METCE EXAMINATION, 2024
(1st Year 1st Semester)
Advanced Digital Communication

Full Marks: 100 **Time: 3 hours**

Answer any five questions

All questions carry equal marks

(Answer all parts and sun-parts of a question serially in the same place)

Q1. a) State the motivation behind Superposition Mapping (SM) scheme over the conventional bijective mapping. [4]

b) State the mapping rules of Equal Power Allocation (EPA) strategy of SM. Using this mapping rule develop a table consisting of input bit load, chips, output symbols and probability mass function (take input bit load of 4). Also, note down your observation in this regard. [3+4+3]

b) Show the variation of Entropy with bit load graphically. Also, summarize your observations. [2+4]

Q2. Answer the following in relation to an OFDM system:

a) How is orthogonality maintained in an OFDM system? [7]

b) Inverse Fast Fourier Transform (IFFT) is used in the transmitter side; whereas, Fast Fourier Transform (FFT) is employed in the receiver side of an OFDM transceiver-explain. [7]

b) The method of Cyclic prefixing can be used effectively in an OFDM system to mitigate the system Inter Symbol Interference (ISI)-explain [6]

Q3.a) Explain, how microscopic and macroscopic diversity techniques can be helpful in mitigating small scale and large scale fading in mobile communication channels. [4]

b) Explain the operations of Selection Diversity and Feedback Diversity techniques. Also, compare their performances. [6+2]

c) Model a radio channel which is suffering from multipath effects. Calculate the overall transfer function of this channel. Hence identify the type of distortion that will occur over the communication channel. Explain how this type of channel can cause frequency selective fading. [2+3+1+2]

Q4.a) Define the following parameters related to the mobile multipath channels: [5+5]

i) Mean excess delay and r.m.s. delay spread
ii) Coherence bandwidth and coherence time

b) When does Flat fading occur in a mobile radio channel? Discuss the characteristics of this type of fading. How does Frequency Selective Fading differ from this? [2+4+4]

Q5. a) A communication system uses an adaptive equalizer in the receiver to minimize the effect of Inter Symbol Interference (ISI). Discuss the operation of the equalizer with the help of proper block diagram and necessary mathematical expressions. [10]

b) Consider a linear adaptive equalizer having transversal structure. How will you train this equalizer? [10]

Q6.a) OQPSK can handle non-linearity in a better way than QPSK-justify the statement. [4]

b) State the principle of operation of Minimum Shift Keying (MSK) technique. Also, draw the block diagram of an MSK transmitter and explain its operation. [4+6]

c) Draw the model of equivalent modulators and derive its equivalence condition. [2+4]

Q7.a) Consider an ideal brick-wall channel model having cut-off frequency equal to the Nyquist frequency as given by $f_N = f_S/2$, where f_S is the symbol rate. Show that for impulse transmission, there is no Inter Symbol Interference (ISI) at the sampling instants. Use necessary mathematical expressions and diagrams. Next, assume that in place of impulses, rectangular pulses are transmitted. What modification would you suggest? [8+2]

b) Write down the expressions of transfer function and impulse response of a Gaussian pulse-shaping filter. Hence draw the impulse response of this filter for various values of BT product, where B and T represent 3-dB bandwidth and symbol period respectively. Also, discuss its salient features. [3+2+5]