08.08.2020
Saturday

UNIT-V

Cellular Communications

Basic ideas of Cellular Network:

* Cellular Network is an underlying technology for mobile phones, personal Communiation systems, wireless Networking etc

* The technology developed for mobile radio telephone to replace high power transmitter/ receiver system.

* Cellular Networks are low (or) power short range and more transmitter for data transmission.

Main Reasons for Using cellular System:-

* Higher Capacity

* Higher number of users
* cellular System can reuse spectrum ace to certain patterns.
* Each cell support a maximum number of users.
* Lens transmission power needed.
* Smaller cells also allow for lens transmission power (less radiation). The mobile Systems can enjoy longer runtime.

Features:-

1. Offer very high capacity in a limited spectrum.
2. Reuse of radio channel in different cells.
3. Communication is always between mobile and base station

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4. Each cellular base station is allocated a group of radio channel within a small geographic are called cell.

5. Neighbouring cells are assigned different channel groups.

6. Keep interference levels within tolerable limits.

7. Frequency reuse or Frequency planning.

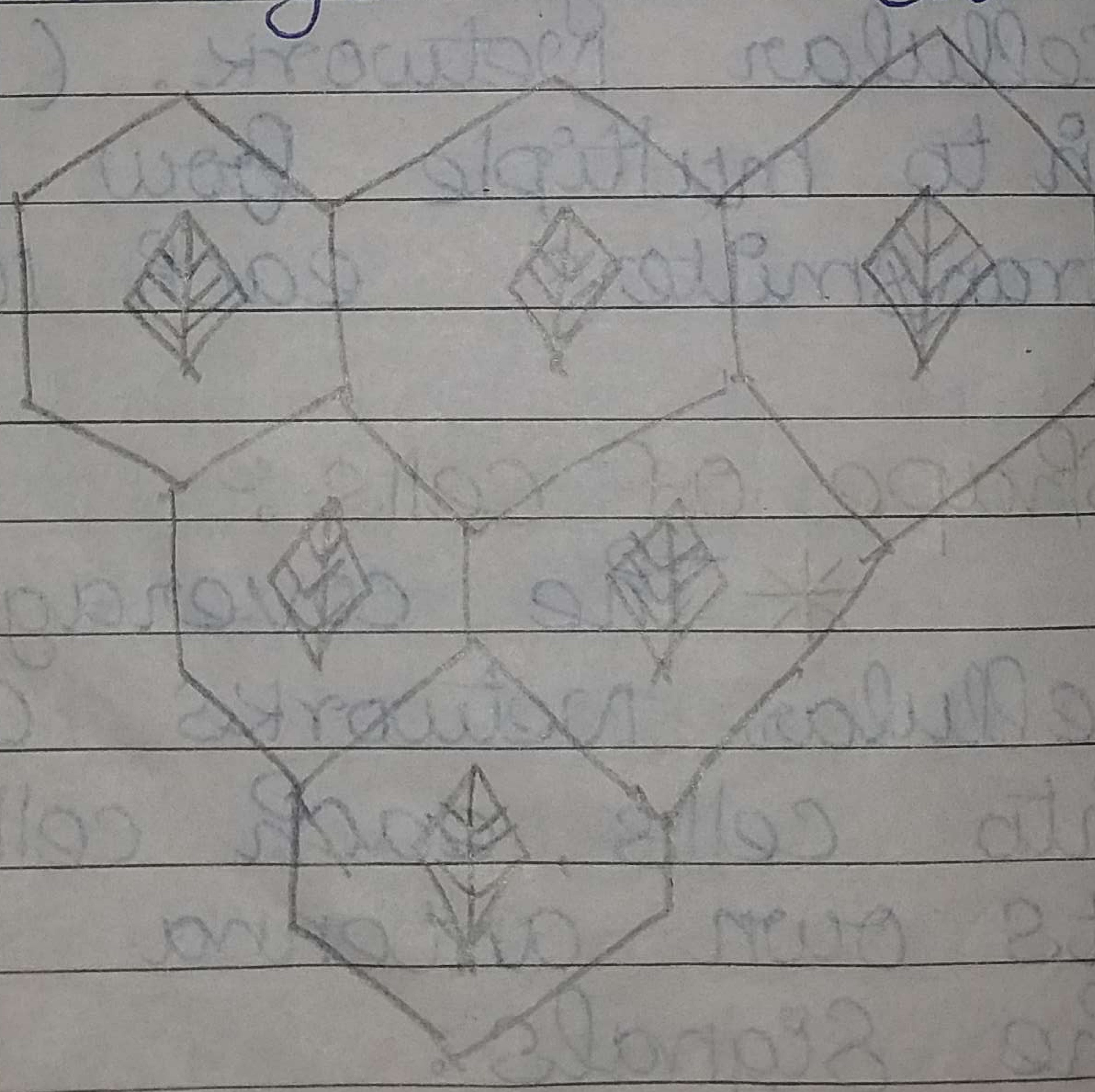
8. Organization of wireless cellular Network. (organized in to multiple low power transmitters each 100 w or less.

Shape of cells :-

* The coverage area of cellular Networks are divided into cells, each cell having its own antenna for transmitting the signals.

* Each cell has its own frequency Data Communication in cellular Network is served by its base station transmitter, and receiver and its control unit.
* The Shape of the cells can be either Square or Hexagon.

Hexagon:-
* Hexagon cell shape is highly recommended for its easy coverage and calculation



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* provides equal distant antenna.

* Distance from center to vertical equals length of side.

WDM concepts and components

10 Mark

A powerful aspect of an optical communication link is that many different wavelengths can be sent along a single fiber simultaneously in the 1300-1600-nm spectral band. The technology of combining a number of wavelengths into the same fiber is known as wavelength-division multiplexing or WDM⁻¹. Conceptually, the WDM scheme is the same as frequency division multiplexing (FDM) used in microwave radio and satellite systems. Just as in FDM, the wavelengths (or optical frequencies in WDM must be properly spaced to avoid interchannel interference.

Key Features of WDM :-

* Capacity upgrade :- The classical application of WDM has been to upgrade the capacity of existing point-to point fiber optic transmission links. If each wave-length supports an independent network signal of perhaps a few gigabits per second, then we can increase the capacity of a fiber network dramatically.

* Transparancy :- An important aspect of WDM is that each optical channel can carry any transmission format. Thus, using different wavelengths, fast or slow asynchronous and synchronous digital data and

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analog information can be sent simultaneously, and independently, over the same fiber, without the need for a common signal structure.

* Wavelength routing : In addition to using multiple wavelengths to increase link capacity and flexibility, the use of wavelength sensitive optical routing devices makes it possible to use wavelength as another dimension, in addition to time and space, in designing communication networks and switches. Wavelength routed networks use the actual wavelength of a signal as the intermediate or final address.

* Wavelength switching : Whereas wavelength-routed networks are based on a rigid fiber infrastructure, wavelength-

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Switched architectures allow reconfigurations of the optical layer. Key Components for implementing these networks include optical add drop multiplexers optical cross connects, and wavelength converters.

Operational principles of WDM:

In standard point-to-point links a single fiber line has one optical source at its transmit end and one photodetector at the receiving end. Signals from different light sources use separate and uniquely assigned optical fibers. Since an optical source has a narrow linewidth, this type of transmission makes use of only a very narrow portion of the transmission bandwidth capability of a fiber.

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To see the potential of WDM. Let us first examine the characteristics of a high-quality optical source. As an example, the modulated output of a DFB laser has a frequency spectrum of 10-50 MHz, which is equivalent to a nomical spectral linewidth of 10^{-3} nm. When using such a source, a guard band of 0.4-1.6 nm is typically employed. This is done to take into account possible drifts of the peak wavelength due to aging the or temperature effects, and to give both the manufacturer and the user some leeway in specifying and choosing the precise peak emission wavelength. With such spectral bandwidth, simplex systems make use of only a small portion of the transmission

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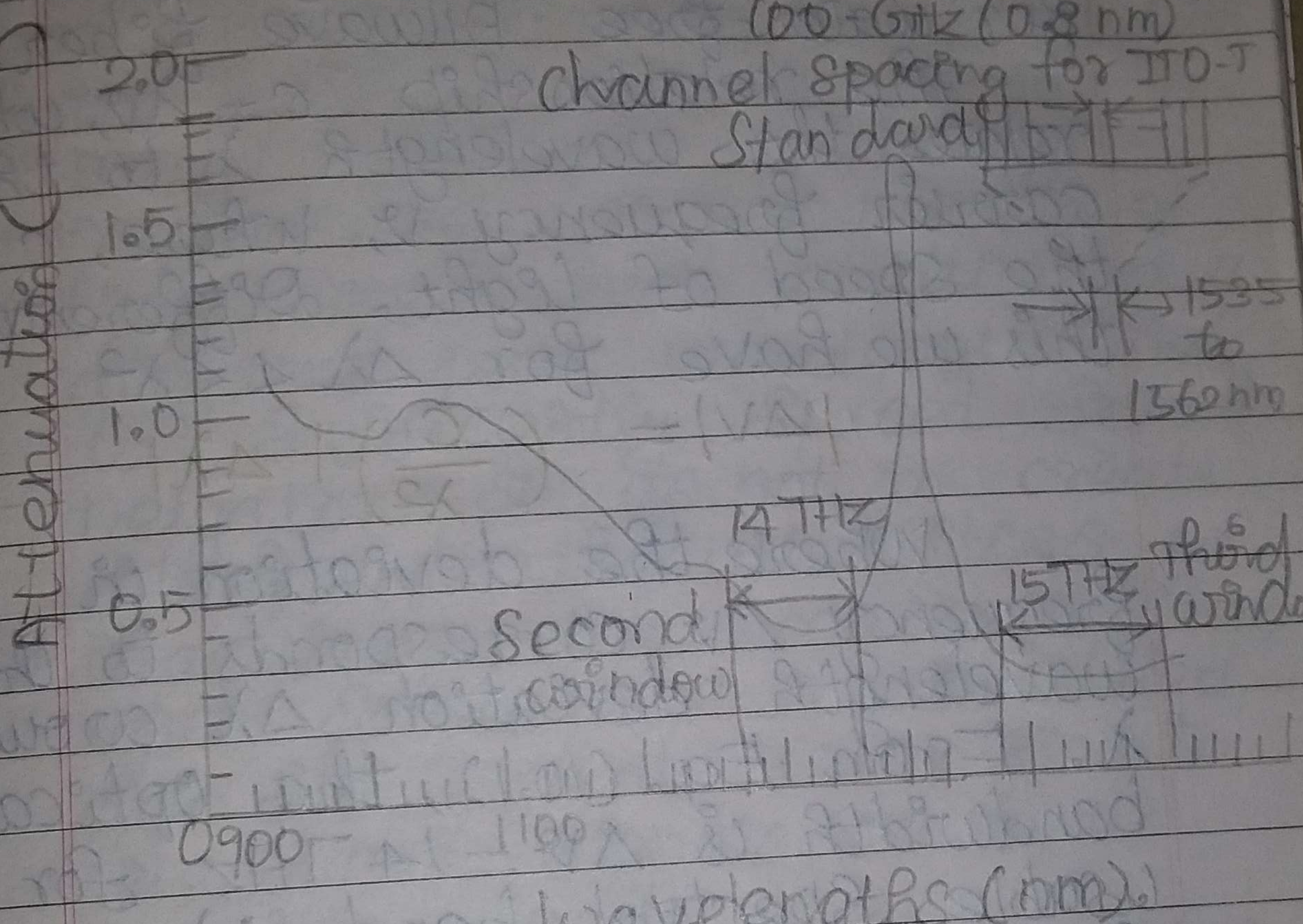
bandwidth capability of a standard fiber. which depicts the attenuation of light in a silica fiber. as a function of wavelength. The curve shows that the two-lengths low-loss regions of a single-mode fiber extend over the wavelengths ranging from about 1270 to 1350 nm. (the 1310-nm window) and from 1480 to 1600 nm (the 1550-nm window). However, note the wider window of Allwave fibers.

We can view these regions either in terms of spectral width the wavelength band occupied by the light signal and its guard band) or by means of optical bandwidth (the frequency band occupied by the light signal). To find the optical bandwidth corresponding to a particular spectral width in these regions. We use



The transmission bandwidths in the 1310 nm and 1550 nm windows allow the use of many simultaneous channels for sources with narrow spectral widths. The ITU-T

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Standard for WDM specifies channel with 100-GHz spacings. Also, for water-free Allwave fiber.

The relationship $c = \lambda \nu$, which relates the wavelength λ to the carrier frequency ν, where, c is the speed of light, Differentiating this we have for $\Delta\lambda << \lambda^2$

$$|\Delta \nu| = \left(\frac{c}{\lambda^2}\right) |\Delta\lambda| \quad \text{--- (10.}$$

Where the deviation in frequency $\Delta\nu$ corresponds to the wavelength deviation $\Delta\lambda$ around λ. From Eq. (10.1), the optical bandwidth is $\Delta\nu = 14$ THz for a usable spectral band $\Delta\lambda = 80$ nm in the 1310-nm window. Similarly $\Delta\nu = 15$ THz for a unable spectral band $\Delta\lambda = 120$ nm in the 1550-nm window. This yeeld a total available fiber bandwidth of about 30 THz in the two low loss windows.

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Since the Spectral width of a high-quality Source occupies only a narrow optical fibre bandwidth, the two low-loss windows provide many additional operating regions. By using a number of light Source, each emitting at a different peak wavelength that is Sufficiently Spaced from its neighbor so as not to create interference, the intergrities of the independent messages from each Source are maintained for Subsequent conversion to electrical Signals at the receiving end.

Since WDM is essentially frequency-division multiplexing at optical carrier frequencies, the WDM Standards developed by the International Telecommunication Union (ITU) Specific channel Spacings