Department of Electrical Engineering
Final-Assignment
Date: 22/06/2020

Course Details

Course Title: Advance Computer Networks **Module:**
Instructor: Dr. Naeem Ahmad jan sb **Total Marks:** 50

Student Details

Name: Muhammad Abobakar Sadiq **Student ID:** 15423

Q1.	(a)	The Advanced Mobile Phone System (AMPS) uses two bands. The first band, 800 to 850 MHz, is used for sending; and 860 to 910 MHz is used for receiving. Each user has a bandwidth of 60 KHz in each direction. The 3-KHz voice is modulated using FM, creating 60 KHz of modulated signal. How many people can use their cellular phones simultaneously?	Marks 6
	(b)	Express a period of 1 ms in microseconds, and express the corresponding frequency in kilohertz and A sine wave is offset one-fourth of a cycle with respect to time zero. What is its phase in degrees and radians?	Marks 4
Q2.	(a)	Explain wave division multiplexing and it's applications?	Marks 5
	(b)	Nine channels, each with a 99-KHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 13 KHz between the channels to prevent interference?	Marks 5
Q3.	(a)	A constellation diagram consists of sixteen equally spaced points on a circle. If the bit rate is 4800 bps, what is the baud rate?	Marks 5
	(b)	Given a bandwidth of 7000 Hz for a 128-PSK signal, what are the baud rate and bit rate?	Marks 5
Q4.		Explain wireless propagation methods & wireless transmission waves? We need to send 265kbps over a noiseless channel with a bandwidth of 20KHz. How many signal levels do we need?	Marks 10
Q5.		What is the difference between Shannon & Nyquist Capacity? Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with 4 signal levels, the maximum bit rate can be ?	Marks 10

Question No 1 (a)

The Advanced Mobile Phone System (AMPS) uses two bands. The first band, 800 to 850 MHz, is used for sending; and 860 to 910 MHz is used for receiving. Each user has a bandwidth of 60 KHz in each direction. The 3-KHz voice is modulated using FM, creating 60 KHz of modulated signal. How many people can use their cellular phones simultaneously?

Solution:

Each band is 50 MHz

If we divide 50 MHz by 60 KHz we get 833.33

So in reality the band is divided into 832 Channels

42 of these are used for control which means only 790 channels are available for cellular phone users.

Question No 1 (b)

Express a period of 1 ms in microseconds, and express the corresponding frequency in kilohertz and A sine wave is offset one-fourth of a cycle with respect to time zero. What is its phase in degrees and radians?

Solution:

As 1 millisecond is equal to 1000 micro seconds

So, mathematically

1**ms**=1000**μs**

Or

1ms=10^3 μs

And frequency

As frequency is inversely proportional to time so

F=1/T which implies that F=1/1000 so F=0.001 Hz

In kilohertz

F=0.001×1000

F=1 kHz

2nd part of this question

Need phase in degree and radian?

Solution

As we know that one complete cycle is 360 degrees

Therefore,

¼ cycle is (1/4)360=90 degrees

In radians

$90 \times 2\pi/360$ rad=1.57 radians

Question No 2 (a)

Explain wave division multiplexing and it's applications?

Answer:

Wave Division Multiplexing (WDM)

- Wavelength-division multiplexing (WDM) is designed to use the high-data-rate capability of fiber-optic cable.
- The optical fiber data rate is higher than the data rate of metallic transmission cable, but using a fiber-optic cable for a single line wastes the available bandwidth.
- Multiplexing allows us to combine several lines into one.
- WDM is an analog multiplexing to combine optical signals
- It combines multiple light sources into one light
- WDM modulates each of several light data streams onto a different part of the light spectrum.
- Optical medium has a higher bandwidth/data rate than copper medium
- WDM utilizes this higher bandwidth or data rate

Applications of WDM:

- SONET (Synchronous Optical Network)
- it can multiplex very large no of channels by spacing channels very close to each other
- It achieves greater efficiency.

Question No 2 (b)

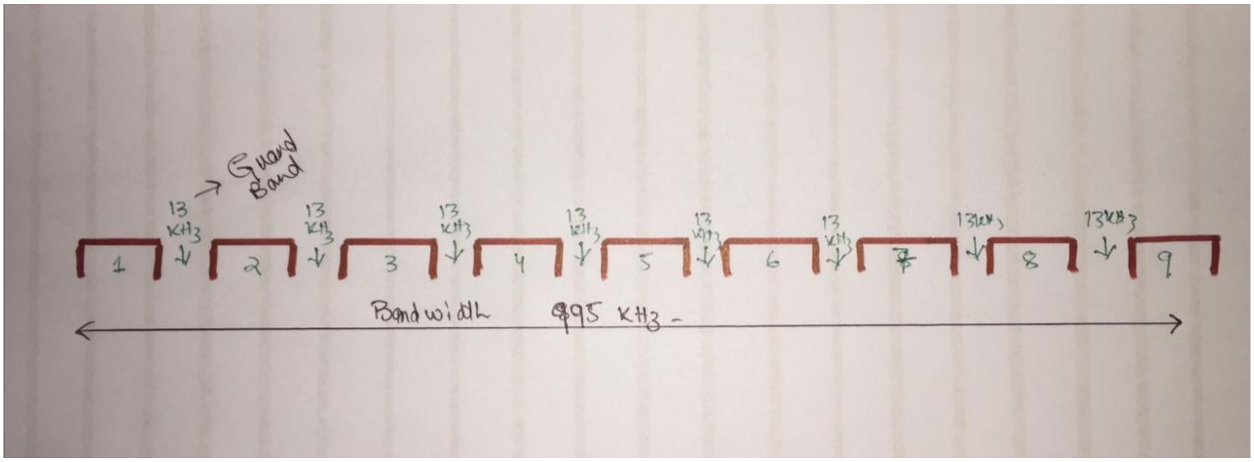
Nine channels, each with a 99-KHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 13 KHz between the channels to prevent interference?

Solution:
For nine channels we need at least 8 guard bands,
So minimum bandwidth is
(9 x 99) + (8 x 13)

891 + 104

995 kHz

As Shown is diagram



Question No 3 (a)
A constellation diagram consists of sixteen equally spaced points on a circle. If the bit rate is 4800 bps, what is the baud rate?

Solution:

Baud rate =?
As 16 = 2^4

So 4 bits are transmitted with each signal unit
Baud rate is

4800/4 = 1200 baud

Question No 3 (b)

Given a bandwidth of 7000 Hz for a 128-PSK signal, what are the baud rate and bit rate?

Solution:
For PSK the baud rate is the same as the bandwidth, which means the baud rate is 7000, but in 128-PSK the bit rate is 7 times the baud rate

$$2^7 = 128$$

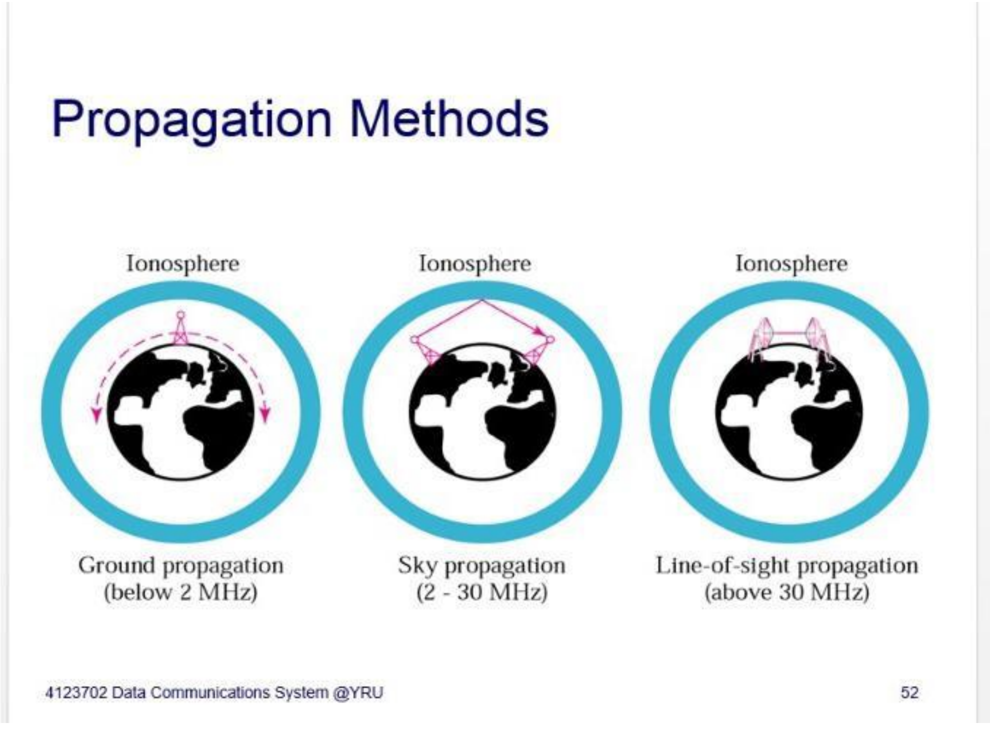
So bit rate is 7 x 7000 = 49000bps

Question No 4

Explain wireless propagation methods & wireless transmission waves? We need to send 265kbps over a noiseless channel with a bandwidth of 20 KHz. How many signal levels do we need?

Answer
Part 1

- Ground – radio waves travel through lowest portion of atmosphere, hugging the Earth
- Sky – higher-frequency radio waves radiate upward into ionosphere and then reflect back to Earth
- Line-of-sight – high-frequency signals transmitted in straight lines directly from antenna to antenna



Bands

Band	Range	Propagation	Application
VLF	3–30 KHz	Ground	Long-range radio navigation
LF	30–300 KHz	Ground	Radio beacons and navigational locators
MF	300 KHz–3 MHz	Sky	AM radio
HF	3–30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF	3–30 GHz	Line-of-sight	Satellite communication
EHF	30–300 GHz	Line-of-sight	Long-range radio navigation

4123702 Data Communications System @YRU 53

Wireless transmission waves:

- Radio Waves
- Microwave
- Infrared

Radio waves:

- Frequency ranges: 3 KHz to 1 GHz
- Omnidirectional
- Susceptible to interference by other antennas using same frequency or band
- Ideal for long-distance broadcasting
- May penetrate walls
- Apps: AM and FM radio, TV, maritime radio, cordless phones, paging

Microwave:

- Frequencies between 1 and 300 GHz
- Unidirectional
- Narrow focus requires sending and receiving antennas to be aligned
- Issues:
    - ➡ Line-of-sight (curvature of the Earth; obstacles)
    - ➡ Cannot penetrate walls

Infrared:

- Frequencies between 300 GHz and 400 THz
- Short-range communication
- High frequencies cannot penetrate walls
- Requires line-of-sight propagation
- Adv: prevents interference between systems in adjacent rooms
- Disadv: cannot use for long-range communication or outside a building due to sun’s rays

2nd Part of the Question 4

Solution:

We ca use the Nyquist formula as shown

$265{,}000 = 2 \times 20{,}000 \times \text{Log}_z L$

Log 2 L = 6.625 L = 26.625 = 98.7 levels

Question No 5

What is the difference between Shannon & Nyquist Capacity? Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with 4 signal levels, the maximum bit rate can be?

Answer:

1st part

Shannon capacity needs Nyquist rate to complete the calculation of capacity with a given bandwidth.

Nyquist rate tells you in order to reconstruct a baseband signal with bandwidth W from sampling, you need to sample the signal at 2W rate. A good intuition is to think about a sine wave. This theory is applying to a signal without noise.

On the contrary, Shannon's Capacity theorem needs to specify noise distribution, Under Gaussian noise,

[math] C = \dfrac{1}{2} \log_2 ({1+\dfrac{P}{N})} [/math] bits per sample,

where [math] P [/math] and [math] N [/math] are power of signal and noise respectively.

Combine with Nyquist rate and calculate the noise power properly, you get channel capacity of bandwidth [math] W [/math] to be,

[math] C = W \log_2 ({1+\dfrac{P}{N_0W}}) [/math] bits per second,

where [math] N_0 [/math] is 2 times of Gaussian noise spectral density.

2nd part of Question No 5

Solution:

Bit rate = ?

Bit rate = 2 x 3000 x Log_2 4

Bit rate = 12,000 bps