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

Course Details

Course Title: Advance Computer Networks **Module:** semester
Instructor: **Total Marks:** 50

Student Details

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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)

Answer:

Solution:

Each band is 50 MHz. If we divide 50 MHz into 60 KHz

50×10^6÷60×10^3=833.33

we get 833.33.

In reality, the band is divided into 832 channels.

people can use their cellular phones simultaneously

Question no:1:(b)

Answer :

Solution:

First we find a period of 1ms in microseconds, and then corresponding frequency in kilohertz.

From the table for 1ms we make substitutions:

$1ms = 1 \times 10^{-3}\ s = 1\times 10^{-3} \times 10^{6}\mu s = 10^{3}\ \mu s$

Now we use the inverse relationship to find the frequency, changing hertz to kilohertz

$1\ ms = 1 \times 10^{-3}\ s = 10^{-3}\ s$
$f = 1/10^{-3}\ Hz = 10^{3}\times 10^{-3}\ KHz = 1\ KHz$

Second part of the question is a sine wave is offset one-fourth of a cycle with respect to time zero.

What is its phase in degrees and radians?

We know that one complete cycle is 360 degrees.
Therefore, 1/4 cycle is
(1/4) 360 = 90 degrees = 90 x 2π /360 rad = 1.57 rad

Question no:02:(a)

Answer:

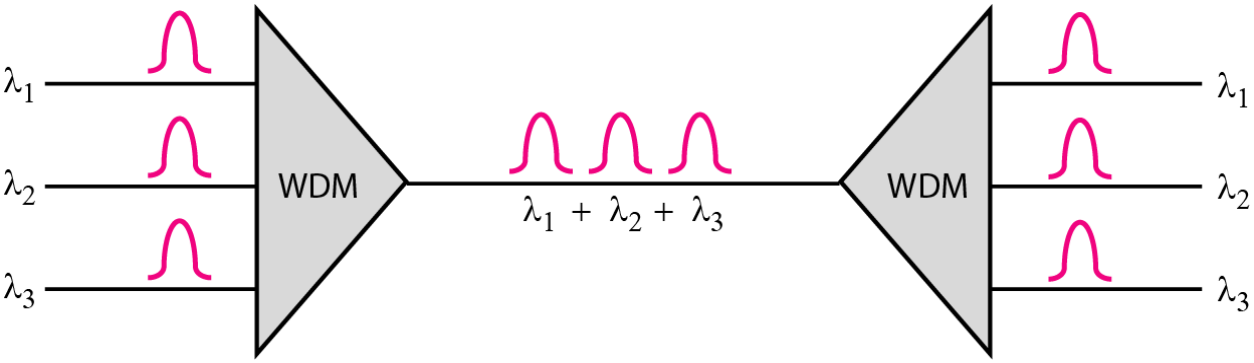
Wave division multiplexing (WDM) is a technique of multiplexing multiple optical carrier signals through a signals through a single optical fiber channel by varying the wavelengths of laser lights. WDM allows communication in both the direction in the fiber cable.

- Use light signals transmitted through fiber-optic channels
- Very narrow bands of light are combined from several sources to make a wider band of light
- A prism is used to bend the light beams based on the angle of incidence and frequency
- Receiver's DEMUX separates signals

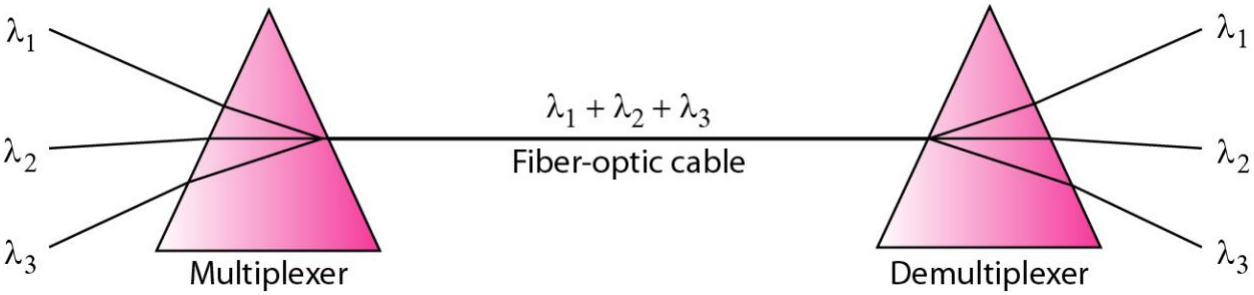
Example:

The following diagram conceptually represents multiplexing using WDM. It has 3 optical signals having 3 different wavelengths. Each of the four senders generates data streams of a particular wavelength. The optical combiner multiplexing the signals and transmits them over a signal long-haul fiber channel, at the receiving end, the splitter demultiplexes the signal into the original 3 data streams. WDM is an analog multiplexing technique to combine optical signals.

WDM:



The following Figure is Prisms in WDM multiplexing and demultiplexing



WDM Applications:

- Application: SONET network

  Multiple optical fiber lines are muxed/demuxed

- DWDM (dense WDM) allows muxing of large numbers of channels by spacing channels closer to one another to achieve greater efficiency

Question no:2 (b)

Answer:

Solution:

For nine channels, we need at least eight guard bands. This means that the required bandwidth is at least

9 x 99 + 8 x 13 = 995 KHz,

Question no:03 (a)
Answer:

Solution:

The constellation indicates 16-PSK.

Since 2^4 = 16

4 bits are transmitted with each signal unit.

Therefore, the baud rate is

4800/4 = 1200 baud.

Question no:03 (b)

Answer:

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.

so the bit rate is =7×7000=49,000 bps.

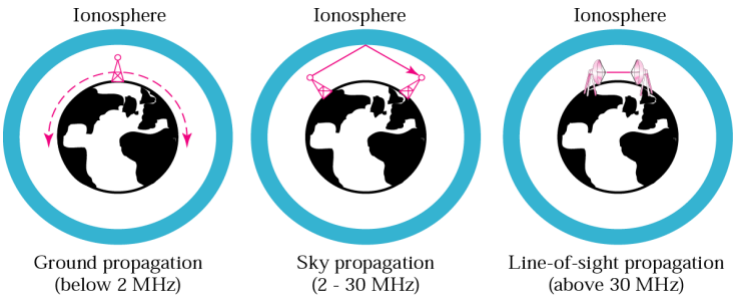
Question no:04

Answer:

Wireless Propagation Methods:

- 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

Propagation Methods:



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

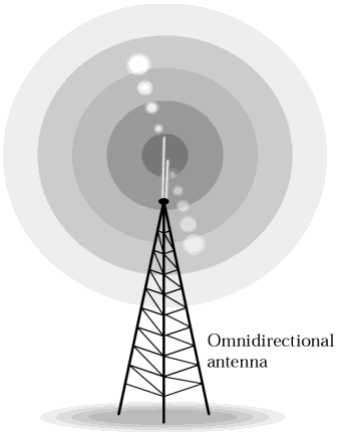
Wireless Transmission Waves

- 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

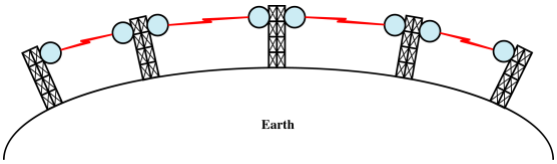
Omnidirectional antennas:



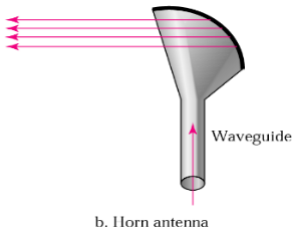
Microwaves:

- 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

Terrestrial Microwave:



- Horn AntennaOutgoing transmissions broadcast through a stem and deflected outward
- Received transmissions collected by a scooped part of the horn and deflected downward into the stem



b. Horn antenna

Microwave Applications

- Unicasting – one-to-one communication between sender and receiver
    - ➡ Cellular phones

- ➥ Satellite networks
- ➥ Wireless LANs

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

Infrared Applications

- Wide bandwidth available for data transmission
- Communication between keyboards, mice, PCs, and printers

Bluetooth

- Bluetooth is a Radio Frequency specification for short-range, point-to-multipoint voice and data transfer.
- Bluetooth can transmit through solid, non-metal objects.
- Its typical link range is from 10 cm to 10 m, but can be extended to 100 m by increasing the power.

Question no:05

Answer:

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

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

On the contrary Shannon capacity theorem needs to specify noise distribution .under Gaussian noise. There is a lot of interference from other source that cause noise on the line.

The Nyquist theorem is extremely important since the measurement tool that you are using needs to be able to sample faster than the source of data.

Solution: second part of the question is

Bit rate=?

Bit rate = 2×3000×Log2 4

Bit rate = 12000 bps