



Information Technology College information networks dep.

Optical Networks

Lecturer :M Eng. Hasan Abdulameer Hasan

Course information

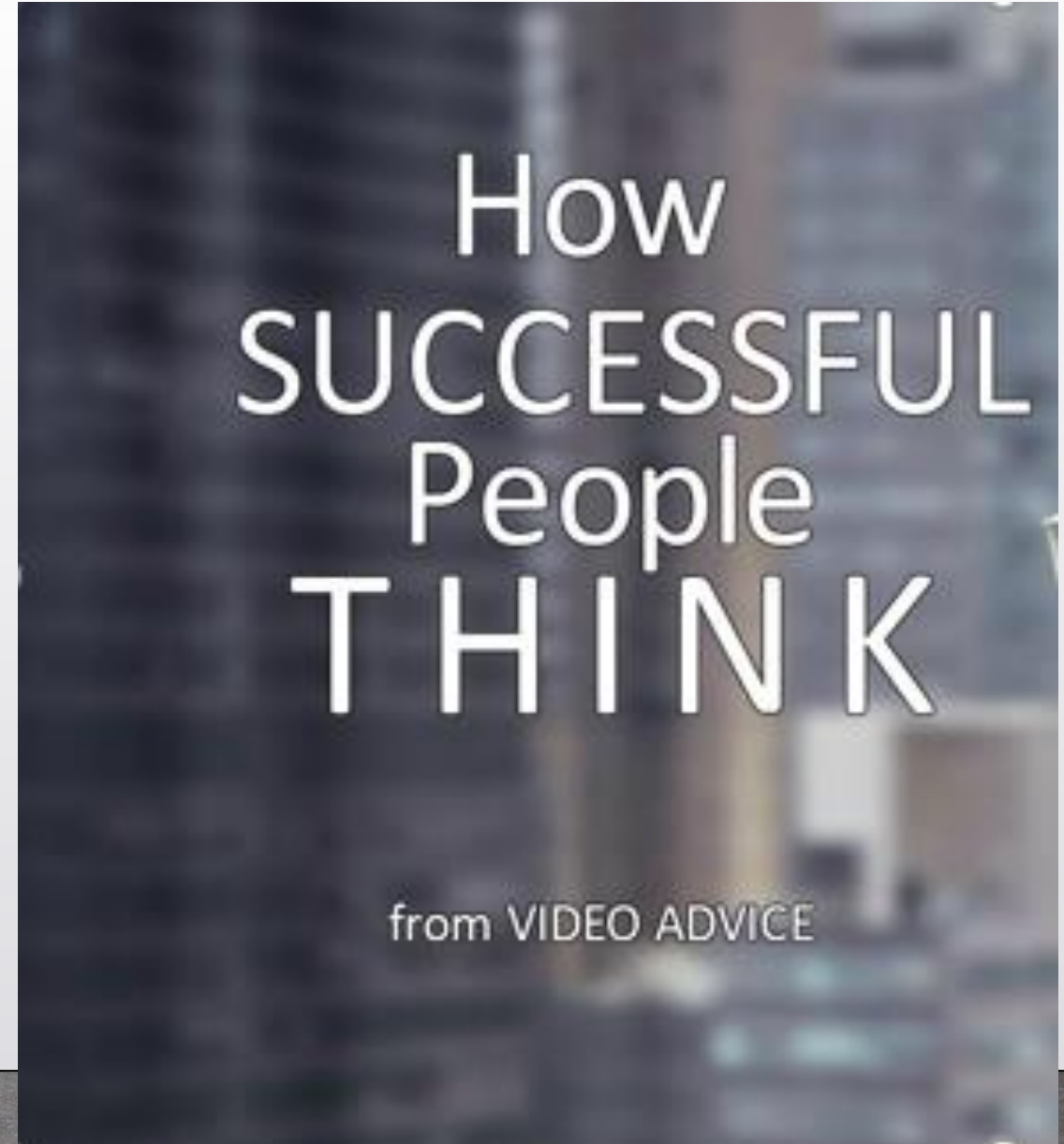
1. Final Exam %50

2. %5 Attendance

3. %5 Research

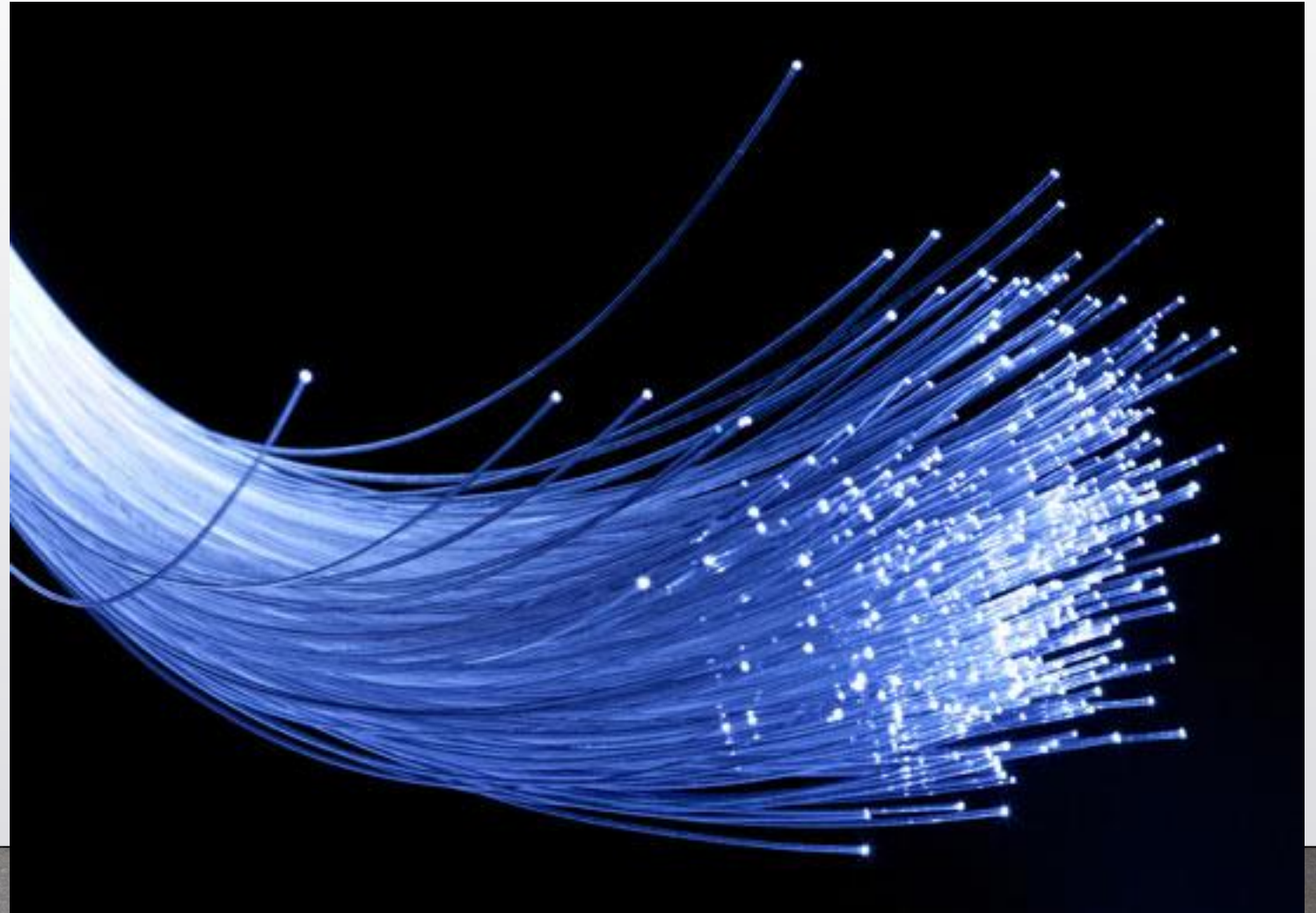
4. %40 First + Second exam

Total %100



this lecture

1. History Of Fiber optics
2. The Main parts of Fiber optics
- 3 Types of Fiber optics
4. Couplers
5. Isolators
6. Circulators
7. switches
8. Multiplexers & Filters



HISTORY

- In 1870, **Tyndall** introduced concept of **Total Internal Reflection** with a demonstration.
- In the same year, **Alexander Graham Bell**, developed a optic voice transmission. which he named the **photo** **ph**



Historical development of optical communication

The use of light for communication has been common for many years



Signal lamp training during World War II.

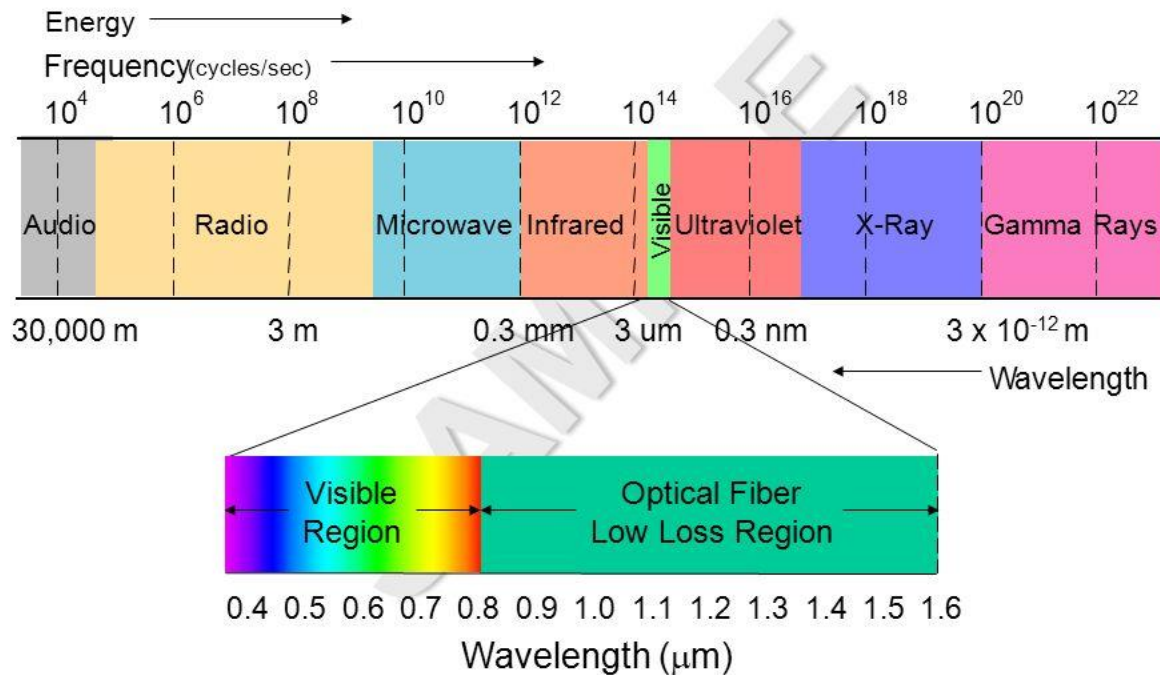


Electromagnetic spectrum

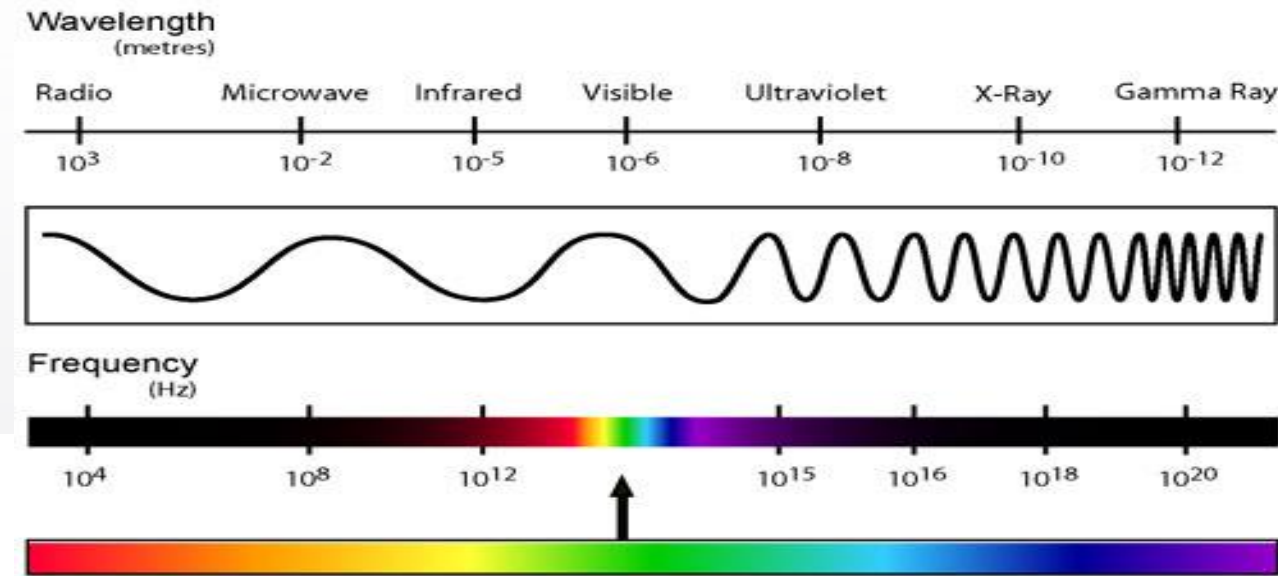
0 - 10^{14} Hz for all communication sys

10^{16} Hz to 10^{12} Hz (Visible Light)

The Electromagnetic Spectrum



THE ELECTRO MAGNETIC SPECTRUM



Glass fiber optics :

$$\lambda = 850 \text{ nm}$$

$$\lambda = 1310 \text{ nm}$$

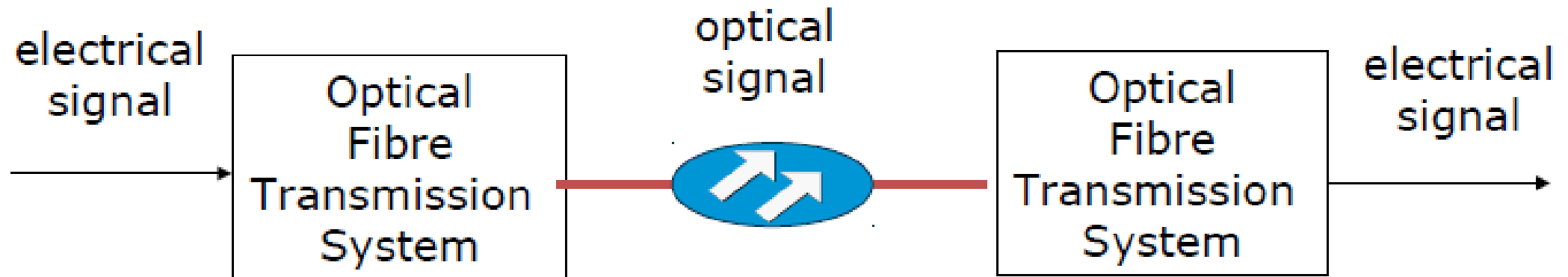
$$\lambda = 1550 \text{ nm}$$

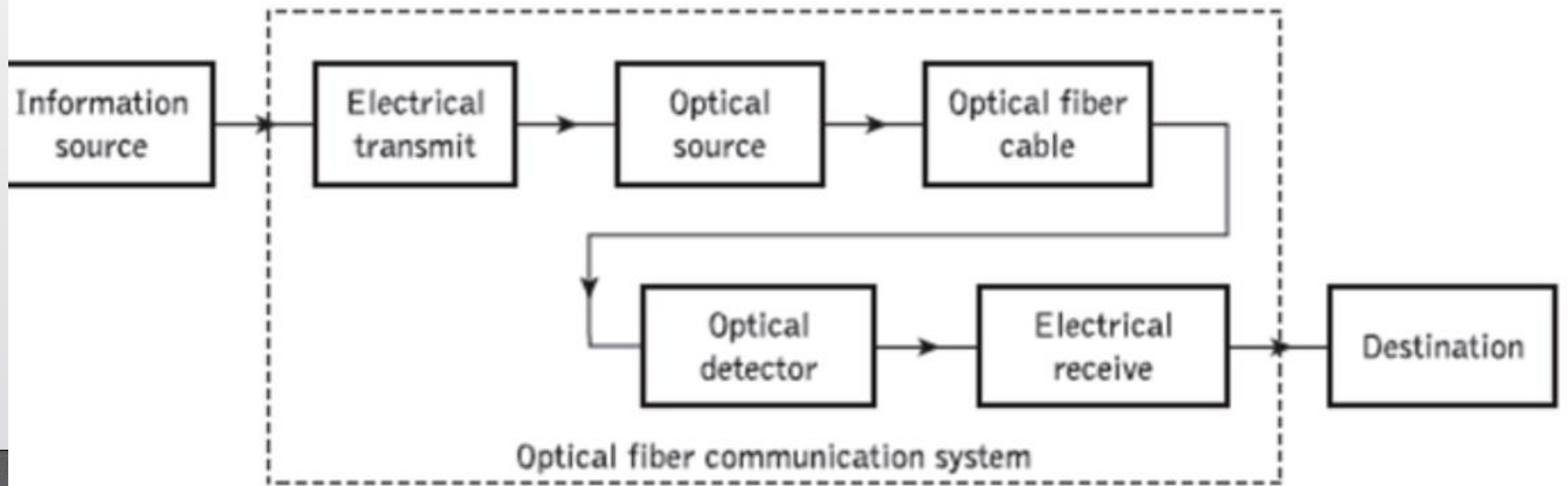
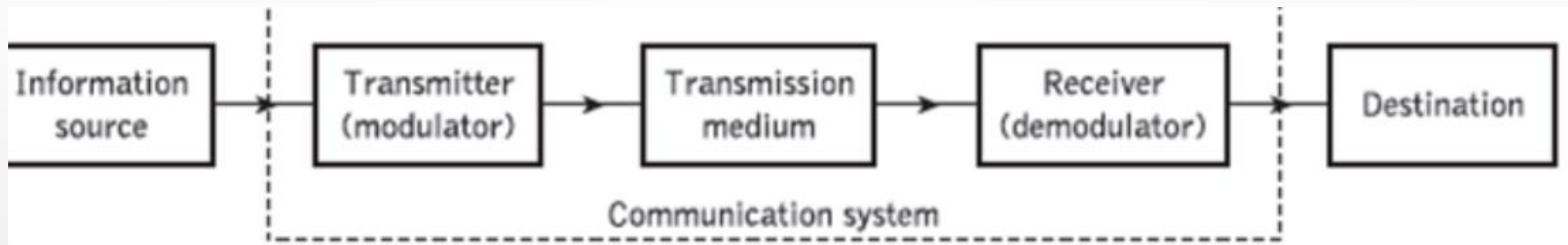
Plastic fiber optics:

$$650 \text{ nm}$$

General Optical Transmission

An optical fiber communication system is similar in basic concept to any type of communication system.

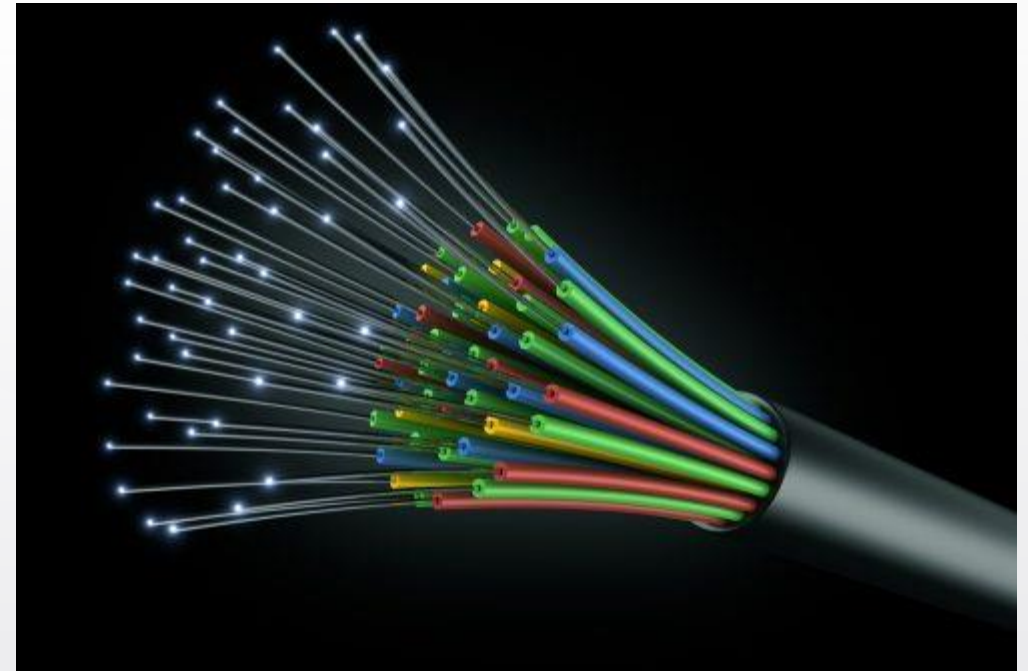




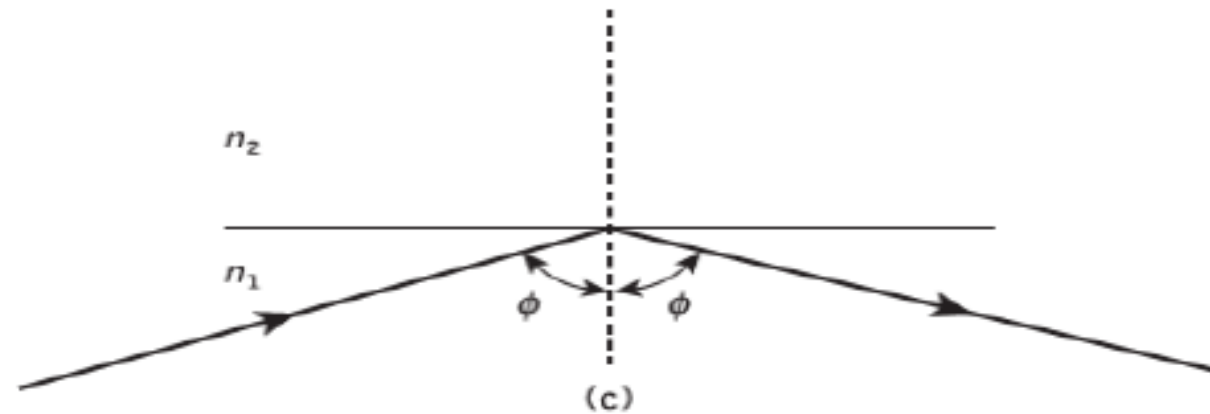
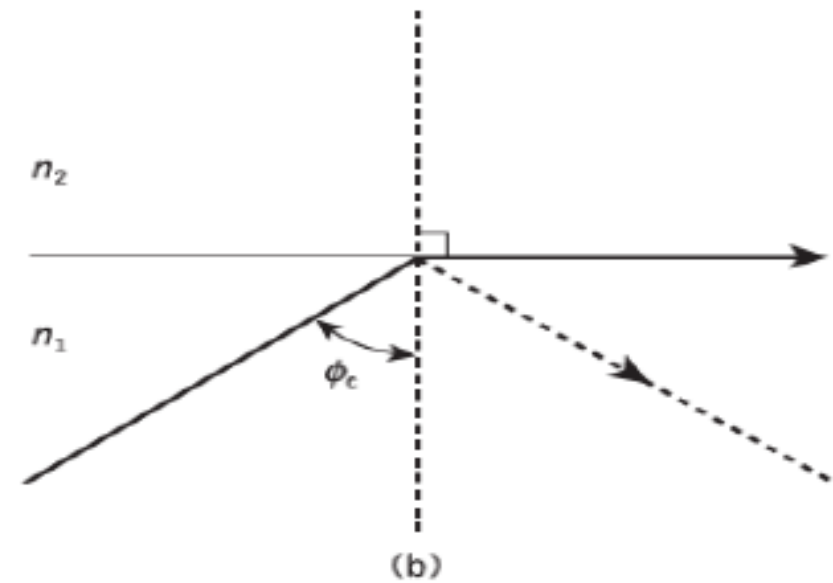
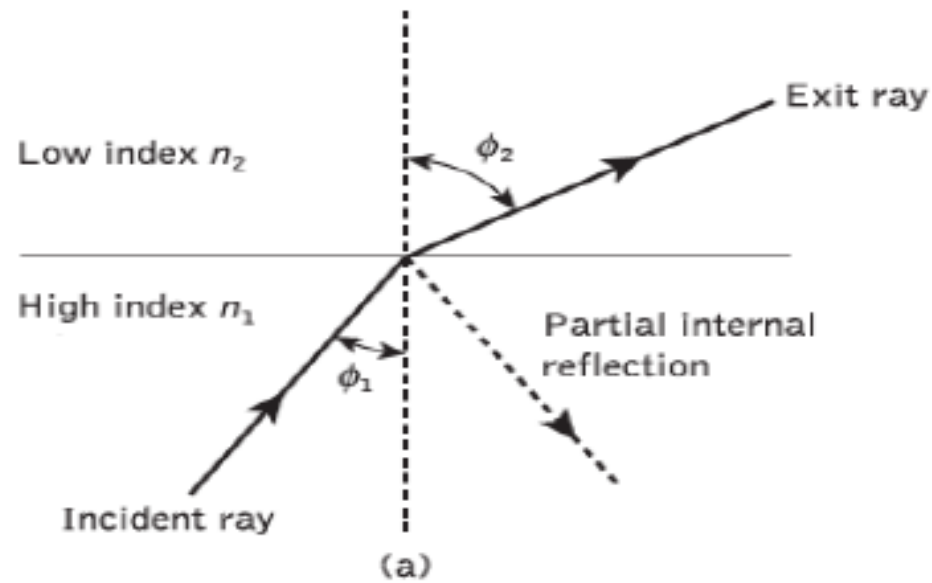
What are Fiber Optics?

Fiber optics (optical fibers) are long, thin strands of very pure glass about the diameter of a human hair.

They are arranged in bundles called **optical cables** and used to transmit **light signals** over long distances at very **high speeds**



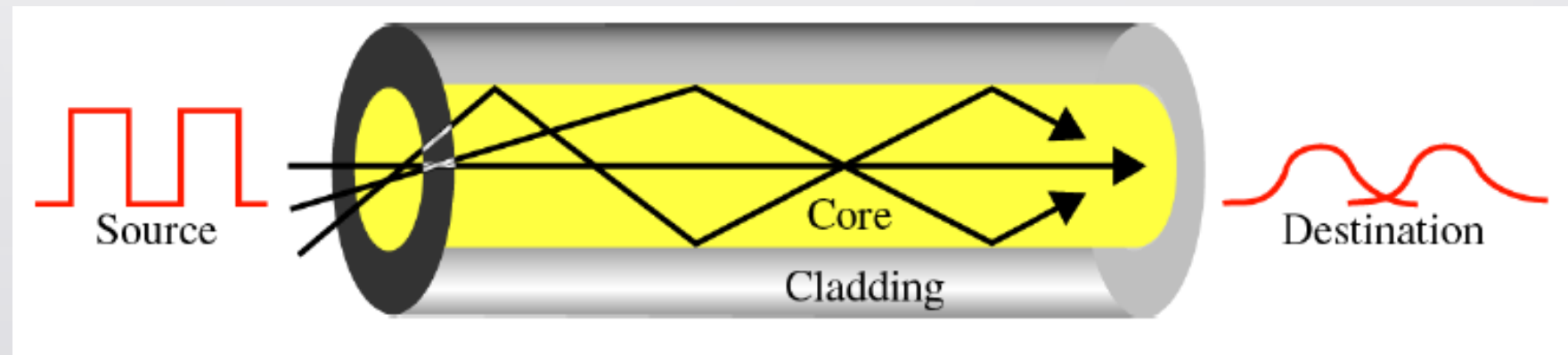
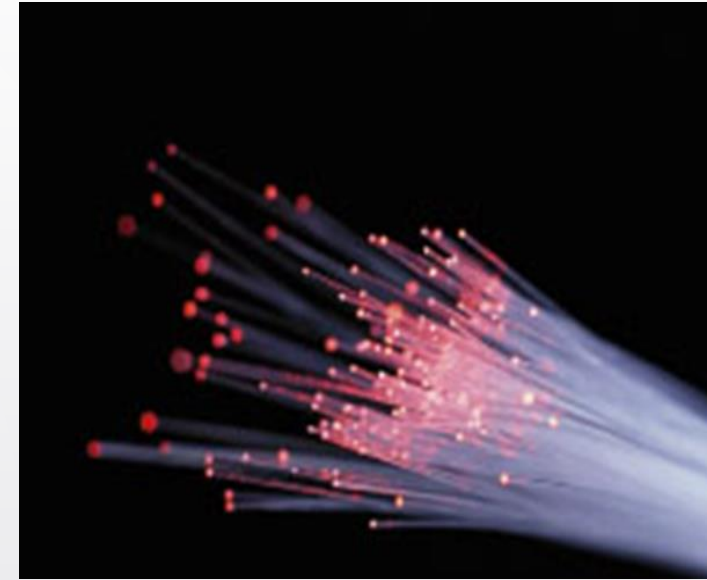
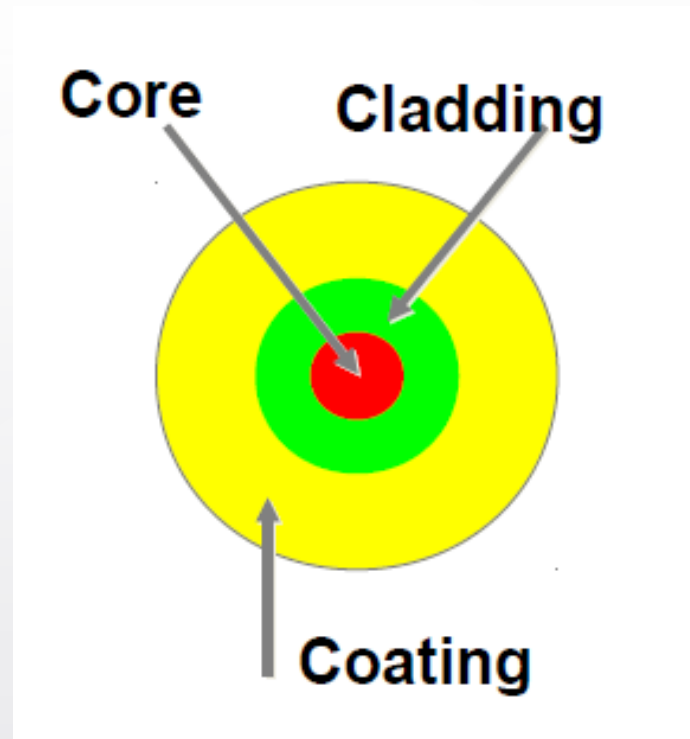
Work Principle of Fiber Optic Cable



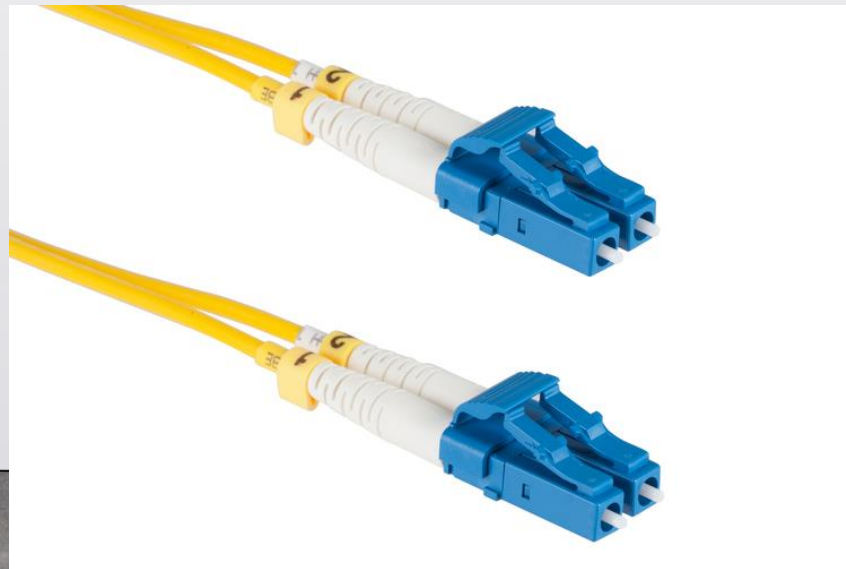
Fiber Optics Content

An optical fiber is made of three sections:

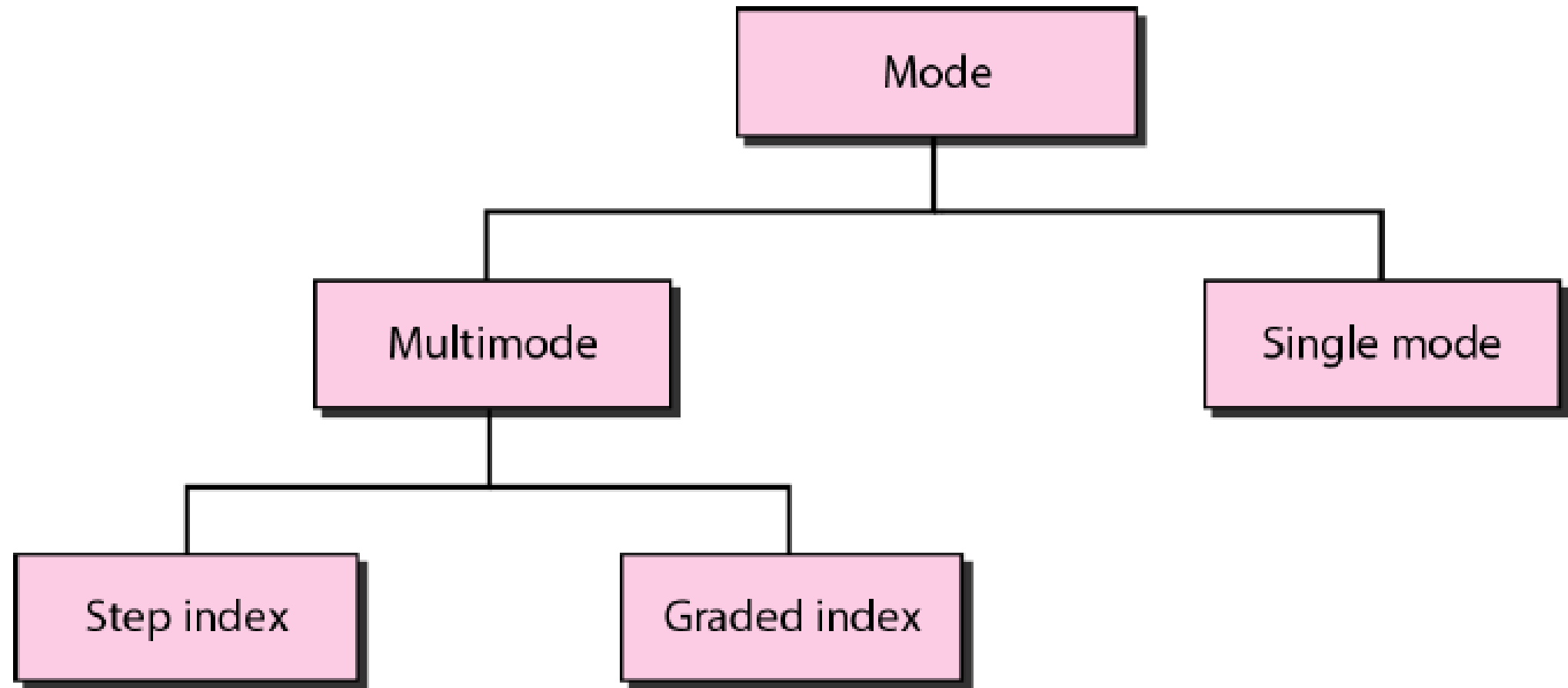
- The core carries the light signals
- The cladding keeps the light in the core
- The coating protects the glass



Fiber Optic Cables



Propagation modes



Optical Fiber Modes (cont.)

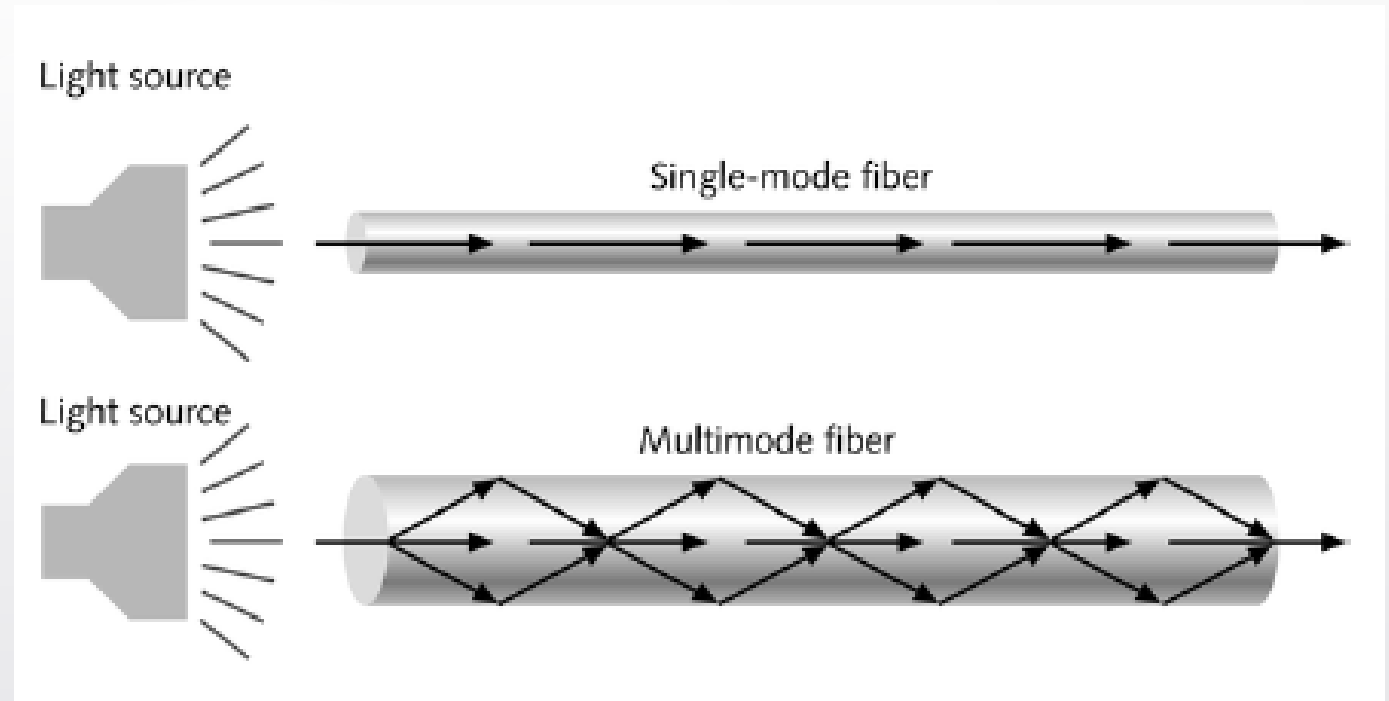
- **Single-mode fiber**

- Carries light pulses by laser along single path

- **Multimode fiber**

- Many pulses of light

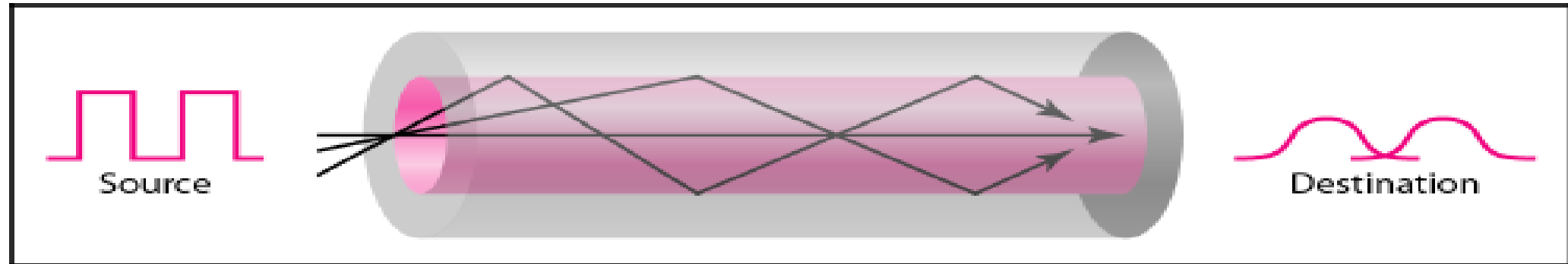
generated by LED travel at different angles



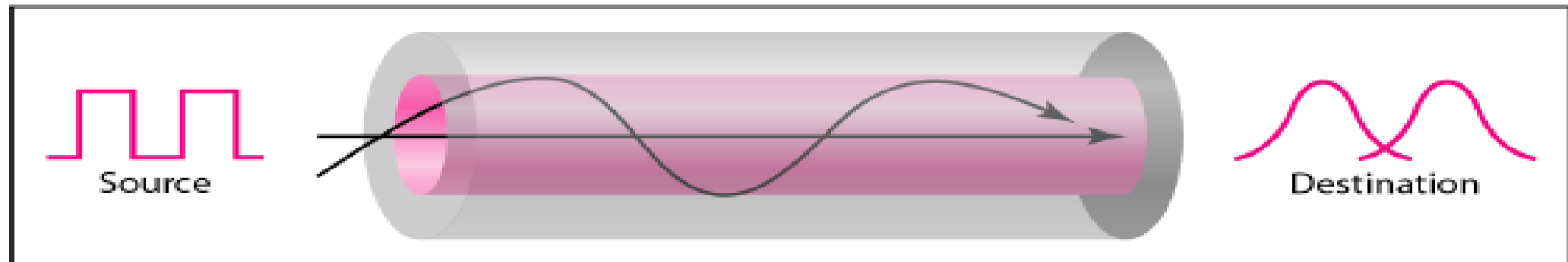
SM: core=8.3 cladding=125 μm

MM: core=50 or 62.5 cladding=125 μm

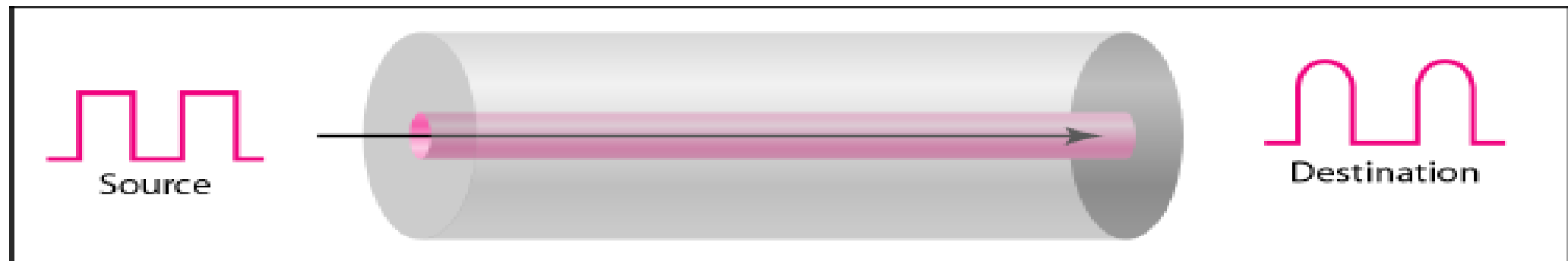
Modes



a. Multimode, step index



b. Multimode, graded index



c. Single mode

Advantage of Fiber Optic

- The transmission bandwidth of the fiber optic cables is higher than the metal cables.
- The amount of data transmission is higher in fiber optic cables.
- The power loss is very low and hence helpful in long-distance transmissions.
- Fiber optic cables provide high security and cannot be tapped.
- Fiber optic cables are immune to electromagnetic interference and crosstalk.
- These are not affected by electrical noise.

Some of the optical devices:

Couplers

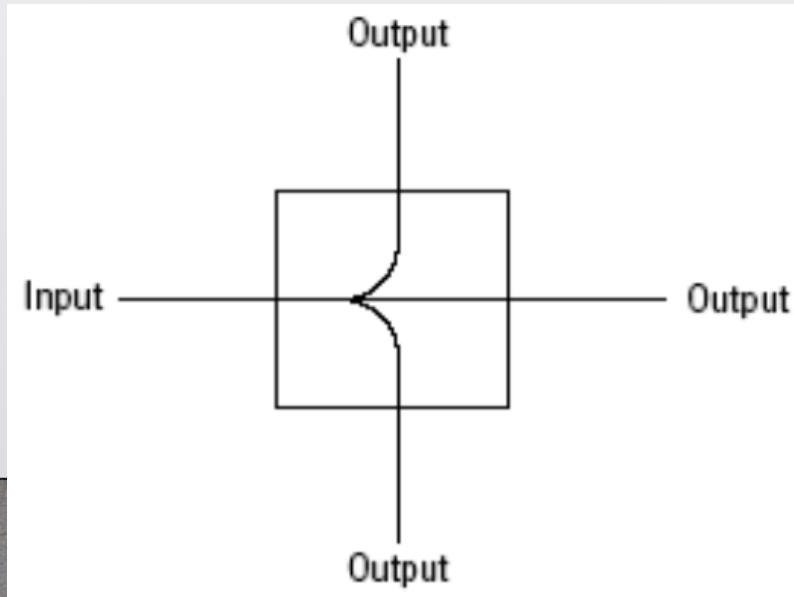
Isolators

Switches

Multiplexers

Filters

- **coupler**
- **A fiber optic coupler** is a device that combines or splits optical signals.
- A coupling device may combine two or more optical signals into a single output



couplers

There are many different types
of couplers

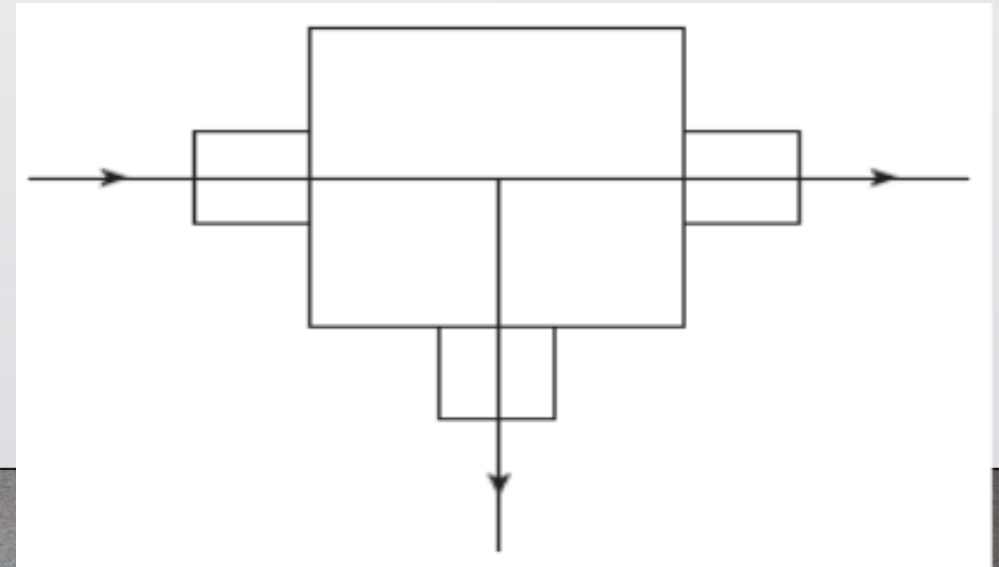
We will only focus :

Tee coupler

Star coupler.

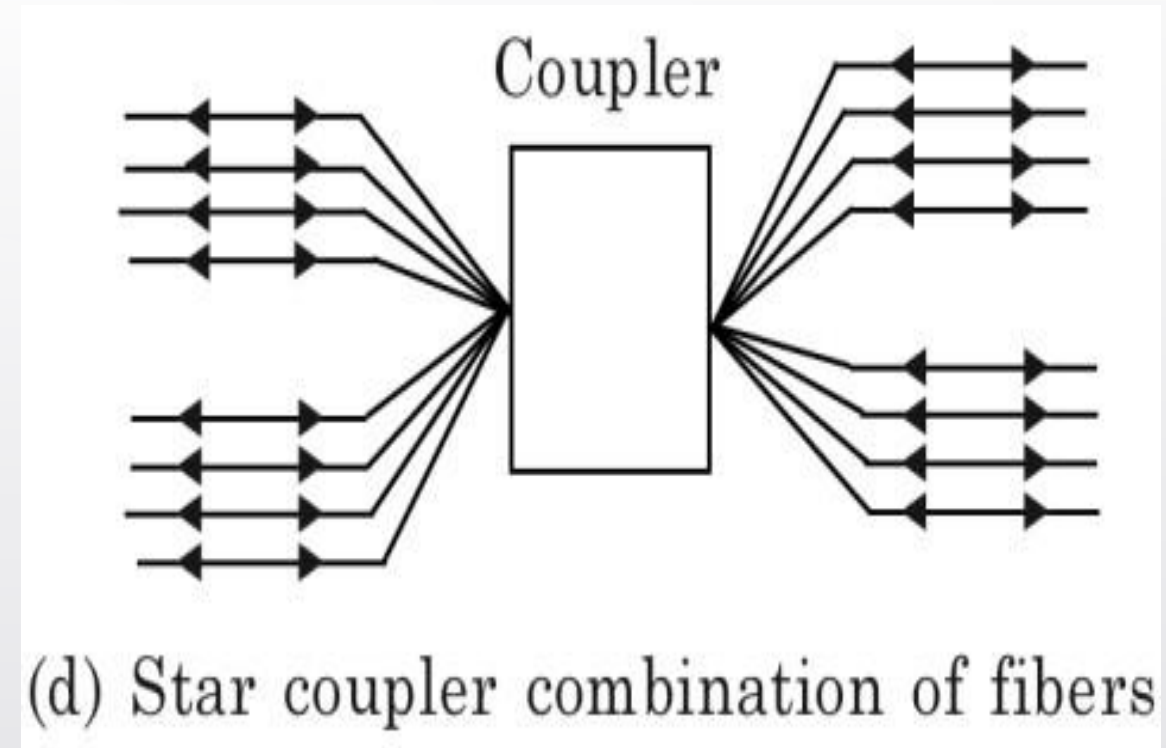
Tee coupler (Three Port)

- A *tee (T) coupler* is a three-port optical coupling device that has one input port and two output ports.
- Tee coupler distributes most of the optical input power to one output and only a small amount of power to the secondary output.
- The tee coupler is also referred to as an optical tap, due to the nature of the device.
- A majority of the power continues forward, but a portion of the signal (determined by the splitting ratio) is tapped to be used for an output port.



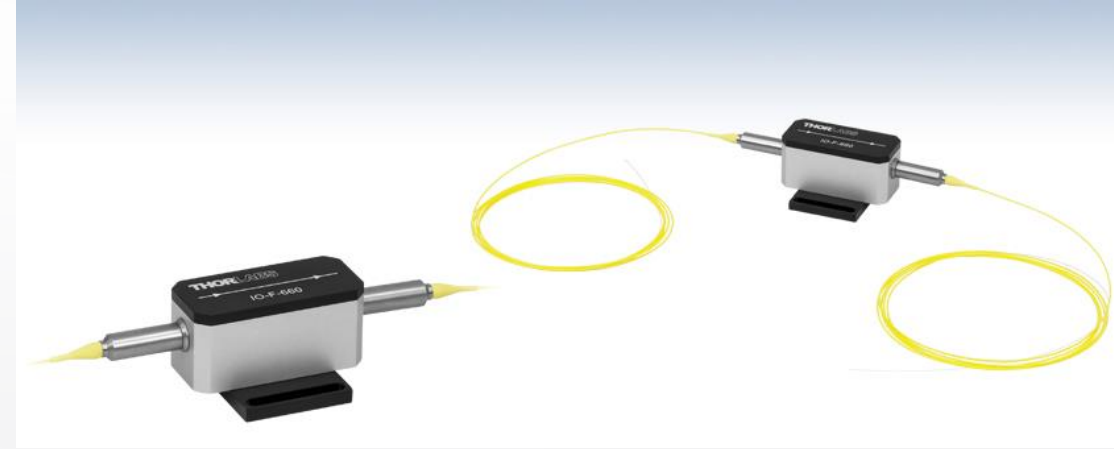
THE STAR COUPLER

- The star coupler is used in applications that require multiple ports—input and output.
- The star coupler will distribute optical power equally from two or more input ports to two or more output ports.
- A special version of the star coupler, called a tree coupler, is used when there is one input port and multiple output ports or when there are multiple input ports and one output port.
- Star couplers are frequently used in network applications when there are a large number of output terminals.

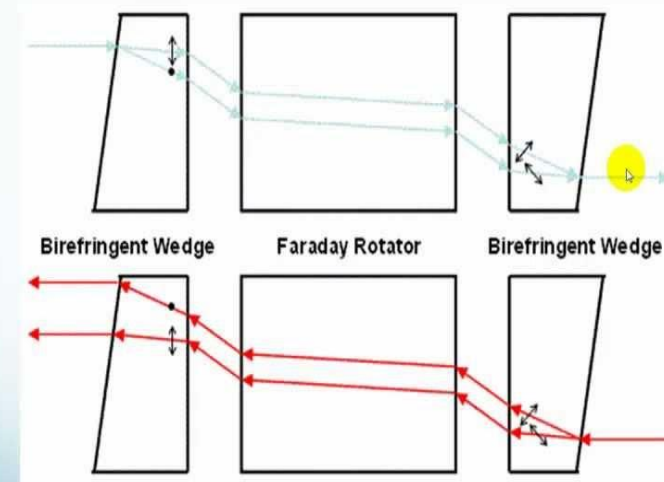


Isolators

- Its main function is to allow transmission in one direction through it but block all transmission in the other direction.
- Isolators are used in systems at the output of optical amplifiers and lasers primarily to prevent reflections from entering these devices, which would otherwise degrade their performance.



Components of an Isolator



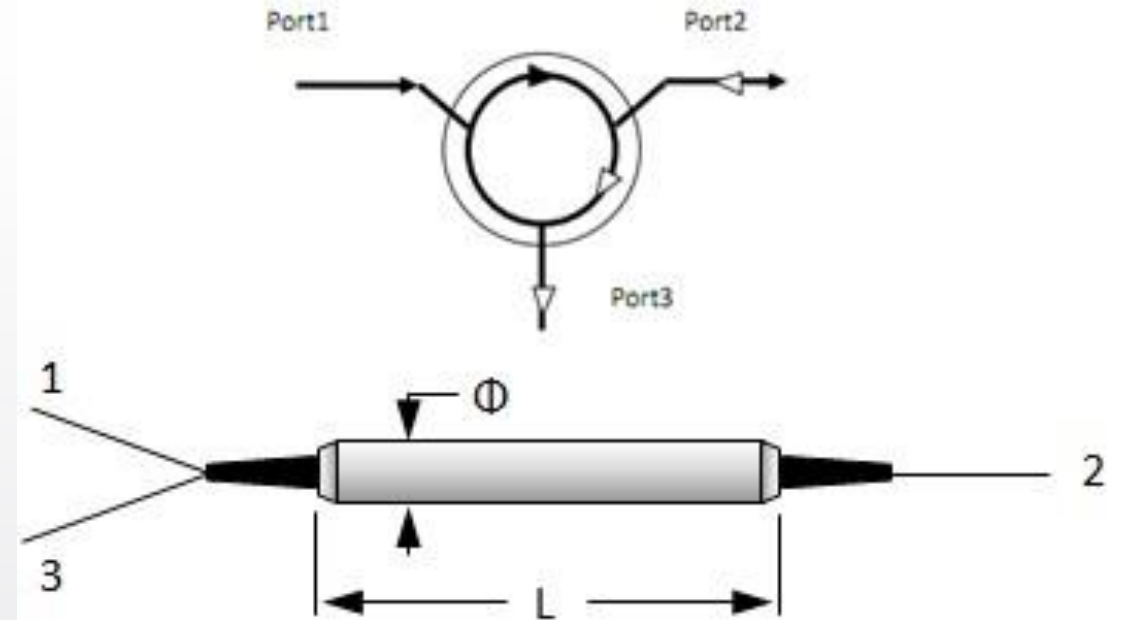
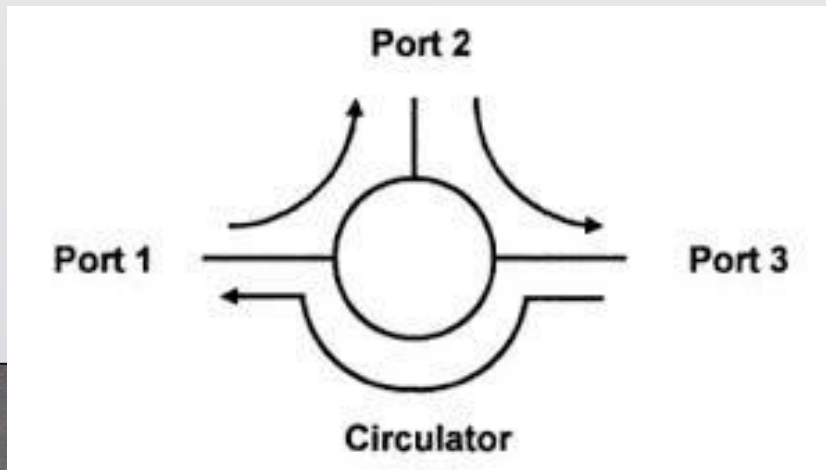
Blue Color: Forward Light

Red Color: Backward Light

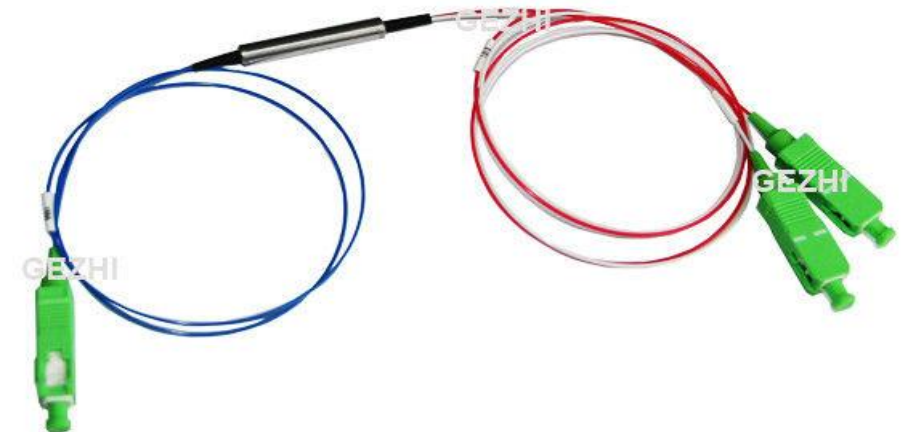
Circulator

A circulator is similar to an isolator, except that it has multiple ports, typically three or four.

In a three-port circulator, an input signal on port 1 is sent out on port 2, an input signal on port 2 is sent out on port 3, and an input signal on port 3 is sent out on port 1.



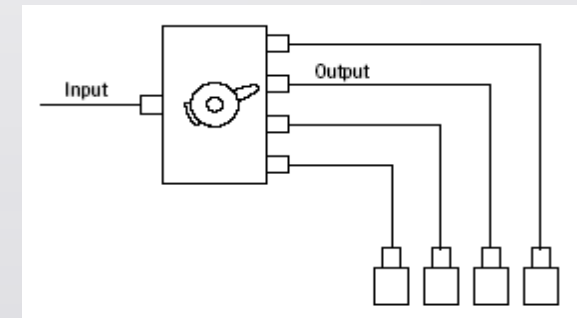
GEZHI C+L Optical Circulator



Switches

- The fiber optic switch can be a mechanical, optomechanical, or electronic device that opens or closes an optical circuit.
- The switch can be used to complete or break an optical path.

❑ **Passive fiber optic switches** will route an optical signal without electro-optical or optoelectrical conversion

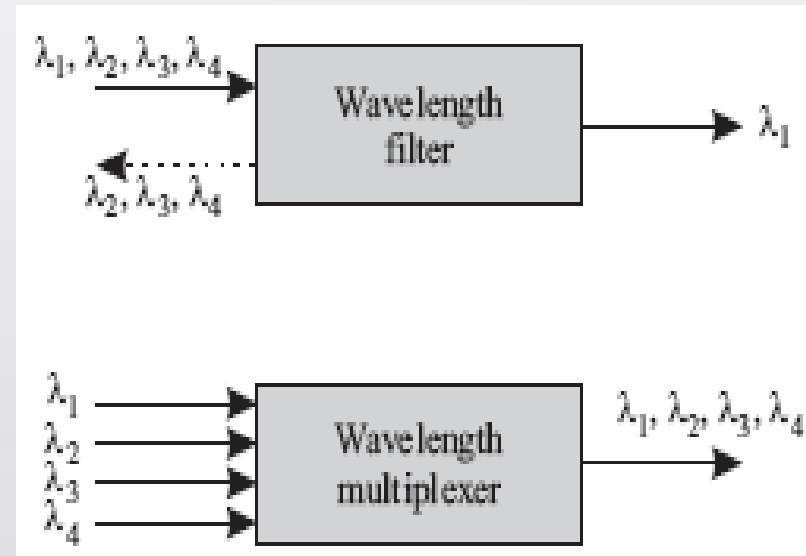


Multiplexer & Filters



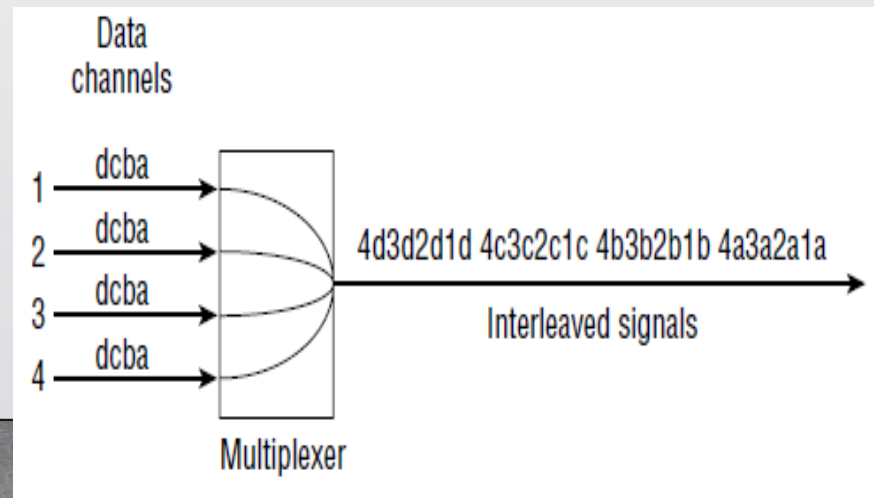
- **Optical filters** are essential components in transmission systems for at least two applications:
- To multiplex and demultiplex wavelengths in a WDM system—these devices are called multiplexers/ demultiplexers—and
- To provide equalization of the gain and filtering of noise in optical amplifiers

- **A simple filter** is a two-port device that selects one wavelength and rejects all others.
- It may have an additional third port on which the rejected wavelengths can be obtained.

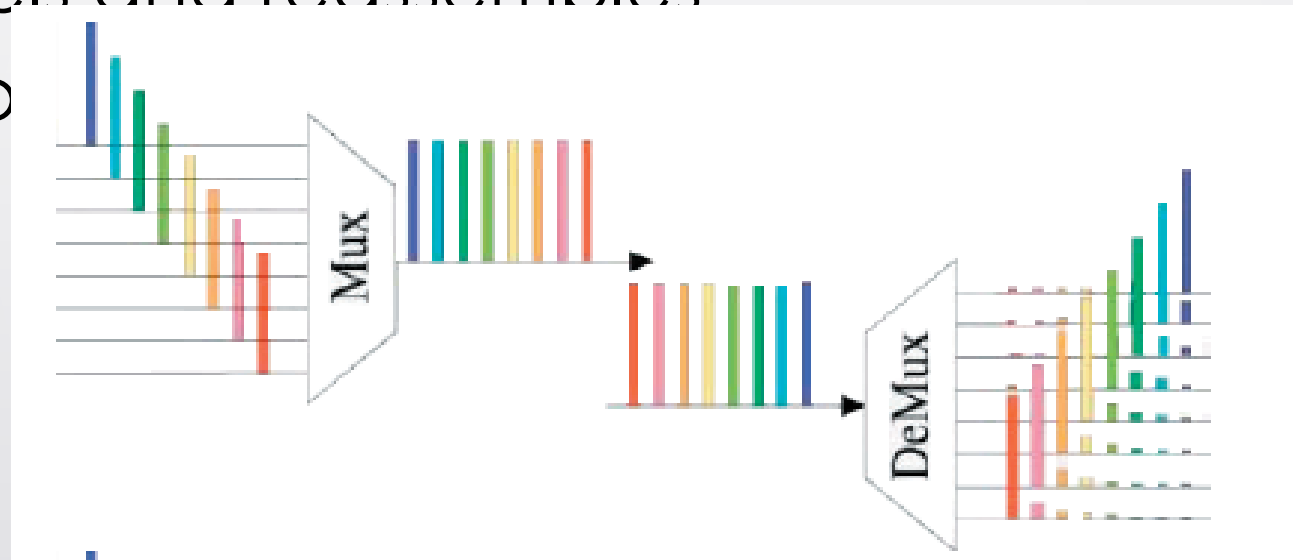


Multiplexer & Filters

- **Multiplexing** is the process of transmitting many channels of information over one link or circuit
- A multiplexer first divides each channel into several parts.
- ❖ In a process known as interleaving, the multiplexer sends the first part of each channel, then the second part of each channel, continuing the process until all of the transmissions are completed.

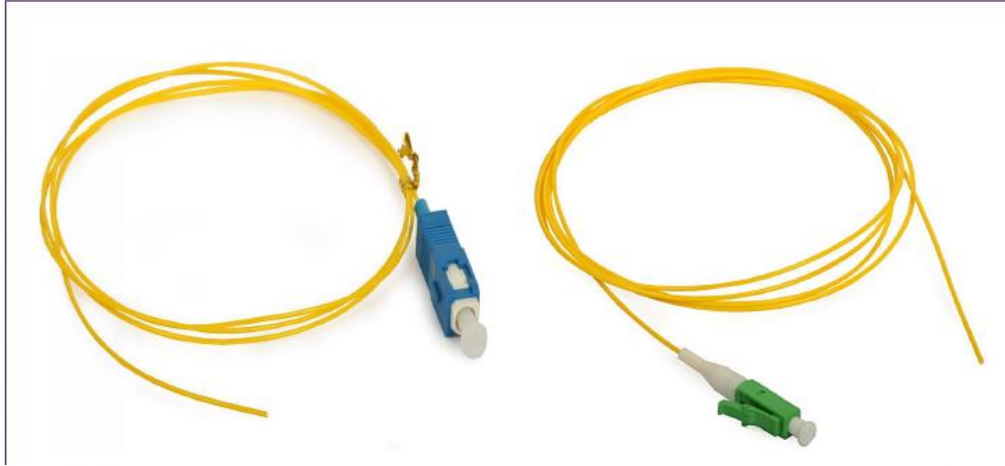


- At the receiving end, a demultiplexer separates the transmissions into their individual channels and reassembles them in their proper

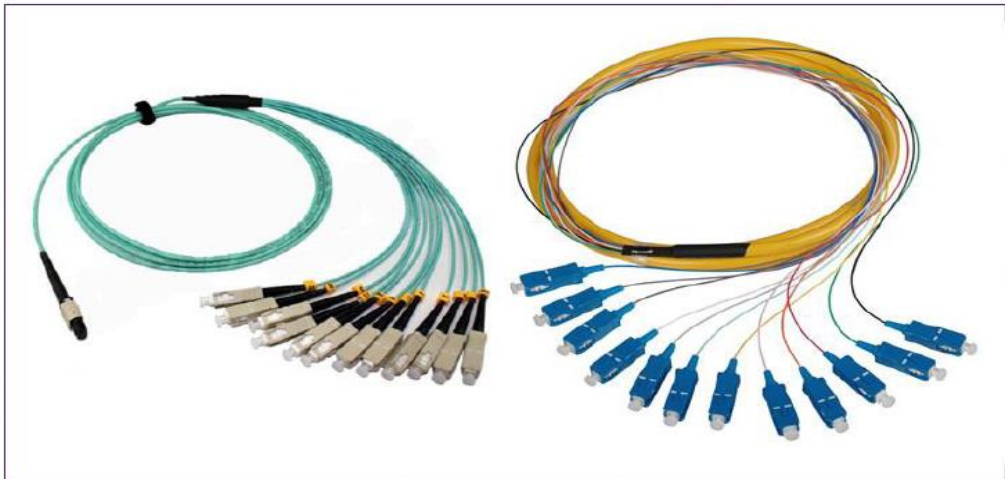


Q & A ACCESSORIES

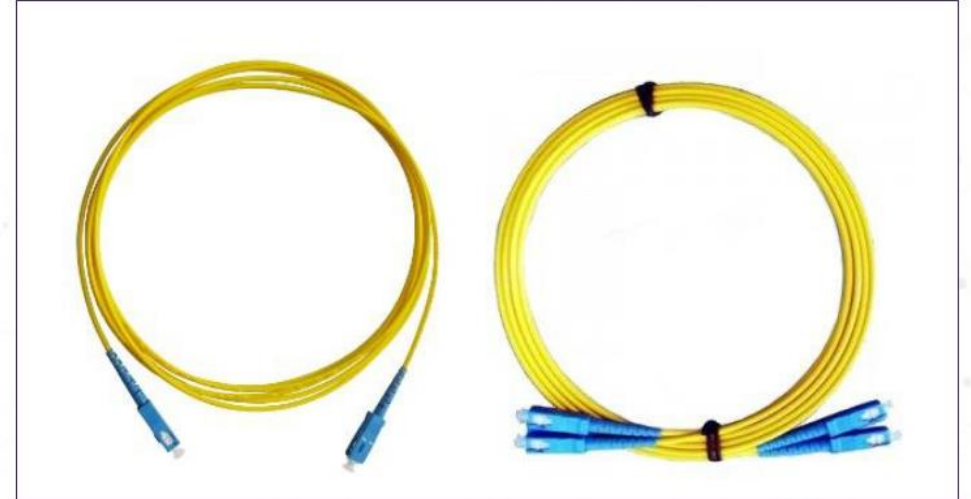
Pigtail



Fan-out



Patch Cords



Connector and Adaptors

