53 (EC 712) SSCM

2021

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 to be satisfied for a spread spectrum system? 5

(b) Consider a binary optimum system with source probabilities $P_1 \triangleq P(m_1)$ and $P_2 = P(m_2)$ for messages m_1 and m_2 respectively. Deduce the optimization criterion for detecting message 'm_2'. 15

2. *(a)* For a binary optimum system with source probabilities P_1 and P_2, 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 $E_i = \int_0^{T_b} \left| S_i^2(t) \right| dt$ is the signal energy and the other symbols have their usual meaning. 10

(b) Show that for a digital baseband signalling technique using uni-polar NRZ signal, the error probability decreases as the input SNR to the receiver increases. 10

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

(b) Show that a BPSK communication system using DSSS will suppress the effect of narrowband interference in the form of a tone signal. 5

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

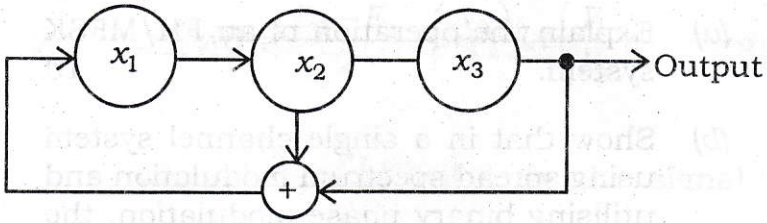
(b) Show that in a single channel system using spread spectrum modulation and utilising binary phase modulation, the total power required for transmission can be obtained (with a specific choice of phase modulation) from the power required for transmitting the data. 10

5. Suppose BPSK is used for data modulation and the interference is a signal 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 idea BPF (IF filter) with transfer function $H(f)$ is given by

$$J_0 = J(T_c/T);$$

where the symbols have their usual meanings. 20

6. *(a)* Assume a 3-stage shift register with an initial load of 111. Show that the output will repeat of the 7th clock pulse. 10



Mod – 2 adder

(b) Explain why an initial load of 000 is not permitted for the generation of PN-sequence. What will be the time period for such a generator? 2+1

(c) 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. 7