



كلية المستقبل الجامعة
قسم الفيزياء الطبية
المرحلة الثانية

Medical Physics

Optics

Lecture Four

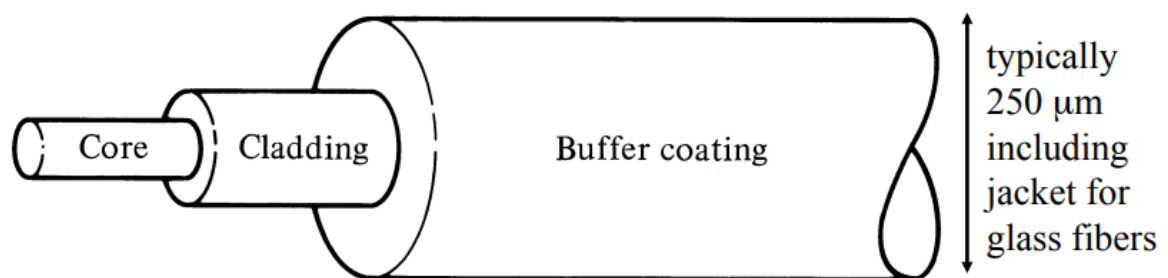
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Optical Fiber Structure :

A typical optical fiber consists of a core, a cladding, and a polymer jacket (buffer coating) .

The polymer coating is the first line of mechanical protection

The coating also reduces the internal reflection at the cladding, so light is only guided by the core .



Principle of operation :

1- An optical fiber is a cylindrical dielectric waveguide (non conducting waveguide) .

2- Optical fiber transmits light along its axis through the process of total internal reflection .

3- The fiber consists of a core surrounded by a cladding layer, both of which are made of dielectric materials, to confine the optical signal in the core .

4- The refractive index of the core must be greater than that of the cladding .

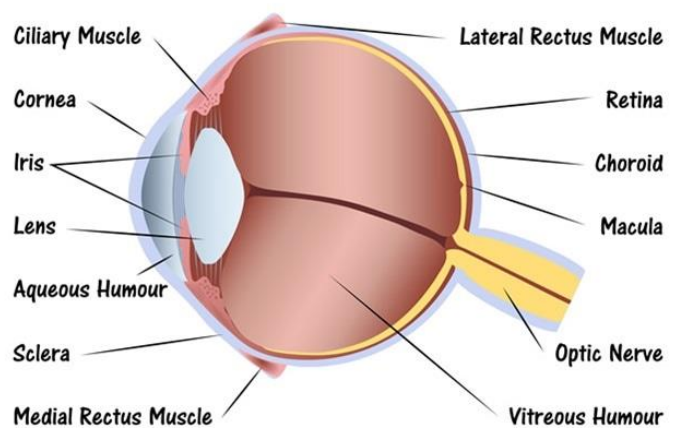
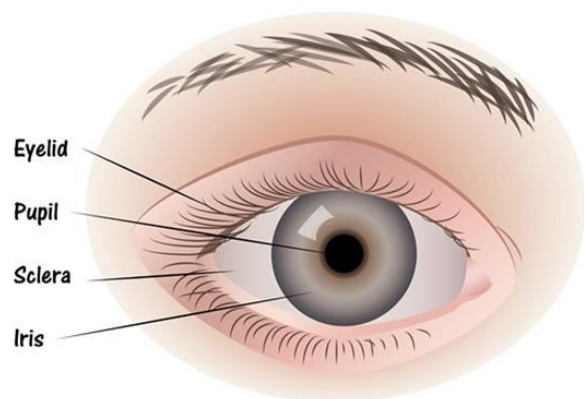
5- Light can be fed into optical fibers using lasers or LEDs .

Optical Devices :

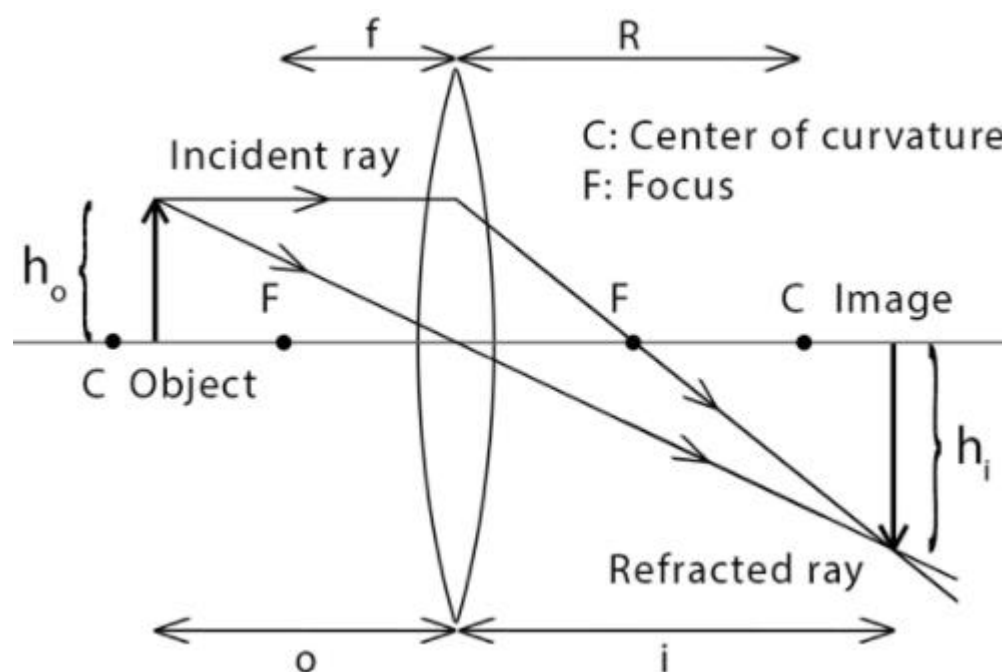
A number of optical devices and instruments have been designed utilizing reflecting and refracting properties of mirrors, lenses and prisms.

Periscope, kaleidoscope, binoculars, telescopes, microscopes are some examples of optical devices and instruments that are in common use.

Optical instruments are the devices which process light wave to enhance an image for a more clear view. The use of optical instruments, such as a magnifying lens or any complicated device like a microscope or telescope, usually makes things bigger and helps us to see in a more detailed manner. The use of converging lenses makes things appear larger, and on the other hand, diverging lenses always get you smaller images.



While using a converging lens, it's important to remember that, if an object is at a larger distance than the image is diminished and will be very nearer to the focal point. While the object keeps on moving in the direction of the lens, the image moves beyond the focal point and enlarges. When the object is placed at $2F$, which is two times the focal distance from the lens, the image and object become of the same size. When the object moves from $2F$ towards the focal point (F), its image keeps moving out of the lens and enlarges till it goes to infinity when the object reaches the focal point, F . As the object moves closer to the lens, the image moves in the direction of the lens from negative infinity and gets smaller when the object gets closer to lens.



A converging lens : is an optical lens that converges all rays of light passing through it. The primary purpose of a converging lens is to focus the incoming rays from an object and converge them to form an image. The image can be magnified, diminished, or remain the same depending on the distance of the object from the lens. In many optical systems, converging lenses are used to get a better view of the object.

Applications of Optical Devices:

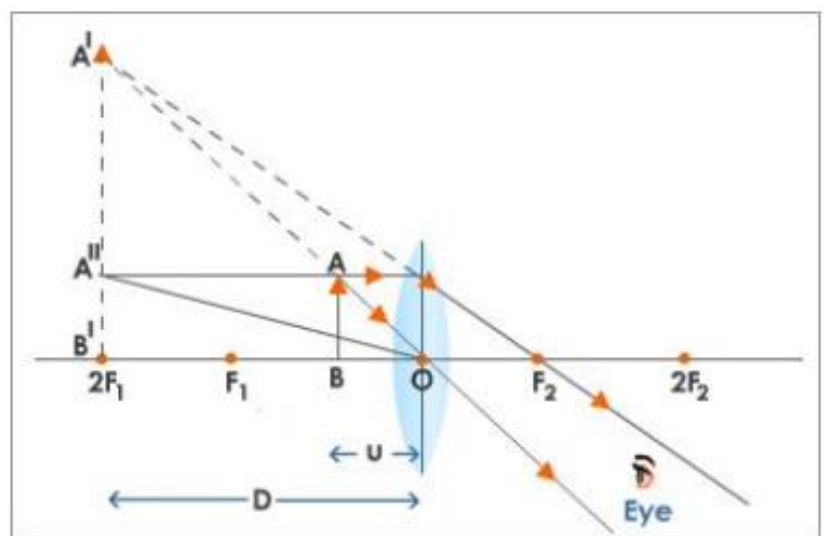
1- Microscope :

As we all know Microscope is an optical instrument used to view small object , A simple microscope is an optical instrument, we use for the magnification of small objects to get a clear image or vision. It is a convex lens having a short focal length.

This microscope is at a small distance from the object for the magnification and hence this forms a virtual image .

There are two types of microscopes :

1- Simple microscope : is a magnifying glass that has a double convex lens with a short focal length ,The examples of this kind of devices enables us to view very small letters and figures Watchmakers also make use of these and include the hand lens and reading lens.



Following are the components of the simple microscope :

1- Eyepiece: It is the lens that is used to study the samples and is placed at the top. It has a magnification of 10X to 15X .

2- Base: This provides support to the microscope.

3- Objective lens: These are found with the magnification of 10X, 40X and 100X and are colour coded.

4- The lower power lenses are the shortest lens and the highest power lenses are the longest lens.

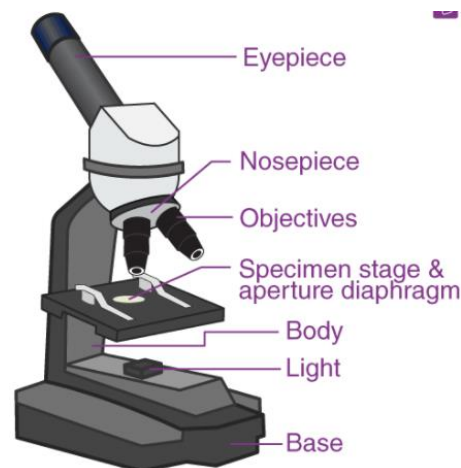
5- Stage: It is the platform used for placing the slides with samples .

6- Condenser: It is used to focus the light on the sample and 400X power lenses are used.

Simple Microscope Works Mechanism :

As we know that simple microscope is used to get a magnified view of the samples, it is widely used in microbiology. Light from the light source is made to pass through a thin object which is transparent.

To get an enlarged virtual image, a biconvex lens is used. For higher magnification and resolution, the lens must be close to the sample. By viewing the details of the sample contrast can be obtained. This is done by staining the sample. To obtain contrast image, the size and intensity of the light beam can be modified with the help of condenser or the diaphragm.



2- Compound Microscope: A compound microscope is a high power (high magnification) microscope that uses a compound lens system. A compound microscope has multiple lenses: the objective lens (typically 4x, 10x, 40x or 100x) is compounded (multiplied) by the eyepiece lens (typically 10x) to obtain a high magnification of 40x, 100x, 400x and 1000x.

Higher magnification is achieved by using two lenses rather than just a single magnifying lens. we get very large values of magnification. We use this microscope to see microscopic objects like microorganisms .

The components of a compound microscope can be known, as it consists of :

- 1- A compound microscope have two convex lenses and magnification occurs in both of these lenses .
- 2- Eyepiece .
- 3- Objective lens .
- 4- fine and rough adjustment screw.

