53 (EC 712) SPCM

2021

(Held in 2022)

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)* 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 a given binary optimum system with source probabilities given in question 1, show that the threshold voltage for decision-making is given by

$$V_T = \frac{E_2 - E_1}{2} + \frac{N_0}{2} \; In \left(\frac{P_1}{P_2} \right) \; ; \text{ where}$$

$E_i = \int_0^{T_h} \left| s_i^2(t) \right| dt$, N_0 is the one-sided power spectral density of the channel noise and the symbols have their usual meaning. 10

2. (a) Show that a BPSK communication system using DSSS will suppress '$n(t)$' noise arising out of narrowband interfering signals. 10

(b) Find an expression for the maximum bit error probability in case of a pulse noise jamming. Hence show that the optimized pulse noise jammer causes a degradation of approximately 31.5 dB relative to continuous jamming at a BER of 10^{-5}. 10

3. *(a)* Calculate the processing gain (G_p) in a BPSK-DSSS system. Assume the jammer to occupy the same carrier frequency and same bandwidth as that of the transmitter. Also assume an ideal bandpass filter with transfer function $H(f)$ and the input and output power to the filter are J and J_0 respectively. 15

(b) What are the advantages of FHSS over DSSS system ? 5

4. *(a)* Discuss the working principle of a PN sequence generator. 10

(b) Discuss how a DSSS system can be used as a 'ranging system' ? 10

5. *(a)* Discuss the working principle of a M-ary BFSK-FHSS system. 10

(b) Show that for a coherent spread spectrum system using binary phase modulation in single channel systems, the total transmitted power can be made equal to the data power 10

$$\left(P_T = P_D \Big|_{\theta = \frac{\pi}{2} \pm n\pi} \right).$$

6. Write short notes on ***any two*** of the following : 10+10

(a) Error probability for a BPSK signal.

(b) Criteria to be satisfied for a spread-spectrum communication system.

(c) Generator polynomial for PN sequence generator.

(d) Direct sequence spread spectrum system (DSSS) in low-probability of detection scheme (LPD).