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Study of the Optical Properties of Optical Fibers

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Abstract:

These systems were operated at the wavelength of 1550 nm, where the loss is less than at the wavelength of 1300 nm. The development of the elements used in these systems, such as sources and detectors, led to the construction of systems that operate at an information transfer rate of Sec/GB10 (research continued to develop the elements of communications systems). Optical fibers to obtain the best operating conditions, which paved the way for the emergence of the fifth generation, which provided numerical elements. This was the beginInnsteinadg of the improvement of the sensitivity of the receiving devices, as heterodyne detection (from detection) was used. Direct, which enables efficient means of channel selection in systems that use Wavelength Division Mull-(WDM)tiplexing. Researchers were able to graft glass fibers with erbium (this grafting led to high-gain pumps called eribum doped fiber amplifiers (s, EDFA). In transportation lines and did not Amplifiers fiber Doped Erbium (which have found widespread use, The use of erbium-doped fibers is limited only to pumps, but extends to the use of lasers, switches, and many nonlinear devices. S,EDFAS amplifiers have also paved the way for fast communication systems and the emergence of transmission systems based on the use of natural pulses (solitons). Which enables it to cover long distances without deformation. These rapid developments have led to the widespread use of fiber optic communications systems throughout the world Used even for long-distance communications,

whether onland or on land, Starting from the fields of communications, Or across the, Fibers Optical, An optical fiber is a guide wave (and is usually made of an electrical insulating material, or the optical fiber consists of two concentric cylinders. The central cylinder is called the core) and has an optical density (refractive index) symbolized by (1n) which is higher than the optical density. For the outer cylinder (2n) which is called the cladding (and this condition is (2n>1n) It works to ensure that the transmission of light in the fiber is according to the principle of total internal reflection (Total). The two-layer fiber is covered with a thick plastic jacket to protect it from external influences. Optical fibers are usually made of tempered glass

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Introduction

Fiber Optical communications have moved from simple systems for delivering light to hard-to-reach places to systems that affect our lives, such as those created by electronics and computers. Optical fibers have many advantages, such as low loss and light weight, but the important advantage is their very high bandwidth, which reaches thousands of billions of bits per second. It replaced copper wires with a distinctive aptpheeafriealndcoef communication, Optical fibers have occupied a place in,In many uses, such as connecting telephone exchanges, long-distance lines, and across seas, fiber optic developed rapidly over the past dteecchandoelos.gy has, Other machines. This technology competed with the means of communication All expectations made it occupy a position in several stages that can be divided. To five generations, we will discuss each generation separately and how the different generations developed: The first generation was designed to transmit information at a bit rate ranging from 2,140 MB (per second). It used optical sources made of gallium arsenide (As Gad) and silicon detectors that operate at wavelengths ranging from nm (900,810) (In the second generation, optical sources and detectors were developed that operate at a wavelength of 1300 nm) (where the loss in the fiber decreases to (Km/ dB1)) In the third generation, the use of single-mode optical fibers led to the elimination of dispersion in multi- mode optical fibers, which led to In order to obtain high bandwidth capacity, in this generation optical links were operated using single-mode fibers with a wavelength of 1300 nm (to obtain less loss and a distance between repeaters (signal boosters) of 40 km) (at a bit line rate of 10 nm in the fourth generation). These systems were operated at the wavelength of 1550 nm, where the loss is less than at the wavelength of 1300 nm. The development of the elements used in these systems, such as sources and detectors, led to the construction of systems that operate at an information transfer rate of Sec/GB10 (research continued to develop the elements of communications systems). Optical fibers to obtain the best operating conditions, which paved the way for the emergence of the fifth generation, which provided numerical elements. This was the beginInnsteinadg of the improvement of the sensitivity of the receiving devices, as heterodyne detection (from detection) was used. Direct, which enables efficient means of channel selection in systems that use Wavelength Division Mull-(WDM)tiplexing. Researchers were able to graft glass fibers with erbium (this grafting led to high-gain pumps called eribum doped fiber amplifiers (s, EDFA). In transportation lines and did not Amplifiers fiber Doped Erbium (which have found widespread use, The use of erbium-doped fibers is limited only to pumps, but extends to the use of lasers, switches, and many nonlinear devices. S,EDFAS amplifiers have also paved the way for fast communication systems and the emergence of transmission systems based on the use of natural pulses (solitons). Which enables it to cover long distances without deformation. These rapid developments have led to the widespread use of fiber optic communications systems throughout the world

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cladding (and this condition is (2n>1n)

It works to ensure that the transmission of light in the fiber is according to the principle of total internal reflection (Total). The two-layer fiber is covered with a thick plastic jacket to protect it from external influences. Optical fibers are usually made of tempered glass. (The core and the cover) and then we call it (silica clad silica) (we symbolize it (SCS)) or from glass and plastic we symbolize it (pcs) or entirely from plastic (pcp) (see Figure (1))

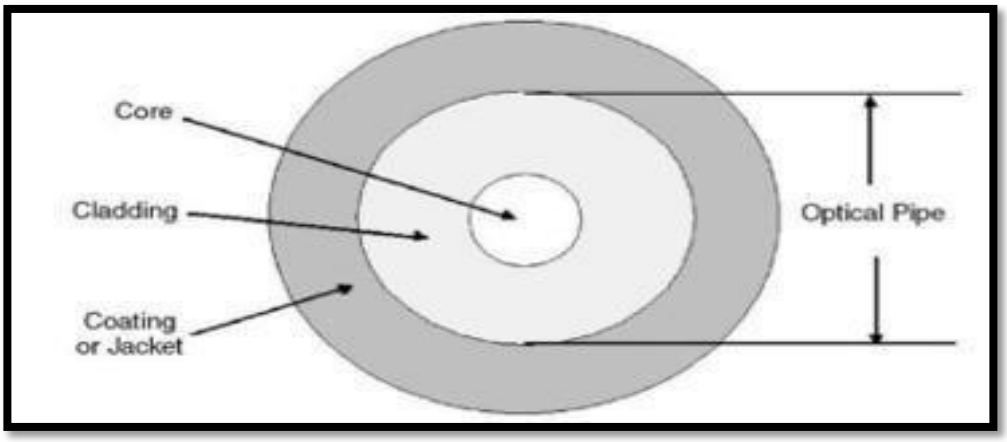


Figure No. (1) Cross-section of an optical fiber

(Advantages of Optical Fibers) Advantages 3.1

Optical fiber has many advantages that make it superior to other systems used in the field of communications, and these advantages include the .following:

1. Its bandwidth is very high.
2. Its diameter is small and its weight is light.
3. There is no interference between them, no matter how close the distance is between them.
4. Not affected by research or electromagnetic interference.

Cost of calls.

5. Lower price.
6. Safer and more secure.
7. Its shelf life is long.
8. It can withstand high temperatures and is not affected by chemicals.
9. Easy to maintain and reliable.

Transmission Theory Ray, As is known, light spreads radiation in a certain direction and speed, the value of which depends on the type of medium in which the propagation takes place. In other words, the medium hinders the spread of light through it in varying proportions, which means that the speed of light propagation through any medium is less than that in the distance. This property of different materials and media is called the index of refraction for the material or media in question and is symbolized by (n). We can calculate the index of refraction for a specific material using the following simple relationship: Where (Cn) is the speed of light propagation through the given substance, 0C is the speed of light propagation through the substance.

10X3=0C (The table gives examples of refractive index for some materials: m/s

Table (1) Refractive index of some materials

Refractive index	Subject
1	Air
1.33	water
1.5	Silicon
3.5	germanium
4	alcohol
1.36	glass

Snell's Law 5.1

Snell's law is considered one of the basic laws in optics, which gives the relationship between the incident ray and the refracted ray and the angles associated with it. The figure below illustrates the idea of Snell's Law.

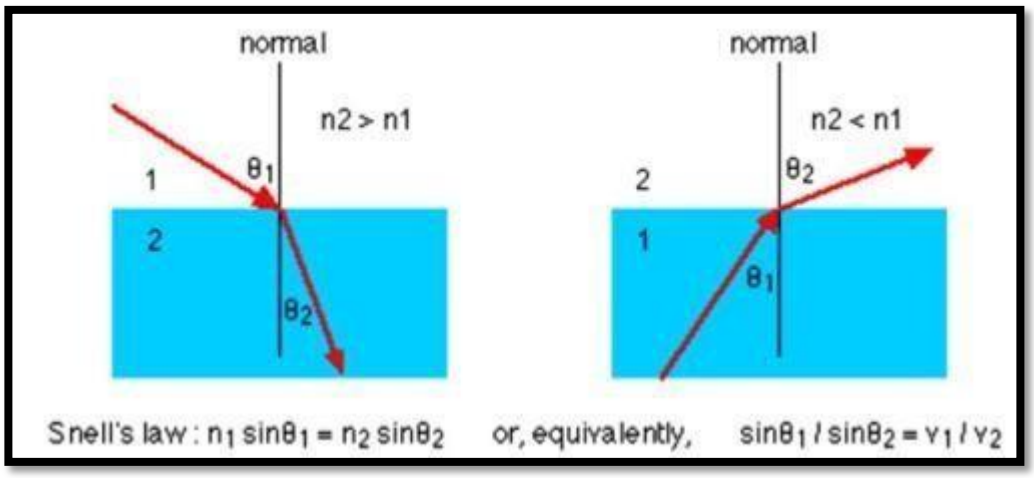


Figure (2) The incident, reflected and refracted ray

We can write Snell's law as follows: 2

Where 1n symbolizes the refractive index of glass and 2n represents the refractive index of air, we will rewrite, Snell's law to become as follows: sin1=2sin(1.3) 21 Where (2n>1n) then (02>01), Angle Critical, The concept of critical angle is defined as follows: It is the special case of the value of an angle of incidence, The beam when the angle of refraction is equal to 900, Figure (3). In this case, the beam spreads to the boundary separating the first and second medRiae.fracted horizontally and parallel

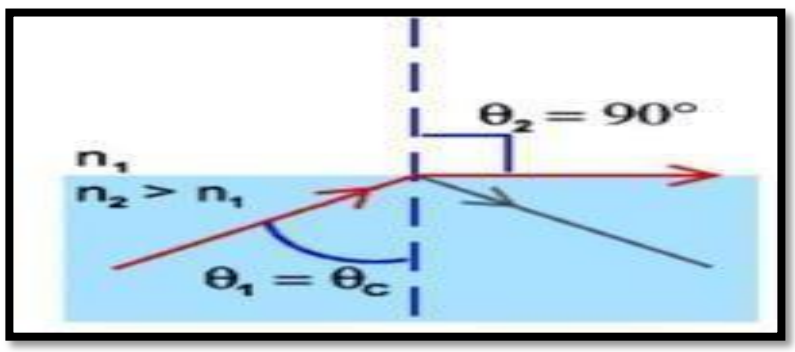


Figure (3) The case of the critical angle of incidence

Referring to Snell's law, we can obtain the following critical angle relationship Less than or equal to one. Because the sine of any angle cannot be greater than one, (1n2/n) is always Internal Total Reflection, It is clear from Snell's law that whenever the angle of incidence changes, it is accompanied by a change in the incidence is greater than the critical angle, we 1 angle of refraction. In the event that the angle of obtain internal clay reflection. Emphasis here on the following condition: It is answered that because the light is completely reflected, no refraction occurs, and the light is transmitted from the media. The propagation of light through optical fibers depends on the principles of total internal reflection. The optical fiber can be considered as a glass tube with a diameter of about 125 mm (mm), consisting of two layers: the inner layer, called the core (which has a refractive index of 1n), and a surrounding layer called the cladding, which has a refractive index of 2n. In order to give the fiber the required durability and degree of endurance, a primary sheath layer must be added. (coating) plastic to cover the perimeter of the fiber. If the light falls at an angle less than the critical angle (), then part of the light will be reflected inside the core of the fiber (partial internal reflection), and another part will be refracted across the perimeter of the fiber, leading to its exit from the fiber and thus leading to increased loss. To clarify the process of light propagation through the optical fiber as follows: In Figure (4), which represents the transmission of the light beam at an angle (ÿ), where the propagation, The principle of total internal reflection. occurs through the entire fiber core, accordion.

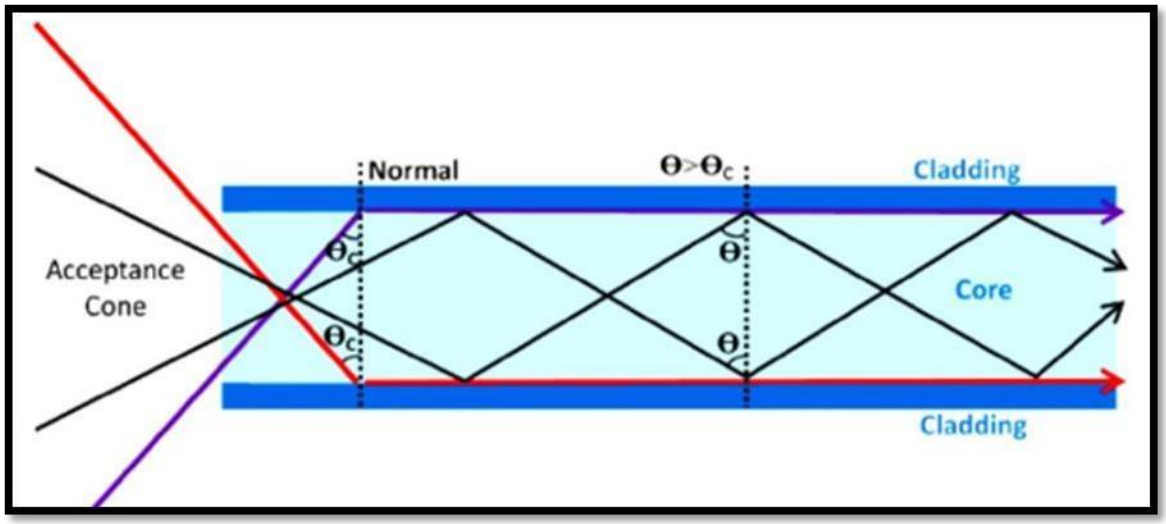


Figure (4) The propagation of a light beam through an optical fiber

Angle Acceptance The angle of acceptance (ÿa) is considered one of the numerical values that must be known about the optical fiber, and in order to clarify the meaning intended by it, we use it in the form shown below:

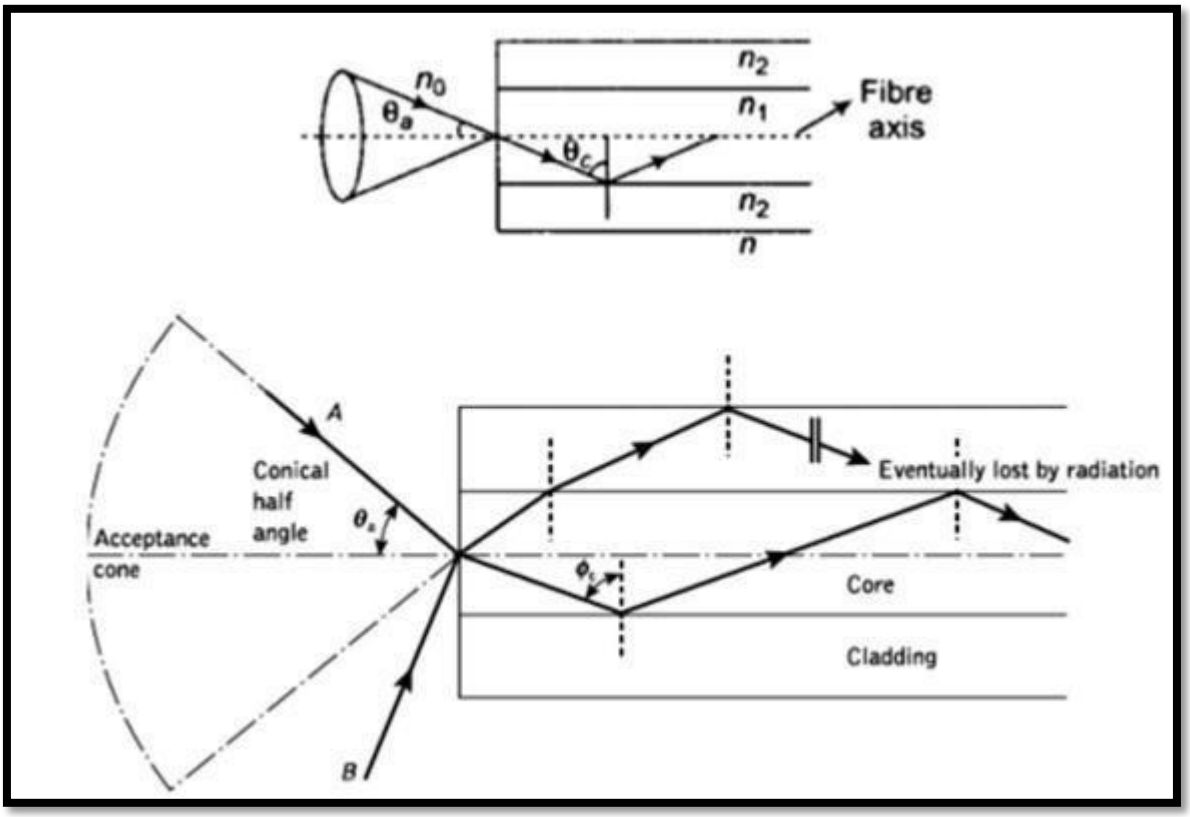


Figure (5) Angle of acceptance when light is introduced into the optical fiber

Ray A enters the fiber at an angle smaller than the angle ÿa and reaches the point of separation between the core and the surroundings at an angle (1ÿ) (larger than the critical angle and thus follows its path through the fiber correctly) (total internal reflection is achieved) and the loss in this case is as small as possible. Ray B would have entered It enters the fiber at an angle greater than the angle of acceptance (ÿa) so that it reaches the, Toward the ocean, its water is refracted angle smaller than (ÿc).sharp separation between the core and the surrounding at an, Thus, it is parted and exits outside the fiber, causing any loss of part of the propagated light, and thus it cannot be achieved. From here the meaning and concept become clear. The acceptance angle is the angle that responds to the total incoming reflection. The incoming ray must enter at an angle equal to or smaller than it in order for total reflection to be achieved. Thus, it propagates through the fiber correctly and with less space loss. In the same time, the ray entering the fiber at an angle greater than the acceptance angle, part of it is refracted. Through the ocean of fiber and thus he will lose what is left of him, It is reflected inside the fiber, and here we get a partial reflection, not a complete one. Therefore, in order for the light to be transmitted over the longest possible distance, light must be taken into account to enter the fiber at an angle that does not exceed the value of ÿa.Aperture Numerical, There is a numerical value more inclusive than the acceptance angle (ÿa), which is a representation or expression of the relationship between the light entering the fiber correctly and the refractive index of both the core of the fiber, 1n, and its circumference , 2n. This value or relationship is called the numerical aperture of influence (NA). =° sin = ÿ 1 Which can be found from the following relationship:22ÿ 2(1.5) Where 0n symbolizes the refractive index of the separating medium, the air is usually 0n=1 between the light sources and the front of the fiber. 2n , We can express NA in terms of the relative difference (ÿ) between 1n= 1ÿ2ÿ (1.7)Where ÿ is calculated according to the following relationship, 22 1ÿ 2 ÿ=2 (1.8) 2 1) takes values between zero and 90, (NA) between zero and one ÿ is usually much less than one (ÿ>1). In practice, lenses are usually used between the light sources and the front of the fiber to help collect and focus the light so that it is easy to enter the fiber. In the same way, lenses are used to

deliver light from the fiber exit to the photodetector. [3] ,8] Propagation modes in optical fibers (Modes Fibers) Light spreads through the optical fiber in the form of a limited number of light beams (or rays) and at certain angles with specific values. These different radiations or light beams are called propagation modes (where a ray is associated with a specific propagation pattern). Therefore, the side numbers are used next to the name of the mode (Index Modes) to distinguish them from each other. We will present the basic types of modes spread across the optical fiber, which are: 1.Transverse electrical modes (Modes Electric Transverse), symbolized by modes-TE. 2. Transverse Magnetic Modes (symbolized as mode-TM). 3. Hybrid modes (containing electric and magnetic fields of the HE type) 4. Hybrid modes (containing both electric and magnetic fields of the EH type) As an example of how to name propagation patterns 01TE12,EH11,HE02.TM.…

When talking about propagation patterns, a numerical value for an optical fiber must be known, which is called the natural frequency (Frequency Normalized) or the numerical value (V number-V), which we can Calculate it according

to the following relationship: 2= .....(1.19)

ÿ 1ÿ2 = 2

… … … … … … … … … … … . . (1.10)

Whereas ÿ wavelength a is the radius of the fiber core [3].

Classifications of optical fibers Fibers are divided into two broad categories, single mode or multiple mode. A mode is defined as a set of similar paths that light rays travel through a fiber. The term "single mode" is used to describe a fiber that supports a single transmission mode, while single mode, Multimode describes a fiber that can support more than one transmission mode. Multimodal fibers are commonly used in biomedical applications and come in two basic configurations: step index and gradient index. The multi-mode fiber is the simplest design, and operates in the basic manner shown in Figure (6). Its name comes from the sharp change in refractive index in the fiber material at the boundary of the sheath with the fiber. Gradation index: The index of refraction gradually decreases from the center of the core. In contrast, the core To the cover.

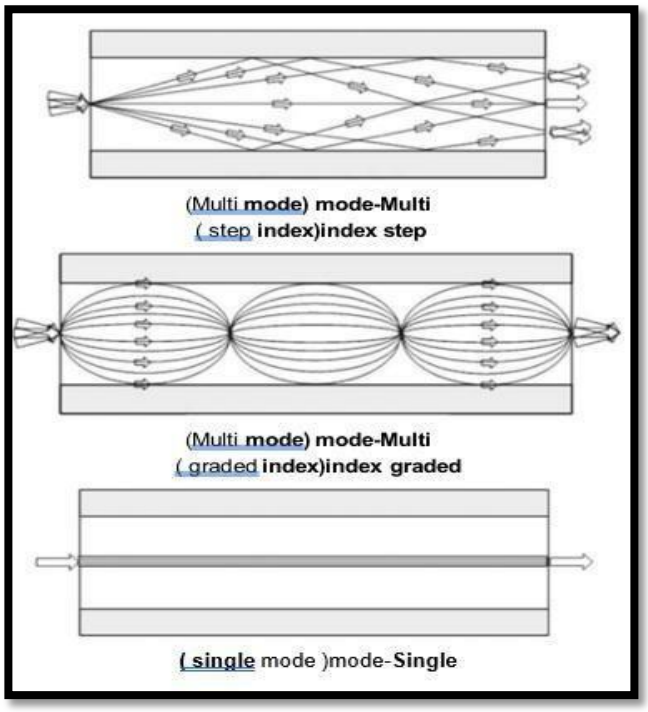


Figure (6): mode-single and mode-Multi fibers

Figure 6 illustrates the concept of the formulas. Fibers with high NA allow light at a wide range of incidence angles to enter the fiber. The result is that incident rays with angles smaller than the angle of incidence will travel along paths shorter than the central (optical) axis of the fiber ((lower order formulas), while rays entering at larger angles will travel through, impurities present can cause a longer path length (higher order formulas). Fiber material for both multi-mode and single-mode fibers Leakage at the interface Due to the long distance traveled by the high order modes, the, that, Core/cladding. And with, With single fibres Enhanced effect by using multimode fibers resulting in comparatively higher transmission lossesT Mode. The number of modes transmitted along the fiber is determined by the natural frequency parameter V. 12.1 Types of fiber optics, Optical fibers are divided into trace types, depending on the standard used for the division process, based on the change in the refractive index through the core of the fiber. Optical fibers are divided as follows: 1.12.1 Fibers Index-Step (where the index of refraction is a constant value through the core of the fiber. Optical fibers Optical fibers began to appear in this type specifically due to the ease of designs, And manufacturing, where the fiberglass core is manufactured pure and has a constant refractive index of 1n, while a fixed but lower value (2n) is manufactured (as shown in Figure (7)) with a refractive indexT. he ocean is also made of glass, Which represents how the refractive index of the optical fiber changes (r) n depending on the radial distance from the center of the fiber (r) d represents the radius of the circumference and the symbol (a) represents the radius of the core as we mentioned previously where, These values are given in units of micrometers (mÿ). If we look at the figure above, we find that the change in the index of refraction from the value 2n to the value 1n or the inverse has no degree or threshold shape, and from here comes the name “threshold fiber.” We can calculate the number of modes spread (Ms) through the threshold fiber with the following relationship, The speed of propagation for all modes is constant and equal, Where n symbolizes the refractive index of the medium in which propagation takes place. Here, for a fiber fabric, the definition of 1n=n is that the reason for the constant speed is that the refractive index of the fiber fabric has a fixed value, and therefore the relationship does not change geometrically, and the light beams or rays spread within the region of the optical fiber core and are above Its path is in the form of straight lines (Figure 8). This is due to the fact that light travels in straight lines, The index of refraction is constant, and this is the case in ordinary fibres. Fibers differentiate through a homogeneous medium Al-Atabiya, with its simplicity and therefore its low price, is modest in its characteristics and features, and that is its problem relatively high level of iTnhteernal dispersion (Intermodal Dispersion), which leads to the effect, The transmission distance and the permissible transmission speeds, as for the reason for obtaining high transmission, Negatively, it is due to the fact that the different light beams follow different paths in length, as in Figure (7), but they spread at constant speeds, which leads to their arrival at different times and, consequently, to a time delay between them, which causes the problem of internal chatter. This will be combated by studying this phenomenon. In the second chapter of this research, which is devoted to studying losses in optical fibers.

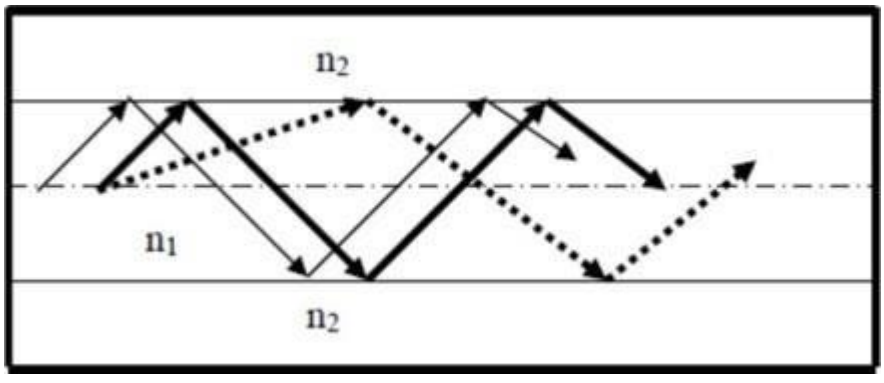


Figure (7) Paths of optical beams through the threshold fiber

Graded-Index Fiber, What distinguishes optical fibers with a gradual modulus is that the refractive index of the fiber core changes its value in a gradual manner, from the center of the fiber (maximum value 1n=n) to the sharpest separation between the core and the periphery (minimum value 2n=n). This gradual change takes different trigonometric and parabolic shapes. Or other shapes 2n (It is clear from the the circumference oflothceatfeibdeirn(between, and the index of refraction remains constant, that is, for above that the refractive index of the fiber core region has a variable value and takes the form of a certain mathematical function (r)n. Here, we can calculate the number of propagated modes (Mg) of thWe hfiibcheris similar to the problems mentioned above, Visual by relationship: = [+ 2][2 2] … . . (1.13), Where the value of (ÿ) represents the function parameter that determines the general shape (triangle, parabola, So the triangular shape has a gradient of 1 = ÿ So the cut shape has a gradual equivalent of ÿ = 2 So the thresholdÿ = ÿ ÿ i.e. a real value greater than one, but from a practical standpoint and after conducting the enumeration since experiments can only take place, it was found that the best values are (ÿ = 1.98) and the resulting shape in this case is a parabolic profile near (where the number of propagating patterns depends On the coefficient of the function ÿ Geome Ltriigchaltlyb, eitaims shoarpera dylsikepr couprvaeg daltienewsi, thnoint sthtreaig cohtrelinaerse, abeoc fatuhseeotpheticinadl efixbeofr raenfr dact thioenirhpaas thasvaarrieab floermvaelude in the lab-man region. The relationship = V, the quotient, which represents the velocity, is not constant, as the velocity is the greatest possible when N is the smallest possible (in the region of the edges of the core), and the velocity is the least possible when n is the largest possible (in the region of the center of the core). This difference in velocity This is the main reason that gives progressive modulus optical fibers the significant positive advantage over optical fibers. The threshold. The beams close to the center of the core are slow in speed, but travel short distances, while the farthest beams are fast, even though they travel long distances, because their refractive index is greater, and therefore all the beams arrive at very close times of time, which reduces the delay between them, and this is the reason. About 100 times less dispersion than fiber is very, The dispersion in this fiber small. Fiber Mode Single, Optical fibers can also be classified according to the number of propagating modes. In this type, only one mode propagates (11HE). In the case of single-mode fibre, there is one mode of propagation (11HE). We find that it is the first, the basic or first mode. This mode begins to appear and spread through the optical fiber and is therefore called the same. At the same time, the unilateral pattern spreads in two states of deduction: 1 - The horizontal state is symbolized by X 2- The vertical state is symbolized by Y, This condition cannot be obtained in the propagation of only one mode unless the value of V is very small, less than (2.405). The limit value is usually called V = 2.405, which ensures the appearance of only one mode with the cut-off value, and we will denote it Vc. The main basic feature of a single-mode fiber is Eliminate internal dispersion due to the presence of only one mode, and therefore there are no delays or time differences between the modes, which are the direct cause of the appearance of dispersion. Therefore, single-mode fibers are preferable. Absolutely in terms of practical characteristics and specifications, despite the difficulty of manufacturing and the high costs. To obtain a single-mode fiber of the threshold type, the following condition must be met: 0 ÿ v ÿ 2.405 (1.14), We can fulfill the condition in two ways 1- By reducing the diameter of the fiber core (a) 2- By reducing the relative difference of the refractive index (ÿ)

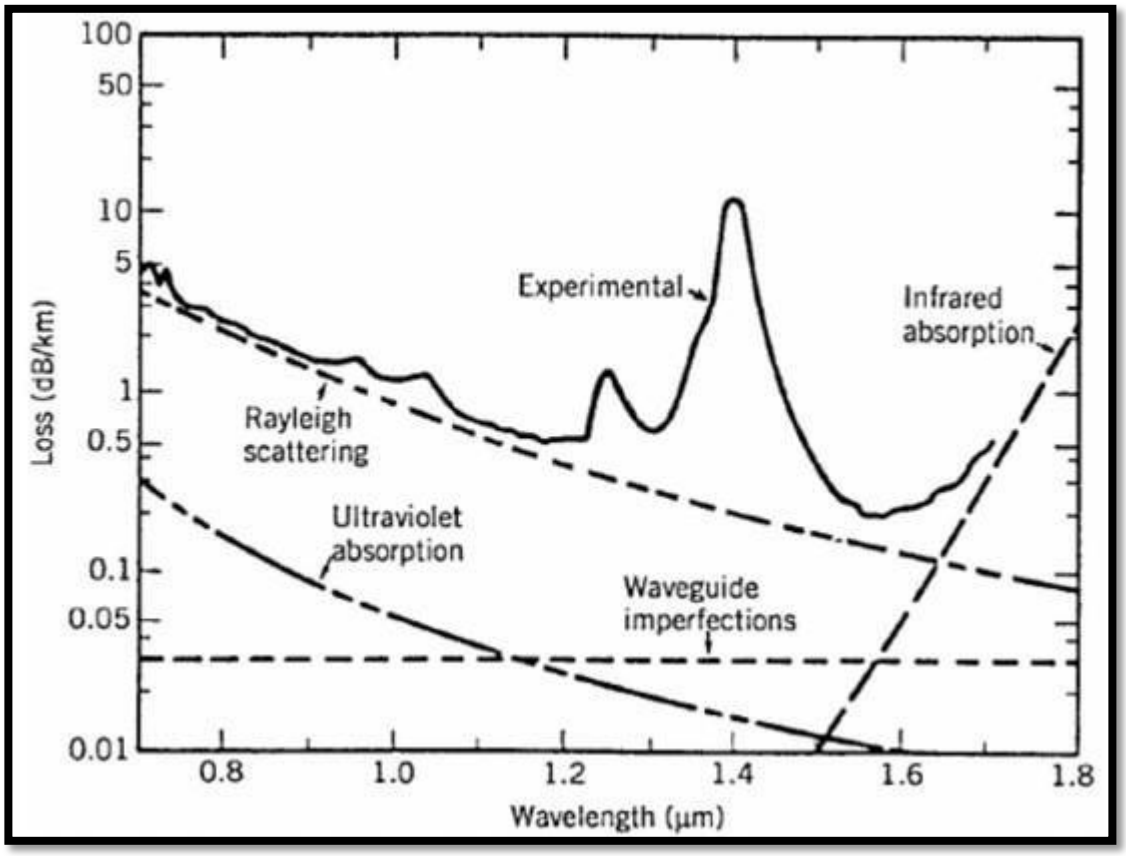
In the case of a single-mode fiber of the progressive type, Vc is calculated according to the following relationship Vc = 2.405ÿ1 + 2/ÿ (1.15) Plastic Optical Fiber 4.12.1, Which is symbolized by the abbreviation Pof (because) it is made entirely of plastic). Plastic fibers are distinguished, which makes them very cheap, as they are now manufactured in the form of multi-mode fibers and are used on Wavelength 650 nm and the most important positive features of plastic fiber 1- Low price 2- The relatively large size (about 100 mm in diameter) makes it easy to use 3- Aperture numerical permeability (NA) is high, about 0.54- Flexibility and high flexibility in application, Disadvantages 1 - Very high attenuation (more than 200 km/dB) 2. The frequency range is slightly

lower, about 5 km.MHZ (the use of fiber is limited to factories and offices. They are also used as replacements for cables insideOn short distances Jada plastic, Electricity in cars. Chapter Two Losses in optical fiber, (Losses in Optical Fiber) be amplified. Rarely, fiber optics are a great way to spread optical signals, as they often need to Yes, Unlike copper cables. High-grade fibers often exhibit power attenuation (up to 0.1dB per km). Oh my love Opinion Qiyun and Qiyun will meet the basic signs of the night) and the network will, some light to the night At the end of the night, where it transmitsstitllhbeecaobnlneetcotiobnrintog the network she but it's important to me The performance suffers, me? connection. It's like this, what's wrong with, Another important part is installing and testing the network. For network planners, it is the largest portion of the budget between the final network and the upstream network station. The large number of properties is the separation of the lattice - and the large quantities of the two are the alcones, the natural connections and the left-handed cosmologies. About me, The terms “IL” and “RL” are not used. revelation because it is a visual sign on the journey of birds. It is not considered a source of divine, This is the information. Like the link dolls , And bright Internal connections and fiber connectors are provided that it comes to a ratio of 0.01 and, He linked it by some mechanical means, suggesting 0.1 dp. milli Now I obey you again, And The optical connectors are removable and attach to the connections, The SMF at high frequency does not exceed 0.25 dB. Layla Harnaq, the electronic insertion of the fiber network on the ground, (The center of the angular fiber tip is used.) Considering water Yes, The number of optical links and links along the transmission length increases, so the total smooth attenuation is not distributed over the fiber links and is added to the optical fiber attenuation. Fiber Optical in Losses, How light propagates through optical fibers is concerned with the rate at which light travels to the nights. Estimate the optical resonance in YBEL per kilometer for the attenuation resonance. Deranged. Hey, The aberration of optical fibers is induced by physical mechanisms 1. Loss absorption of material (loss absorption) is caused by fibers, impurities, structure, and rays. Automatic absorption contains two components of radiation absorption Y, That refers to the emission of soft light in 2SiO. Optional absorption of subsulfuric acids refers to the absorption of organic substances such as electrolytes, minerals, and OH ions. 2. Linear scattering (loss scattering linearity) - B B The linear method of optical energy is scattering, up to and including the lengths in the modes. Rayleigh's slceantgtethrisngofdates back to the lengths of the universe and the great the universe. Come on, Al-Loali. It is a night of endless distraction, Optical emission by s`Mie scattering. 3. Loss scattering linear – Non-linear scattering (which are objects of high density, For fiber optics. Non-linear astronomer technology is available Y High m optical power, Al-Tizwi Al-Tiyali. Brillouin scattering is the definition of light on the thermal vibration of aether atomizations. It is, The air, like there is no air Y Optical fiber. About what light encounters, the parallels Y resonant to the compositionssc?attering. What is the meaning of the matter and what is the time for the flow of bare thetons

Frequency. T to her, In a way that the energy is reduced so that the emitted neutrons are dissipated Non-resonant scattering is specular scattering. 4. Losses Bending The bending of optical fibers is created as a result of millions of optical fibers. The electromagnetic signal requires the second part Y Conditions for the propagation of light Y , the colors on the outer line of optical fibers, the spread and growth of the machine. This paralyzes the losses resulting from the total bending and the losses resulting from the partial bending. The text of the critical diameter has a relationship between curvature and curves with a critical diameter. The risks incurred, Deranged include non-metallic fibers and non-mineralized fibres. BB: And there are subsequent reasons such as impurities - absorption) and the reasons for optical Y, The last one fibers, etc. There are the following research, The mechanism is like the bends (and this value is considered an on fiber conductors: Y Light equation + + = 1 … … … … … … … … … … … … . . (1.2), Where IT, IR, and IA stand for infrared light energy, communication, and nano, respectively. The expression for the photovoltaic energy is T (which is defined as T) in the following equation: Lambert's Law ÿ… . . (2.2) Where

and where:. Io: light energy before its meaning, Absorption coefficient. Z: photometric length. And the things that bring me back to life, and the scattering, the absorption, and the physiological factors, so that they can be returned to me. Attention: Attenuation, And the shadow of communication on the other and its forms, but it is naked Y, The visual ringing between the night and the exit. Y, Where distraction is considered a fundamental problem to, Telling the person who is vomiting that he has vomited, Attenuation = (ÿ 10) log (3.2), Where and where: L: As long as I can see. Pout: The machine does not ring. Pin: off light ring.

If the word is in kilometers, we express the meaning of the word as the word per kilometer (Km/dB). indication of the usury connection).



Figure(8)-The one who sees Y Curved my cheeks ,Yu.

Attenuation losses can be classified according to their causes into the following types: 1. Astronism. 2. Absorption. 3. Military losses., Scattering optical, Optical fibres, the first astronomers, the highest Y There are some types of astronomy coherence, some of which have some types of optical fibersS.ilica shells, which are not crystalline, are distributed in a random and irregular manner. Scattering Rayleigh (scattering Rayleigh) The second type is known as Brillion scattering (and Raman scattering). It should be Single fiber fibres noted that this is the type of scattering at high resonance levels of light, which are very long. Absorption Lengths, Optical fibers and Yahya Th Yes, The second global absorption of waste materials is the result of the electrons absorbing the energy from the formation beam to the conduction beam, followed by a non-radioactive path. There are two methods and types of absorption:

(Intrinsic Absorption) A In many cases, the light will bounce off something in the area of the eye of May Al-Tayy. And the brown one is Ultra, The plan is y It is the type of electrolytic absorption, The state of my resonance to UV (Alertba).NS yall Violet (UV) electrolytic folding of the, Turkish electrolyte band for Lyca dissociation and absorption at night. Infrared (IR) in the case of IR

resonance, And the structure is both alive and absorbed due to the infrared vibrations of the infrared, the result of which is a Y .relatively wide areaY.

B. Absorption Extrinsic Etc. The next one came without a delay Oh my sunshine. And it is the land, In the world, the glut This type of absorption is related contains molecules and impurity strings, so that time can absorb from me the divine lengths, and it R (The contaiÿ ns desires such as the unicorns of the lions, and the yoke of the divine spirit, which are O. thief is my fault. C. Absorption due to atomic defects Y President of the Earn imperfection (which is the Yahya is the type of absorption resulting from defects and general tuning of the bottom that is similar to each other) and the high density is the result of the resulting defects.

Geometrical Losses, Light is reflected by geometric contours and curvature contours, where the curvatures are represented by the contours of the curves. Cladding Y And spread In terms of light, light is bound to light, and geometric properties are classified into their two types: (Micro bending Losses) A, The most important reasons for frequent scattering are the strong curvatures and bending of the optical signals through which the fibers are installedY. They returned from using the mother of those who see On anything like cables. I am sorry for the shortcomings of the night and the fear of the night, the mechanical Turkish bow, the bow that touches me and the night, and that it bends what I brought to you in a foldable way and follows the random bends of the night birds that you touch with me, oh electro, The one who smells amazing curves Y The resulting damage has significant curves. Wt liB B Here is the insight into how to solve these environmental conditions. Valuable and motivating as well, Twist twists (which tend to have strong bends and spreading yoke mean that the lengths of. And every outcome is a twist that leaves me unsettled, The night, The formal distribution is based on the method of combining the terms M The light bulb. It is based on high- class activities that are inherently Jewish. The low frequency of the bird has curves with an increase in the numerical aperture of the visual aperture (Aperture Numerical) NA (Macro bending Losses) B So, she is the one who is afraid of me, and the one who bends is like a drop of bending on the centrifuges and less, Chinese Recommendation Club my father. And when they are created, they are the curves that are the only thing about me that reminds me of, The light is shining M Boxes Junction (large curves are not reversible) that it. And m m You can write about the spread of light as a function of winding It is clear from the above that the value of lost light depends. on: ÿ The type of light ÿ Paralysis conditions. ÿ Soft to manufacture. Glazing and plastic. ÿ The type of laden that is made from it. ÿ The interstitial length, where the minimum of the following interstitial lengths: Window First Window second = Which comes to me = Which follows the third nan (Window Third) Which follows the I am the one who is moving and at low transmission speeds between me and my family. first nan M And it ends with, High-speed broadcasting.

Y Second and third = Leave the length of my life in one direction and say that it belongs to him 2 Losses Dispersion, For optical signals, the pulse shape of the message is as follows: Y Using optical fibers to distort Y lightalong the optical fiber, where some pulses arrive before others. The shape of the scattering light pulse, which is inspired by a wave of light that rises and rises. Y What a mess that is happening, Here the distraction is give, Fundamentally, along the length, the dispersion increases as the length increases, and the distance increases with the required N per kilometer km/ns (where the dispersion increases to: Also Chromatic or Intramodal Dispersion, These types of fibers are single-stranded and flexible. The scattering of waves, according to the following, goes back to how light is emitted from sources on a beam of light and along the wavelengths, not the wave length, and it is entirely. Here are the options for the appropriate distraction, Chromatic, but not known in physics Spreading through, May your dealings with me be exalted the night Denial, which is pure, rises over the long length, so the velocity is never equal, which leads to the convergence of the transmission pulses and thus the occurrence of dispersion. Internal distraction is divided into

two types: (Material Dispersion) A And throughout the dysfunctional conversations that will save me

The light emanates from the thief, No Asharna sab a and spreads across the light at different speeds and the same lengths and to the next one it directs to me the result of the scattering It reaches the end of the night at different times, and it is of the fields leading to the pulse wave, and thus its distortion of the night, which is the phenomenon that uses radioactive sources. What is the width of Line Spectral Narrow? And it's not the same as the RMS I love you, I pray to you, I pray to you, I pray to you, I pray to you, I pray to you, I pray to you, I pray to you, I pray for you ÿ) and the following relationship: × × = Value) The nat's impulses plead for the distraction of the world … … … … … … … … … … … … … . . (4.2) (It symbolizes the folded width or the linear width spectral width) Where I say, The optical meter is expressed in nanometers (nm), which symbolizes L (to the length of the night M) to the thief. Dispersion Material parameter (and then we evaluate it) km×nm/Ps) where it is given to the lye mawasat to obtain the lyadin chitite Intermodal, Dispersion, The length is fine Y, Those who see multiple modes of light beams have different paths Y, All of them yearn for the kind of splendor that when they learn it, they reach the end of what is with a disordered heart, and for them the begging occurs in a natural way. Begging occurs through the impulses and what, The fibers and Hadal to Allah and the iods are the distraction of Allah. Yes follows is the dispersion that is typical day of this type, and I consider it one of the fibers of the mother and the love of a single soul that spreads through those who love it. Tawassul is based on the impulses that lead to the desire to reach its average educational level 1ÿ ÿ = 2ÿ3, For the following relationship: (rmsValy).. . (5.2) The one who sees Y Where the symbols that are filled with similarity to the motherboards and what I can estimate are the values of the RMS squared (for multi-level pulse scaling of the type that is based on the scattering ÿ): 1ÿ2 ÿ = 20ÿ3 in. . (6.2) Altriti, The condition of the one Y relation to the elasticity of the pulses, which is much lower than) that of my load, about 100 elastics less). The one who enjoys the world Y 2ÿ 2 = ÿ 2 + ÿ . (7.2) 2 Where ÿ (symbolizes misleading dispersion, may God protect you from ÿ) for the threshold or ÿ) 2 ÿ (is the product of the dispersion of the ladin and the lolial night. As for you, please, For me 2ÿ 2 = ÿ 2 + (8.2) Illitad al r metosa total terbilization = ÿ 2 + 2 (9.2) 2 = 2 + 2 = 2. . (10.2), What about the letter and the resultant, because the dispersion of the fold is not interpreted by the squared term of the method? = ÿ 2 +2 (11.2).

Dispersion Waveguide, Aden is not the same as the night of the night of the night ÿ (the last few days of the night of the night of night ÿ) and the type of night rises on the long night of the night ÿ (and on the folded length ÿÿ). ÿ = 1.31 (where the wavelength on the side of the dispersion is Wavelength Dispersion - Zero). This is equal to 1.55 ÿ) where the fibers are subjected to electro-dispersion. On the lengths of the next one

Fibers shifted Dispersion (DSF) is the vector that causes a value for the state of the metal fibers that are not given A dispersal evidence of its origins in Eila Al a covering large areas to Its specifications. Connection losses, It is known that optical communications networks are reach and connect optical fibers to obtain the required lengths so that the people can reach a high speed. To deliver the data to the transmitter (Transmitter)

Itad is an easy and economical way to deliver Y And not even Receiver). If the basic shape is that the fibers are to me until they are joined together and quicklyc.onnected to each other with the slightest property, then the fibers return, Because it is made of glass. K, Fiber Connectors .They are simple and fast moving connections where fibers are connected to each other automatically, Loss Joint and Alignment Fiber Connecting them to each other and what comes together Y, In all types of optical fibers, there is an additional

problem with each one of them: initializing and aligning the fibers before providing opinions on the connection method. Reflection Fresnel, But we can define Renal reflection as expressions of

phenomena related to the dispersion of diffraction coefficients from me. You are the light from the night to the night that connects to it, which leads to the partial reflection of the light that is directed to me The night of the night, The following relationship: MNkh, For the reflective factor ÿ = (1 +)12…. (12.2), Where r (the triangulation of the reflection of light on the object and the single Interface (which symbolizes a metal like air) is 1=n) and 1=n (to n) is the refraction index of the medium between the two, Total loss of sleep (Twice) until the end of the day, What is the reflexology? The refractory coefficient of, Al-Nat A Reflection Renail M One God Tablet N Al Yabil: LossFresnel = ÿ10 log(1 ÿ) (13.2), I have to spend a few minutes until we get the total meaning of the night, a resonant reflection that is filled with the original worlds of the worlds, which are the meanings of the world, the meanings of which are the meanings of the world. 1=n) Ayra

.) IndexMatching Gel, Loss associated with misalignment between fibres. Loss associated with longitudinal misalignment, Shown is the shape of a connection using connectors (whereby the longitudinal fit leads to a direct reflection between them, and we will denote it S). Raga the son of the father. Y, Loss associated with lateral misalignmentm, We studied, Shown is the figure for connecting a ligature using welding or connection tools, where a displacement of the buttock joint is, The light rings louder Y It happens Y shown, which we will symbolize as d (following its position according to the type of ligature and the location of the displacement d). Loss associated with angular misalignment This problem appears when connecting a wire using welding or connection tools, where an angle appears between Y It happens Y the angular alignment along the first and second lines, which we will symbolize as ÿ (it follows the ray of light and its angle is based on the type of light and the angle ÿ).

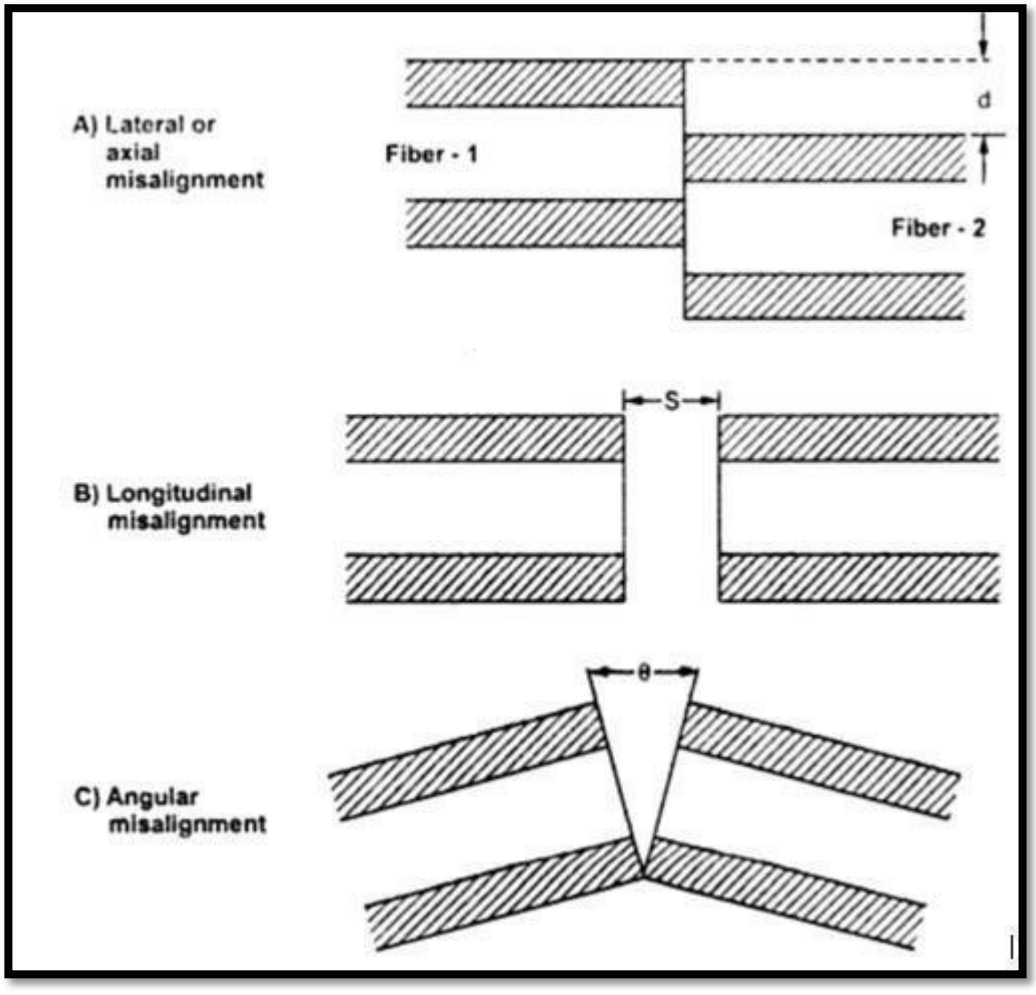


Figure (9) Loss associated with misalignment between fibers (A) lateral misalignment, (B) longitudinal misalignment, (C) angular misalignment.

Study the effect of bends and calculate the resulting losses in optical fibers, Multiple styles, In this chapter, devices originally existing in the Najaf Post and Communications Department were used, where readings were taken in, The aforementioned circuit, and in our research we address multimode optical fiber in particular (Multimode). Which has the properties shown in Appendix No. (1), and the length of each of them was (10 m) (and the readings were taken and the losses were calculated, In the transmitted optical energy, Unit Transmission, The Synchronize (4SDH) (Digital Hirsch) device was used, which is located in the Najaf Post and Communications Department. An optical fiber was connected between it and the receiver, Unit Receiver Receiver unit, In this study, a power meter was used, which contains five wavelengths, It is (850nm) (nm, 1625nm, 1550nm, 1310nm, 1300nm, and five radii were taken for each length. To determine the amount of losses in transmitting the optical signal, the critical radius of curvature is calculated theoretically Calculate The Band Losses, The bending losses were found for an MMF optical fiber with different wavelengths and different radii of curvature, and the results. were as follows: for the wavelength 850. Multimode fibers were used in this research because they are distinguished by their ability to transmit more than one piece of information at the same time without the information interfering with each other. Its losses were recorded before taking the readings, which we called the zero reading, which is calculated in the absence of bending in the optical fiber and is caused by a number of factors, including what depends on the properties of the optical fiber, its composition, how to prepare the material, its purity, and the material of manufacture of the optical fiber, and some that depend on the material. The optical fiber is made from it. From the observation of Figure (3-1), it becomes clear that at a radius of curvature of 1 (mm7) there was a distortion in the signal, and this distortion increased at a radius of curvature of 1 (mm3). Then there was a complete interruption of the signal when the radius of curvature became (1 mm). (Through the information of the optical fiber used, Appendix No. (1), and by applying Equation No. (2), the critical radius of curvature was calculated theoretically, in which complete signal interruption occurs, and it was found to be equal to (nm034 = Rcs). A reading was also obtained The zero of a multimode

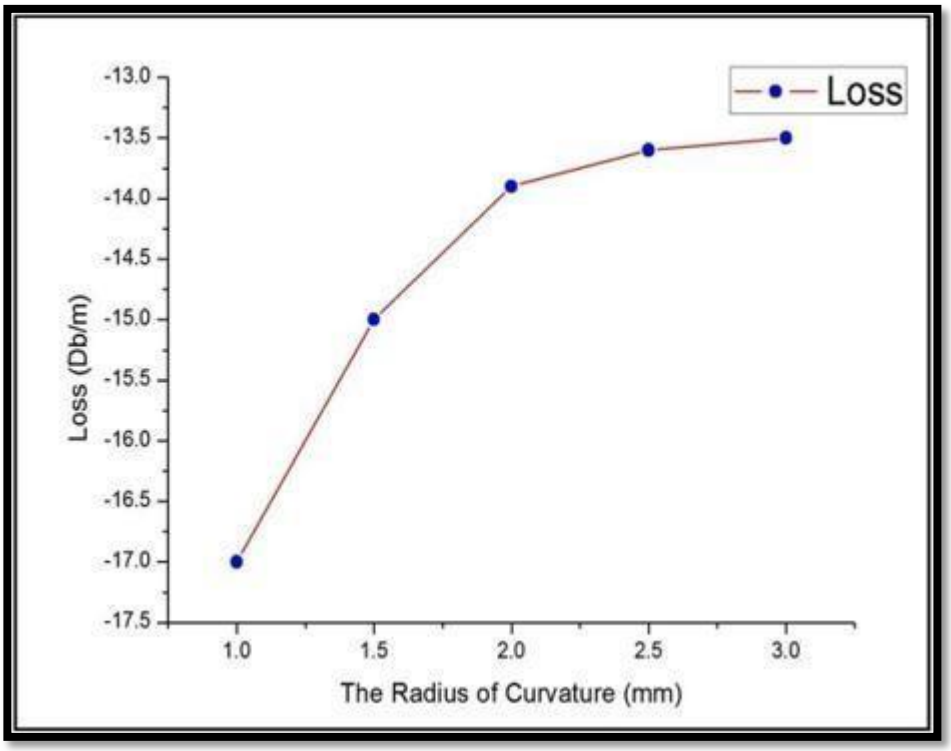


Figure (10) Bending losses at wavelength 850 nm.

Table (1-3) Bending losses for a multimode optical fiber with a wavelength of 850nm

STEP	Rmm	Loss dB/m
1	3	-13.5
2	2.5	-13.6
3	2	-13.9
4	1.5	-15
5	1	-17

For wavelength

From observing Figure (3-2), it is clear that at a radius of curvature (1.5 mm) there has been distortion in the signal and a gradual, About an increase at the radius of (1.2 mm), while the value of the radius at which the signal was cut off was, At (mm1), the value of the critical radius (radius of curvature) was theoretically equal to (mm0.52(.mm52)) As for the zero reading of the optical fiber, it was (db8.0 -)

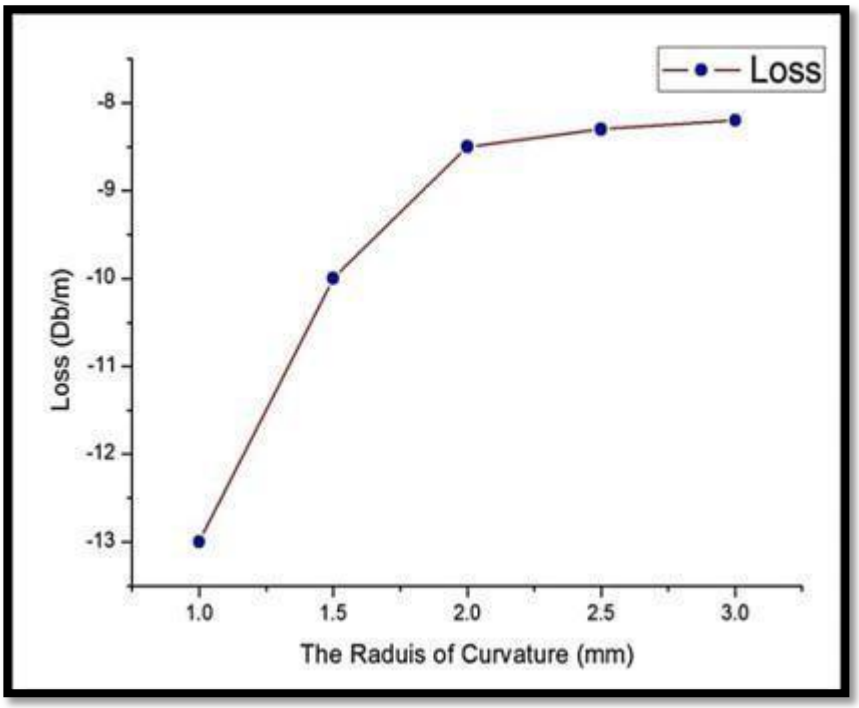


Figure (11) Bending losses at wavelength 1300 nm

Table (2-3) Bending losses for a multi-wavelength optical fiber

ste	R mm Loss	B/m
1	3	-8.2
2	2.5	-8.3
3	2	-8.5
4	1.5	-10
5	1	-13

for wavelength

Figure (3-3) shows that at a radius of curvature (1.5 mm). There was a distortion in the signal and the amount of this increased, The distortion occurred when the radius of curvature became (1.3 mm) and there was a complete interruption of the signal at a theoretical radius of 0.9 mm (0.53 mm) while the zero reading of the device was (db-8.0) and the critical radius of curvature.

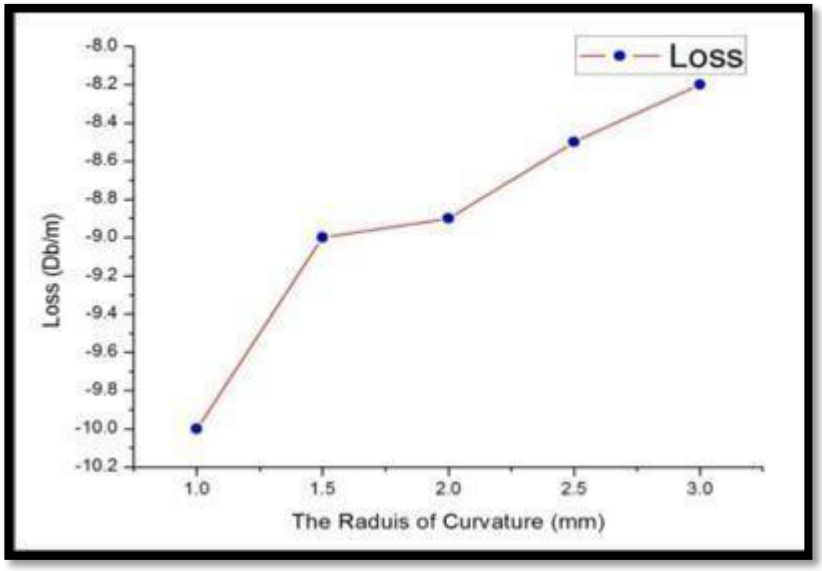


Figure (12) Bending losses at wavelength 1310 nm

Table (3-3) Bending losses for a multi-wavelength optical fiber

step 1	R mm Loss	dB/m
		-8
2	3	-8.5
		-8.9
3	2.5	-9
4 5	2 1.5 1	-10

for wavelength 1550 nm

Through Figure (3-4), we find that there is distortion of the signal at a radius of curvature (mm2) and this distortion increases with increasing, At the radius of curvature (1.3 mm). The signal was completely cut off at a radius of (mm1) and the device reading was: Theoretically, it is equal to (0.62 mm (zero equals) db6.2), while the critical bending radius

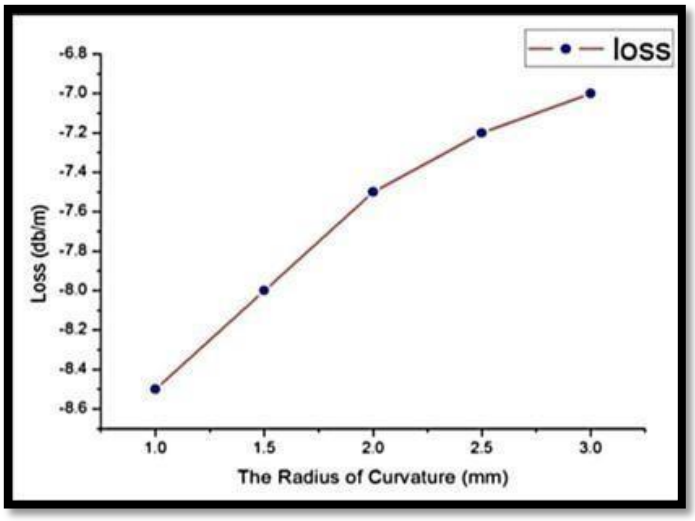


Figure (13) Bending losses at wavelength 1550 nm

Table (4-3) Bending losses for a multi-wavelength optical fiber

step	R mm	Loss dB/m
		-7
1	3	-7.2
		-7.5
2 3 4	2.5	-8
5	2 1.5 1	-8.5

Wavelength nm1625

Distortion of the signal at a radius of curvature of (1.75 mm) and this noticeably increased through Figure (5-3) has occurred, The distortion occurred at a radius of (1.53 mm) and a complete interruption of the signal occurred at a radius of (1 mm) and the reading was Theoretically, it is equal to (0.65 mm) the zero device is (db-20) (as for the critical bending radius

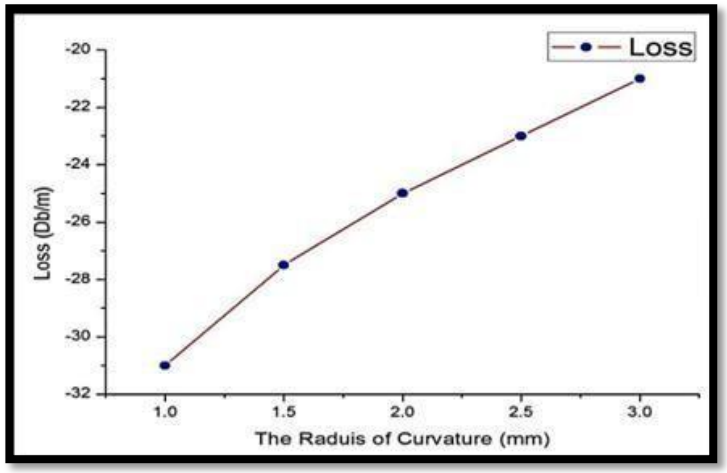


Figure (14) Bending losses at wavelength 1625 nm

When comparing the losses resulting from bending of the first optical fiber (the mail fiber), we notice that the length is 1550 nm It has less loss than other wavelengths. Because it is the least dispersion among the wavelengths used. Bending losses in the second optical fiber MMF , for wavelength 850 nm, Through Figure (6-3), we notice that there is a distortion in the signal at a radius of curvature (1.6 mm). This was taken, A larger amount at a radius of 1.3 mm (and a complete interruption of the signal occurred at a radius of 1.3 mm). The distortion occurred, We obtained the zero reading of the device and its value was (db-13.5). As for the theoretical critical bend radius, according to, Equation (2) and found that it is equal to (mm 0.53)

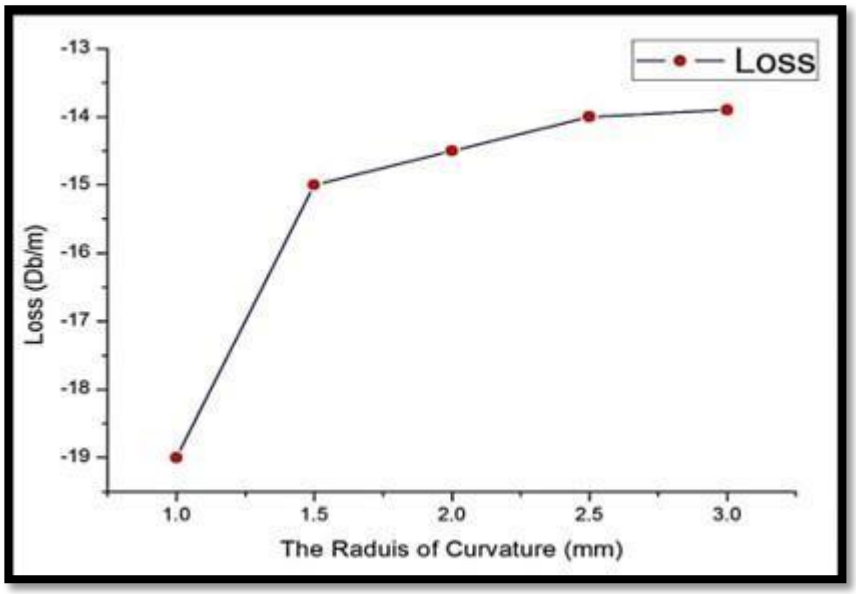


Figure (15) Bending losses at wavelength 850 nm

Table (6-3) Secondary optical fiber bending losses at wavelength

Step	R mm	Loss dB/m
		-13.9
1	3	-14
		-14.5
2 3 4	2.5	-15
5	2 1.5 1	-19

Wavelength nm1300

Through Figure (7-3), we notice that there is a distortion in the signal at a radius of curvature (1.8 mm). This was taken Exactly at the wavelength (mm1). The distortion increases at a radius of (mm1.5) until the signal is cut off. For equation (2), it was found to be equal to (0.8 mm) and we obtained When calculating the critical bend radius theoretically according to the zero reading of the device, its value was (db-6.6)

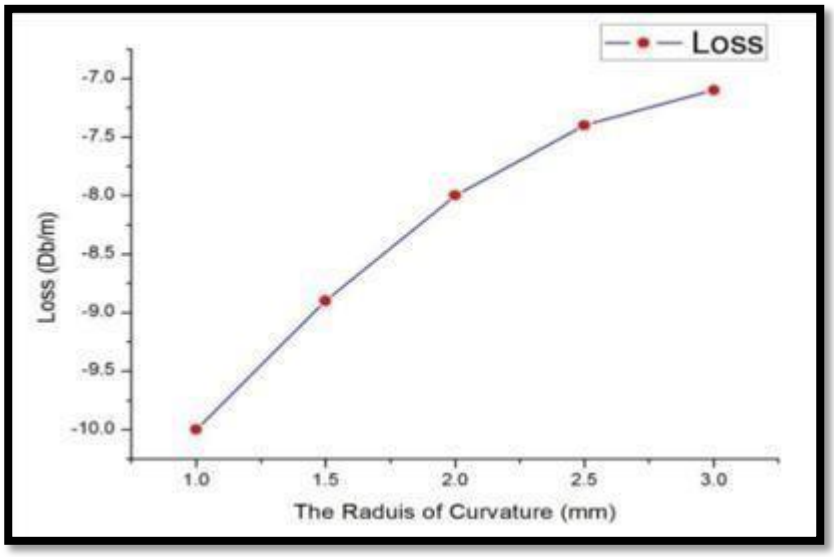


Figure (16) Bending losses at wavelength 1300 nm

Table (7-3) Secondary optical fiber bending losses at wavelength

step	Rmm	Loss dB/m
1	3	-7.1
2	2.5	-7.4
3	2	-8
4	1.5	-8.9
5	1	-10

Wavelength nm1310

Through Figure (8-3), we notice that there is a distortion in the signal at the radius of curvature (m2) (and this distortion took Exactly at the wavelength (mm1). When Increasing at a radius of 1.2 mm (until the signal is cut off) calculating the critical radius of curvature theoretically, it was found to be equal to (mm0.81). We obtained a zero reading. for the device and its value was (db-7)

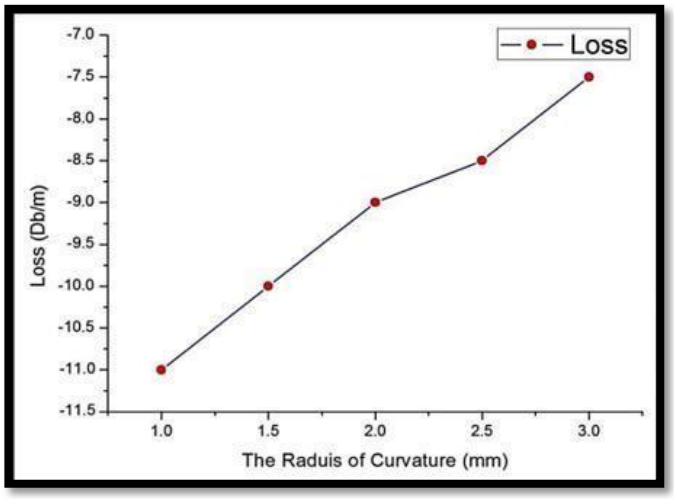


Figure (17) Bending losses at wavelength 1310 nm

Table (8-3) Secondary optical fiber bending losses at wavelength

step	Rmm	Loss dB/m
1	3	-7.5
2	2.5	-8.5
3	2	-9
4	1.5	-10
5	1	-11

for wavelength 1550 nm

From observing Figure (9-3), we find that the signal was distorted at a radius of (mm2) and the distortion took, Increasing at half the diameter (mm1.7), and there was also a complete cutoff of the signal at half the diameter (mm1) For equation (2) The zero reading was (db -5.7) and when calculating the theoretical critical bend radius according to, It was found to be equal to (mm0.93)

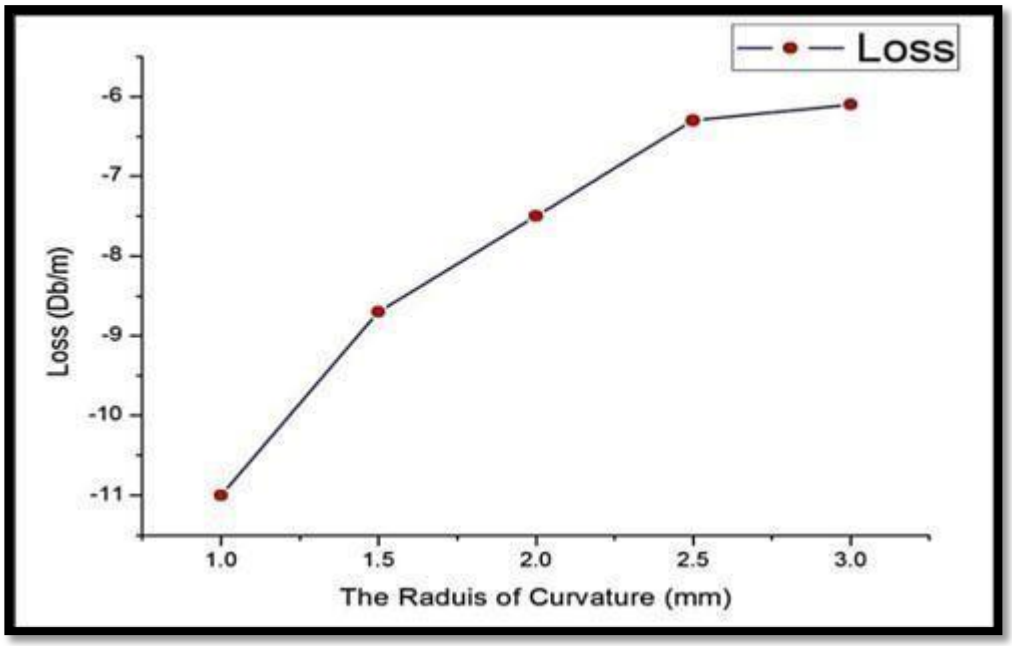


Figure (18) Bending losses at wavelength 1550 nm

Table (9-3) Secondary optical fiber bending losses at wavelength

step	R(mm)	Loss(dB/m)
1	3	-6.1
2	2.5	-6.3
3	2	-7.5
4	1.5	-8.5
5	1	-11

for wavelength 1625 nm

From observing Figure (3-10), we find that the signal was distorted at a radius of (mm2) and the distortion took Increasing at half the diameter (mm1.5), and there was also a complete interruption of the signal at half the diameter (mm1), For equation (2) The zero reading was (db -24.3) and when calculating the theoretical critical bend radius according to It was found to be equal to (mm1.01)

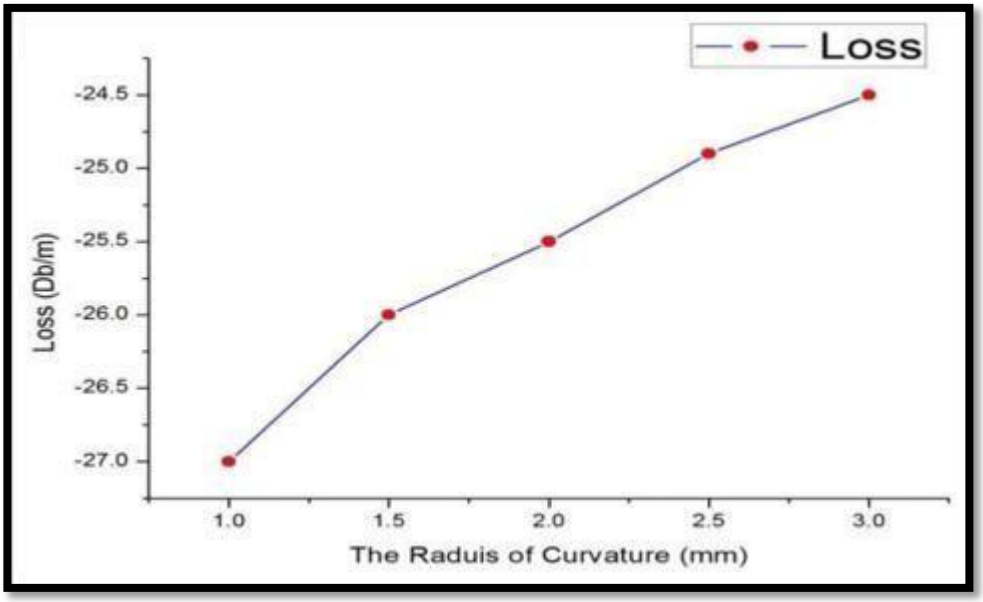


Figure (19) Bending losses at wavelength 1625 nm

Table (10-3) Secondary optical fiber bending losses at wavelength

Step 1	R(mm) 3	Loss(dB/m)
		-24.5
2	2.5	-25.2
		-25.5
3	2	-26
4 5	1.5 1	-27

Conclusion

Through the previous discussions of the wavelengths of the first fiber, as well as the drawings for each wavelength, we find that the least loss was at the wavelength (1550 nm). Therefore, it is considered better than the rest of the lengths, even though it is greater than the dispersion between the wavelengths. The wavelength is (850 nm). At least, if we make a comparison between the two types of optical fibers used, we find that the results obtained using the laboratory fiber are close to the results obtained when using the existing fiber that was in the Al-Najaf Al-Ashraf post office.

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9. See. Huygens, 1690, tr. Thomson, p. 38.^ Wolff, 1970, p. 13; Jenkins & White, 1976, pp. 9-10. This definition uses space as the "reference medium". In principle, any isotropic medium can be chosen as a reference.
10. For some purposes, it is convenient to choose air, where the speed is of light is about 0.03% less than in a vacuum (cf. Rutten and van Venrooij, 2002, pp. 10, 352). The current article, however, chooses a void.
11. Jenkins & White, 1976, p. 25.
12. Jenkins and White, 1976, pp. 10, 25.
13. DK Lynch, “Snell’s window in wavy water,” Applied (February 2015). Optics, 54(4): B8–B11, doi:
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