7c. optical **Advantages**. Disadvantages. 4

Advantages	**Disadvantages**
High Bandwidth: Optical fibers have a much higher bandwidth than copper cables, allowing for higher data transfer rates.	Cost: Optical fibers are generally more expensive than copper cables.
Low Attenuation: Optical fibers have much lower signal attenuation than copper cables, allowing signals to be transmitted over longer distances.	Difficult to Install and Maintain: Installing and maintaining optical fiber cables requires specialized equipment and trained personnel.
Immunity to Electromagnetic Interference: Optical fibers are immune to electromagnetic interference (EMI) and radio-frequency interference (RFI), which can cause signal degradation in copper cables.	Fragility: Optical fibers are more fragile than copper cables and can be easily damaged if bent too sharply or subjected to excessive force.
Security: Optical fibers are more difficult to tap into compared to copper cables, making them more secure for transmitting sensitive information.	Limited Availability: Optical fibers may not be available in all locations, limiting their use for data communication.
Durability: Optical fibers have a longer lifespan compared to copper cables, and are less prone to damage from environmental factors such as moisture and temperature fluctuations.	Compatibility: Optical fibers are not always compatible with existing network infrastructure, requiring additional equipment to be installed.

8. a) What do you know about frequency bands for satellite communication? 2

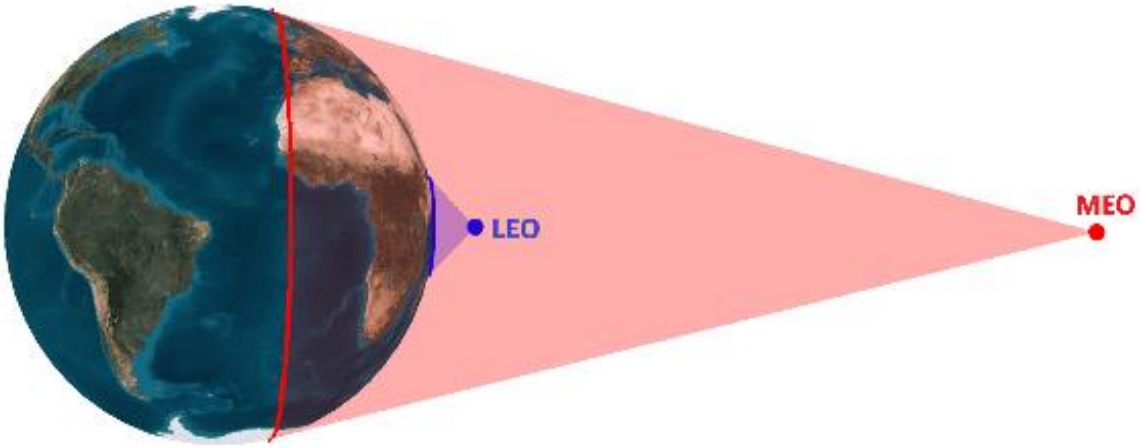
b) What is MEO satellite? Describe it with the example of GPS? 3.75

c) What type of propagation does satellite communication use? How does that mode differ from other propagation modes? 3

a) Answer: Lecture-13 slide-10 book pg-484 (L , S, C, Ku, Ka)

b) Book -485 to 488
Medium Earth orbits (MEO) are Earth-centered orbits with an altitude from 2000 Km to 35,786 Km above the surface of the Earth. The most prominent satellites traversing the MEO are the GPS & the Galileo Satellite constellations which power navigation across the world.

The MEO orbit is located in the Van Halen Radiation belt which is a zone of energetically charged particles that are created due to solar winds by the sun and are captured in the region by the earth's magnetic pull. This region is very dangerous for humans, which is the primary reason for the nonexistence of ISS (International Space stations) or habitable space stations in the MEO as the astronauts are susceptible to high amounts of radiation.



Satellites orbiting in the MEO are highly shielded with materials such as Gold, aluminum, and Kevlar which are stacked in layers that keep the radiation at bay. It is advised that Satellites or manned space missions that need to pass the MEO and venture into space, must do so by crossing the MEO at a very high speed with a maximum thrust thereby limiting the time spent in the Van Halen radiation zone.

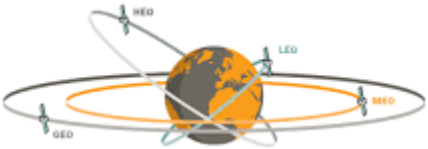
For a satellite to remain in an MEO orbit, it needs to travel at a speed of 7,000 miles per hour (3.13 Km per second). If the satellite's Orbital Velocity is higher than the optimal value, it faces the risk of flying out of orbit and into space, rendering the satellite out of bounds. Additionally,

If the orbital velocity is kept too low, the satellite will be pulled back to earth due to gravity causing it to crash and burn. Hence, if the correct Orbital velocity is maintained the gravity of the earth balances the inertia of the satellite, pulling it down to the earth's surface just enough to enable the satellite to traverse in its intended orbit. At Higher altitudes, the speed required to keep a satellite in an orbit changes. The speed of the satellite in an orbit is inversely proportional to the altitude from the earth's surface.

MEO is the core of navigation systems that make communication and navigation possible on Earth. The number of satellites that are required for earth's coverage is less when compared with LEO (Low earth orbits) due to the increased coverage. A Satellite in an MEO completes around 1-2 Orbits in a day. To achieve a 12-hour orbit (2 orbits in a day), an MEO Satellite must be placed at a height of 20,200 Km from the earth's surface. Hence most communication and Navigation satellites are placed in and around this distance from the earth.

Global Navigation Satellite Systems (GNSS) is the network of satellites that broadcast orbital information to be used for communication and navigation to the earth's base station on the surface. At present GNSS includes two fully operational Global systems. Some examples of GNSS satellites include the United States Global Positioning System (GPS) (Altitude of 20,200 kilometers), The Russian Federation's GLONASS (Altitude of 19,100 Kilometers), and Europe's Satellite Navigation system known as Galileo (Altitude of 23,222 kilometers). Communication Satellites covering the North and South Pole also revolve around MEO.

What is an example of MEO satellites?



This orbit is ideal for navigation and communication satellites. Some examples of satellites that operate from this orbit include GPS (Altitude of 20,200 kilometers), GLONASS (Altitude of 19,100 kilometers) and Galileo (Altitude of 23,222 kilometers)

c) Answer:

Space wave communication is used in satellite communication. LOS Line of sight wave propagation is used in this mode. The frequency range used is 54MHz to 4.2 GHz because if the frequency of radio waves is greater than 54 MHz, then the wave cannot travel along the surface of the earth and also cannot be reflected by the ionosphere.

https://www.tutorialspoint.com/antenna_theory/antenna_theory_types_of_propagation.htm

Sure! Here's a summary of the main topics covered in the page, organized by the type of propagation:

Ground Wave Propagation:

- Definition of propagation and ground wave propagation
- Characteristics of ground wave propagation
- Factors affecting ground wave propagation
- Antennas used for ground wave propagation

Sky Wave Propagation:

- Characteristics of sky wave propagation
- Ionosphere and its effect on sky wave propagation
- Critical frequency and maximum usable frequency
- Antennas used for sky wave propagation

Line of Sight Propagation:

- Definition of line of sight propagation
- Factors affecting line of sight propagation
- Antennas used for line of sight propagation

Space Wave Propagation:

- Characteristics of space wave propagation
- Geostationary satellites and their use in communication
- Antennas used for space wave propagation

The article also briefly touches upon other topics such as frequency bands and the use of polarization in antennas.

To answer your question, satellite communication primarily uses space wave propagation. This mode differs from other propagation modes in that it involves transmitting the signal directly from the antenna to a satellite, which then relays the signal back down to the receiver. This is different from ground wave and line of sight propagation, which involve the signal traveling along the earth's surface or in a straight line between the antennas. Sky wave propagation is also different from space wave

propagation in that it involves bouncing the signal off the ionosphere rather than transmitting it directly to a satellite.