53 (EC 712) SSCM

2016

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)* For a given binary optimum system with source probabilities P_1 and P_2 respectively, show that the threshold voltage for decision making is given by

$$V_T = \frac{E_2 - E_1}{2} + \frac{N_0}{2} ln \left(\frac{P_1}{P_2} \right);$$ where the symbols have their usual meaning. 15

(b) For the above optimum binary system, why the transmitted symbols in presence of noise gives probability of error ? 5

2. (a) Prove that for digital baseband signalling technique using uni-polar NRZ, the error probability decreases as the input SNR to the receiver increases. 12

(b) Prove that the error probability for a BPSK signal is given by

$$P_e|_{PSK} = \frac{1}{2} erfc \sqrt{\frac{E_b}{N_o}};$$

the symbols have their usual significance. 8

3. (a) Show that a BPSK communication system using DSSS will suppress the effect of different forms of noise including the noise arising out of interfering signals. 10

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

5+5

4. Calculate the power spectrum of the DSSS transmitted signal when BPSK is used for both the data modulation and the spreading code modulation. Also assume that the spreading code is 100 times that of the data rate and the period of the spreading code is infinitely large. 20

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 passed by an IF filter with transfer function $H(f)$ is given by $J_0 = J\left(\frac{Tc}{T}\right)$; where the symbols have their usual meaning. 20

6. *(a)* Describe the operation of a FHSS/BFSK system. 8

(b) An FHSS/BFSK system is used for transmitting binary data coming at the rate of $20kbps$. The unspread BFSK signal occupies a B.W. of $25kHz$. The received signal power is $-15dBm$. A jammer which can produce a received power of at the most $-20dBm$ either has a narrowband signal of $25kHz$ BW or as a broadband signal occupying the full BW of the FHSS system, is trying to jam the FHSS signal. If the spreading factor is 'L' with a numerical value of 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 $10^{-11}W/Hz$. 12