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53 (EC 712) SPCM

2021

(Held in 2022)

**SPREAD SPECTRUM
COMMUNICATION**

Paper : EC 712

Full Marks : 100

Time : Three hours

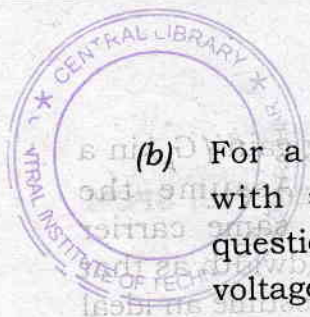
***The figures in the margin indicate
full marks for the questions.***

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

Contd.



(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

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

$E_i = \int_0^{T_h} |s_i^2(t)| dt$, 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

$$\left(P_T = P_D \mid \theta = \frac{\pi}{2} \pm n\pi \right)$$



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).

