decision making is given by

$$V_T = \frac{E_2 - E_1}{2} + \left(\frac{N_0}{2}\right) ln \left(\frac{P_1}{P_2}\right)$$

where $E_i = \int_0^{T_b} \left| S_i^2(t) \right| dt$; '$N_o$' is the two-sided PSD and other symbols have their usual meaning. 10

3. (a) Find an expression for the maximum BER in case of a pulse noise jamming. Hence show that this optimised pulse noise jammer can cause a degradation of approximately 31·5*dB* relative to a continuous jamming at a BER of 10^{-5}. 15

(b) Show that a BPSK communication system using DSSS will suppress the effect of narrowband noise '$n(t)$' ; you may assume that the noise arises because of a narrowband interfering signal. 5

4. 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

5. (a) An FHSS/BFSK is used for transmitting binary data coming at the rate of 20*kbps*. The unspread BFSK signal occupies a bandwidth of 25*kHz*. The received signal power is –15*dBm*. A jammer which can produce a received power of at the most –20*dBm* either has a narrowband signal of 25*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. Assuming the one-sided PSD of the AWGN channel to be 10^{-11} *W/Hz*. 15

(b) A DSSS system is used for range measurement. It gives a range resolution of 0·01*km*. Find the value of the chip rate that will be required for this purpose. 5

6. *(a)* Explain the operation of an FH/MFSK system. 10

(b) Show that in case of a single channel system using spread spectrum modulation and utilizing binary phase modulation, the total power required for transmission can be obtained from the power required for transmitting the data. 10
