Assignment - 03
Total Marks: 44

1. Why are guard bands used in FDM? [4]

2. Distinguish between the two basic multiplexing techniques (FDM and TDM) using appropriate diagrams. [4]

3. Assume that a voice channel occupies a bandwidth of 6 kHz. We need to multiplex 15 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth. [4]

4. Why is statistical TDM more efficient than a synchronous TDM? Why is the synchronization bit required in TDM and why addressing bits are required in statistical TDM? [4]

5. Suppose, you have 5 voice channels, each of 50MBps. You have to use synchronous TDM to multiplex these channels. If 2 characters at a time are multiplexed (2 characters in each output slot), answer the following: [4]
    a. What is the size of an output frame in bits?
    b. What is the output frame rate?
    c. What is the duration of an output frame?
    d. What is the output data rate?
    e. What is the input bit duration?
    f. What is the output bit duration?
    g. What is the output slot duration?

6. We have 14 sources, each creating 500 characters per second. Since only some of these sources are active at any moment, we use statistical TDM to combine these sources using character interleaving. Each frame carries 6 slots at a time, but we need to add four-bit addresses to each slot. Answer the following questions: [4]
    a. What is the size of an output frame in bits?
    b. What is the output frame rate?
    c. What is the duration of an output frame?
    d. What is the output data rate?

7. Two channels, one with a bit rate of 190 kbps and another with a bit rate of 180 kbps, are to be multiplexed using pulse stuffing TDM with no synchronization bits. Answer the following questions: [4]
    a. What is the size of a frame in bits?
    b. What is the frame rate?
    c. What is the duration of a frame?
    d. What is the data rate?

8. Show using a diagram the contents of the **six output frames** for a synchronous TDM multiplexer that combines four sources sending the following characters. Note that the characters are sent in the same order that they are typed. The third source is silent. [4]
    a. Source 1 message: SPRING
    b. Source 2 message: CSE
    c. Source 3 message:
    d. Source 4 message: DATA

9. Four channels, two with a bit rate of 200 kbps and two with a bit rate of 150 kbps, are to be multiplexed **without** adding extra pulse in the input channel. If there are two synchronization bits in the output frame. Write the following answers: [4]
    I. What is the size of a frame in bits?
    II. What is the frame rate?
    III. What is the duration of a frame?
    IV. What is the data rate?
    V. What is the input bit duration?
    VI. How many input channels are there after doing multiplexing?

10. Suppose, you are given a k-bit pattern and Carrier Frequencies as follows:

k-bit pattern

11 01 00 10

K-bit	Carrier Frequency
00	100 KHz
01	200 KHz
10	300 KHz
11	400 KHz

Draw **FHSS** cycle **2 times** using the above pseudo-random generated k-bit pattern and the given frequency table. (** Hint: Draw the Carrier frequency graph against hop period) [4]

11. Assume that we want to send the Original signal **"101"** using **DSSS** technique.

For ensuring higher security, we have invented a **5-bit** spreading code **"01001"**. Draw the corresponding spread signal. You can use bipolar NRZ encoding (0 = negative voltage, 1 = positive voltage) for signal drawing. **Comment** on the **bandwidth** of the spread signal in brief. [4]