**The University of New Mexico**

**School of Engineering**

**Electrical and Computer Engineering Department**

**ECE 535 Satellite Communications**

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Module # 2: Problems 1.1, 1.2, 1.6, 1.7, 1.8, 1.11

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1. Describe briefly the main advantages offered by satellite communications. Explain what is meant by a distance-insensitive communications system.
   1. Satellite communications offer major advantages, including wide geographic coverage, the ability to connect remote or hard-to-reach areas, and support for services like broadcasting, data transfer, and emergency response. Because a satellite can simultaneously link many users over large distances, it is ideal for creating global communication networks. A key feature of satellite systems is that they are distance-insensitive ie the cost to transmit signals does not significantly change with distance. Whether the two points are close together or across continents, the satellite serves as the same central relay, making it efficient for large scale and continuous use.
2. Comparisons are sometimes made between satellite and optical fiber communications systems. State briefly the areas of application for which you feel each system is best suited.
   1. Satellite communication is best suited for applications requiring global coverage, such as in remote or rural areas, maritime and aviation communication, emergency response, and broadcast services like satellite TV. It is ideal where terrestrial infrastructure is limited or unavailable. In contrast, optical fiber communication is best for high speed, high capacity data transmission over long distances in urban and suburban areas. It is preferred for internet backbones, cloud services, and enterprise networks where low latency and reliability are critical. Each system complements the other depending on the coverage and performance needs.

6. Referring to Table 1.4, determine the power levels, in watts, for each of the three categories listed.

- High Power: 5.6 W

- Medium Power: 7 W

- Low Power: 3.4 W

7. From Table 1.5, determine typical orbital spacing in degrees for (a) the 6/4- GHz band and (b) the 14/12-GHz band.

a. 2 degrees

b. 1.5 degrees

8. Give reasons why the Ku band is used for the DBS service.

The Ku band is used for DBS because its higher frequency allows for smaller, affordable satellite dishes for home use. It provides enough bandwidth for high-quality broadcasts and experiences less interference from terrestrial signals. The band also supports frequency reuse, increasing satellite capacity. Although it is affected by rain, modern technology helps maintain reliable service.

11. Explain what is meant by a polar orbiting satellite. A NOAA polar orbiting satellite completes one revolution around the earth in 102 min. The satellite makes a north to south equatorial crossing at longitude 90°W. Assuming that the orbit is circular and crosses exactly over the poles, estimate the position of the subsatellite point at the following times after the equatorial crossing: (a) 0 h, 10 min; (b) 1 h, 42 min; (c) 2 h, 0 min. A spherical earth of uniform mass may be assumed.

The orbital period can be used to find the semimajor axis via

a^3=mu \* T^2 / 4\*pi^2

from there the angular velocity can be found since we assume it to be a circular orbit

w=2pi/T

The latitude can then be found by

Phi = 90 – w\*T

The longitude can then be found by

Lambda = lambda\_0 + w\*T

Where lambda\_0 = 90 ie where it crosses the equator. Using this we can find the lat lon (phi, lambda) of each crossing

1. (89.03, 94.68)
2. (0,180)
3. (89.03, 85.32)