زانکۆی سەلاحەدین - هەولێر
Salahaddin University-Erbil

Studying the properties of laser and it is uses in the medical field

Research Project

Submitted to the department of Physics in partial fulfillment of the

requirements for the degree of BSc. in Physics

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بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

سورة البقرة الاية32

Supervisor Certificate

This research project has been written under my supervision and has been submitted for the award of the degree of BSc. in (Physics).

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Name: Dr.Runas Y .Sula

Date / /5/4/2023

I confirm that all requirements have been completed.

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Head of the Department of physics

Date / /5/4/2023

to: This project is dedicated

Allah Almighty, my

Creator and my Master,

My great teacher and

messenger, Mohammed

(May Allah bless and grant him), who taught us the purpose of life,

My homeland Kurdistan, the warmest womb,

The Salahadin University; my second magnificent home;

My great parents, who never stop giving of themselves in countless ways,

My beloved brothers and sisters;

To all my family, the symbol of love and giving,

My friends who encourage and support me,

All the people in my life who touch my heart.

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CONTENTIS:

SUMMARY

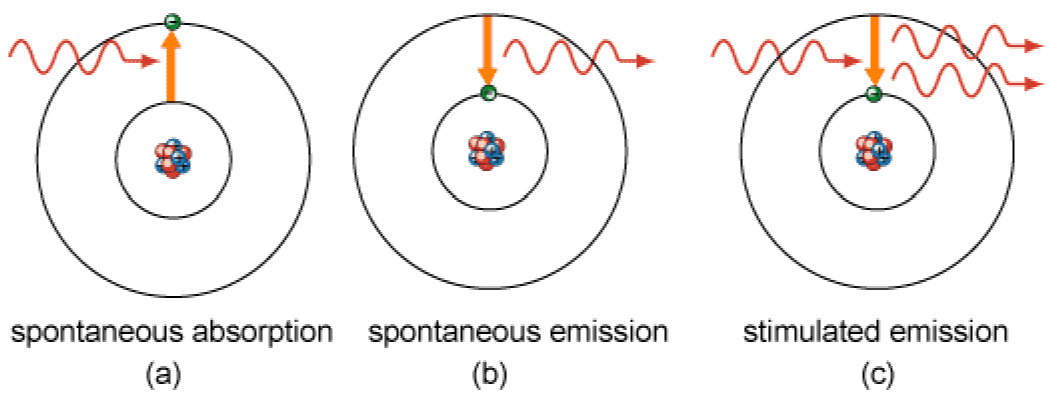
the aim of the research Demonstrate the importance of lasers in different fields of medicine in firstly I discus about proerties of laser next discus about type of laser in medical field after discuss about the application of laser in medical field .

LASER stands for "Light Amplification by Stimulated Emission of Radiation". It is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. It has three parts: gain medium, pump, and lasing threshold. Laser light exhibits some peculiar properties compared with conventional light, such as monochromatic, coherence, directionality, intense or brightness, and high energy. It is used in many types of surgical procedures, such as cosmetic surgery, refractive eye surgery, dental procedures, general surgery, and midical field.

CO2 lasers are the highest-power continuous wave lasers available, producing an infrared beam that has wavelengths centered around 9.6 and 10.6 µm. Lasers are widely used for medical applications, such as surgery, ophthalmology, dermatology, angioplasty, cancer treatment, urology, cosmetic applications such as laser hair removal, tattoo removal and liposuction.

1.1 introduction:-

LASER stands for “Light Amplification by Stimulated Emission of Radiation”. In (1917) ,Einstein postulated that: The incident photons of energies equal exactly to the energy that an excited atom must eject if it falls to its lower energy state. These incident photons stimulate the excited atom to fall to the lower state and the photon ejected by the atom is in phase with the incident photon that stimulates it to make the transition.



Figures 1.1 postulated Einstein

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. The word "laser" is an acronym for "light amplification by stimulated emission of radiation . The development of lasers since 1960 has been extremely rapid and although application for lasers had a very slow start during their first decade, new applications for laser radiation are being found now almost every day.

1.2 making laser:-

• All laser oscillators (as opposed to amplifiers) have 3 parts:

• **Gain medium** - gas, solid state, liquid - what provides the lasing transition.

•**Pump -** source of energy to create population inversion - usually another light source e.g. flashlamp or another laser, can be electrical discharge or current.

• **Cavity -** need to recirculate photons to stimulate emission on lasing transition - often mirrors around gain medium, can be medium itself.

•**Lasing threshold** - when gain (no. photons emitted in round trip) exceeds loss (number lost to absorption, through mirrors ets.)

you want laser light all the time (continuous wave, cw) or pulsed?
Pulses can be from femtosceonds - nanoseconds

• **And that's it!**

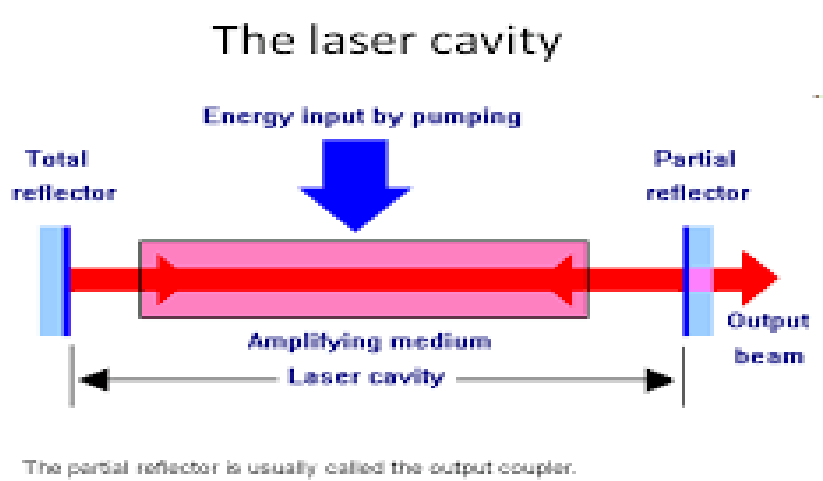


Figure 1.2 making laser

• Pump gain medium to upper level
• A photon decays spontaneously & stimulates more emission
• The photons bounce back and forth along the cavity - if the number of photons emitted each round trip exceeds losses (mirrors etc.) laser is above threshold
• One of the mirrors allows a small amount of this light out - laser output!

Laser output controlled by gain of medium and longitudinal & transverse modes of cavity.

1.3 properties of laser

The laser light exhibits some peculiar properties compared with the conventional light which make it unique. Let us study the factors that make laser light stand out. These are

1-Monochromatic
2-Coherence
3-Directionality
4-Highly Intense or Brightness
5-high energy

1.3.1 monochromtic :-

Monochromatic light is a light containing a single colour or wavelength. The light emitted from ordinary light sources have different energies, frequencies, wavelengths, or colors. But laser light has a single wavelength or colour.

Laser light covers a very narrow range of frequencies or wavelengths. This can be due to the stimulated characteristics of laser light. The bandwidth of the conventional monochromatic light source is 1000 Å. But the bandwidth of an ordinary light source is 10 Å. For a highly sensitive laser source it is 10-8 Å.

1.3.2 Coherence :-

A predictable correlation of the amplitude and phase at any one point with another point is called coherence.That means if two or more waves of same frequency are in the same phase or have constant phase difference then these waves are said to be coherent in nature.

In the case of conventional light, the property of coherence exhibits between a source and its virtual source whereas in the case of laser the property coherence exists between any two or more light waves.There are two types of coherence. Temporal coherence and Spatial coherence

(a)

(b)

Figure 1.3 :Incoherence and Coherence

1.3.3-Directionality:-

The light ray coming from an ordinary light source travels in all directions, but laser light travels in a single direction. For example, the light emitted from torchlight spreads 1km distance it spreads 1 km distance. But the laser light spreads a few centimeters distance even it travels lacks kilometer distance.

The directionality of the laser beam is expressed in terms of divergence

[dalta (theta)=r2-r1/D2-D1]

Where r1 and r2 are the radii of laser beam spots at distances of D1 and D2 respectively from the laser source

1.3.4. Highly Intense or Brightness

Laser light is highly intense than conventional light. We know that the intensity of a wave is the energy per unit time flowing through a specific area. A one mill watt He-Ne laser is more intense than the sun intensity. This is because of the coherence and directionality of the laser. Suppose when two photons each of amplitude a are in phase with another, then young’s principle of superposition, the resultant amplitude of two photons is 2a and the intensity is 4a2. Since in laser many numbers of photons are in phase with each other, the amplitude of the resulting wave becomes na and hence the intensity of the laser is proportional to n2a2. So the 1mW He-Ne laser is more intense than the sun.

1.3.5 high energy :-

1.4 Laser Physics

Lasers are devices that produce light with properties very different than those of other light sources, e.g., incandescent bulbs or LEDs. These unique characteristics enable a remarkably wide range of applications. Laser light can travel large distances as a narrow beam without diverging, allowing it to be used in laser pointers, laser light shows, and even for communication between satellites. The light can also be focused to a very tight spot, enabling sub-cellular microscopic imaging, reading/writing large amounts of data to/from DVDs and Blu-ray discs, and photolithography, which is critical in the production of modern microelectronics. Furthermore, if this tightly-focused light is confined to very short bursts or pulses, high-intensity lasers can be used for a variety of micromachining applications, including cutting/marking materials such a ceramics, glass, and metals as well as safe ablation of human tissue. Finally, laser light can have a very narrow spectrum or singular color that enables high-resolution spectroscopy and optical fiber communication.

1.4.1 Stimulated emission

is the process by which an incoming photon of a specific frequency can interact with an excited atomic electron (or other excited molecular state), causing it to drop to a lower energy level. The liberated energy transfers to the electromagnetic field, creating a new photon with a frequency, polarization, and direction of travel that are all identical to the photons of the incident wave. This is in contrast to spontaneous emission, which occurs at a characteristic rate for each of the atoms/oscillators in the upper energy state regardless of the external electromagnetic field

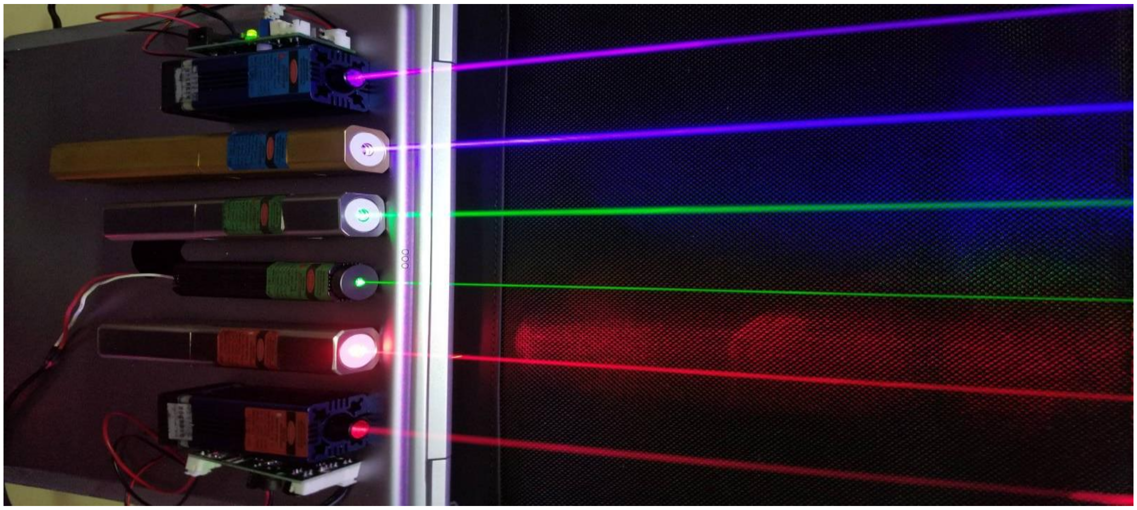


figure 1. 4 Laser light is a type of stimulated emission of radiation.

According to the American Physical Society, the first person to correctly predict the phenomenon of stimulated emission was Albert Einstein in a series of papers starting in 1916, culminating in what is now called the Einstein B Coefficient. Einstein's work became the theoretical foundation of the MASER and LASER. The process is identical in form to atomic absorption in which the energy of an absorbed photon causes an identical but opposite atomic transition: from the lower level to a higher energy level. In normal media at thermal equilibrium, absorption exceeds stimulated emission because there are more electrons in the lower energy states than in the higher energy states. However, when a population inversion is present, the rate of stimulated emission exceeds that of absorption, and a net optical amplification can be achieved. Such a gain medium, along with an optical resonator, is at the heart of a laser or maser. Lacking a feedback mechanism, laser amplifiers and superluminescent sources also function on the basis of stimulated emission.

1.4.2 the light emitted

A laser is created when electrons in the atoms in optical materials like glass, crystal, or gas absorb the energy from an electrical current or a light. That extra energy “excites” the electrons enough to move from a lower-energy orbit to a higher-energy orbit around the atom's nucleus

when an electron jumps from a higher orbit to a lower orbit and absorbed when it jumps from a lower to higher orbit. The energy and frequency of light emitted or absorbed is given by the difference between the two orbit energies

Some lasers emit radiation in the form of light. Others emit radiation that is invisible to the eye, such as ultraviolet or infrared radiation. In general, laser radiation is not in itself harmful, and behaves much like ordinary light in its interaction with the body.

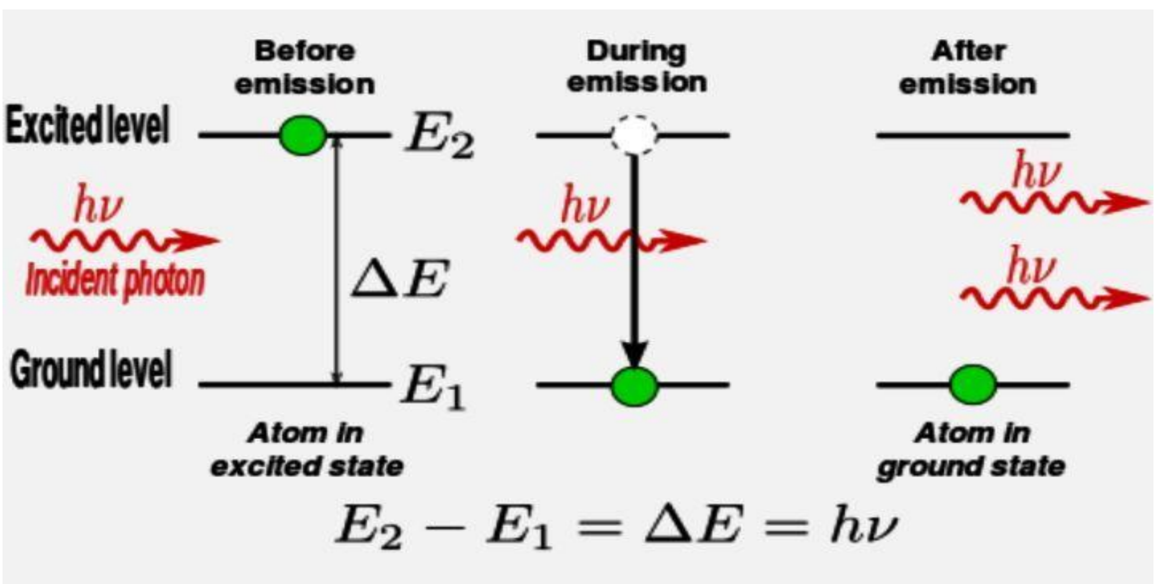


figure 1.5 light emitted

1.5 type of laser :

Lasers are classified into 4 types based on the type of laser medium used:

1-Solid-state laser

2-Gas laser

3-Liquid laser

4-Semiconductor laser

1.5.1 Solid-state laser:-

A solid-state laser is a laser that uses solid as a laser medium. In these lasers, glass or crystalline materials are used.

Ions are introduced as impurities into host material which can be a glass or crystalline. The process of adding impurities to the substance is called doping. Rare earth elements such as cerium (Ce), erbium (Eu), terbium (Tb) etc are most commonly used as dopants. Materials such as sapphire (Al_2O_3), neodymium-doped yttrium aluminum garnet (Nd:YAG), Neodymium-doped glass (Nd:glass) and ytterbium-doped glass are used as host materials for laser medium. Out of these, neodymium-doped yttrium aluminum garnet (Nd:YAG) is most commonly used.

The first solid-state laser was a ruby laser. It is still used in some applications. In this laser, a ruby crystal is used as a laser medium

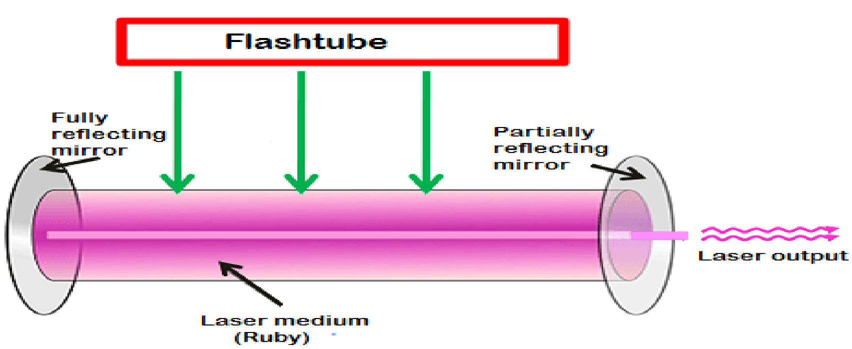


figure 1.6 solid state laser

In solid-state lasers, light energy is used as pumping source. Light sources such as flashtube, flash lamps, arc lamps, or laser diodes are used to achieve pumping.

Semiconductor lasers do not belong to this category because these lasers are usually electrically pumped and involve different physical processes

1.5.2 Gas laser:-

A gas laser is a laser in which an electric current is discharged through a gas inside the laser medium to produce laser light. In gas lasers, the laser medium is in the gaseous state

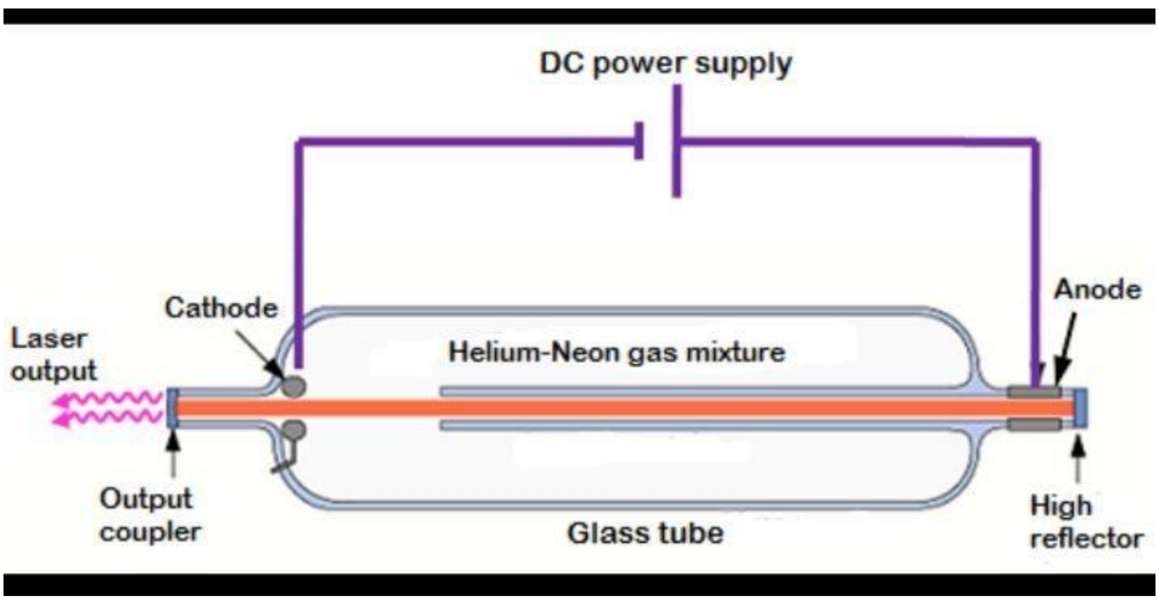


figure 1.7 gas laser

Gas lasers are used in applications that require laser light with very high beam quality and long coherence lengths.

In gas laser, the laser medium or gain medium is made up of the mixture of gases. This mixture is packed up into a glass tube. The glass tube filled with the mixture of gases acts as an active medium or laser medium.

A gas laser is the first laser that works on the principle of converting electrical energy into light energy. It produces a laser light beam in the infrared region of the spectrum at 1.15 µm.

Gas lasers are of different types: they are, Helium (He) – Neon (Ne) lasers, argon ion lasers, carbon dioxide lasers (CO2 lasers), carbon monoxide lasers (CO lasers), excimer lasers, nitrogen lasers, hydrogen lasers, etc. The type of gas used to construct the laser medium can determine the lasers wavelength or effici

1.5.3 Liquid laser:-

A liquid laser is a laser that uses the liquid as laser medium. In liquid lasers, light supplies energy to the laser medium.

A dye laser is an example of the liquid laser. A dye laser is a laser that uses an organic dye (liquid solution) as the laser medium.

A dye laser is made up of an organic dye mixed with a solvent. These lasers generate laser light from the excited energy states of organic dyes dissolved in liquid solvents. It produces laser light beam in the near ultraviolet (UV) to the near infrared (IR) region of the spectrum

Laser	type	Wavelength	CW or pulsed	output power	Aplications
ArF, Krf XeCl, Xef	Gas(excimer)	193nm, 248nm, 308nm, 353nm,	ns	10 w	UVlithography, laser Surgery, LASIK, laser annealing
Nitrogen	Gas	337 nm	Ns	100 mW	Dye laser pumping Measuring airpollution
Dye	Liquid	400-1000 nm	CW-fs	1 W	Spectroscopy,laser medicine
GaN	semiconductor	410nm	CW, ns	50 mW	Optical disc(Blu-ray) Reading/recording
Argon-ion	Gas	488nm	CW	10 w	Microscopy,retinal Phototherapy,scaning
HeNe	Gas	632.8 nm	CW	10 mW	Interferometry, Holography,barcode scanning
AlGalnp, AlGaAs	semiconductor	630-900 nm	CW, ms	10 mW, 10 W	Optical disc (CD,DVD) Reading/recording, Laser pointers, solid machining
Ti:saph	Solid-state	650-1100 nm	CW-fs	10 W	Spectroscopy,LIDAR Nonlinear frequency Conversion,Multiphoton microscopy
Yb:YAG	Solid-state	1030nm	CW-ps	W-kW	Material processing, Optical refrigeration, LIDAR
Yb:glass	Fiber	1030 nm	CW-fs	W-kW	Materials processing, Ultrashort pulse research,LIDAR

Nd:YAG	Solid-state	1060 nm	CW-ps	W-kW	Materials processing, Rangefinding, Surgery, tattoo/hair Removal,pumping Other solid-state lasers
Nd:glass	Fiber	1060 nm	CW-fs	W-kW	Material processing, Pumping other solid-State lasers, Extremely high Power/energy Systems for laser fusion
InGaAs, InGaAsP	Semiconductor	1100-2000 nm	CW, ms	mW-W	Telecommunications, Solid-state laser Pumping, machining, medical
Er-glass	Fiber	1530-1560 nm	CW	10 w	Optical amplifiers for Telecommunications
Tm:YAG, Ho:YAG	Solid-state	2000-2100 nm	Mus,ns	w	Tissue ablation, Kidney stone Removal, dentistry, LIDAR
Cr:ZnSe	Solid-state	2200-2800 nm	CW,fs	10w	MWIR laser radar, Missile Countermeasures, Ultrafast and high-Resolution Spectroscopy, Frequency metrology
Co2	Gas	10600 nm	CW,Mus	kW	Material processing, Sugery, dental laser, Military lasers

chapter two

(laser in medical field)

2. 1 introduction

While the history of laser begins in 1951, the first medical application is reported by Goldman in 1962. In cardiovascular surgery McGuff first used a Ruby-Laser in 1963 for the experimental ablation of atherosclerotic plaques . u

Medical lasers are medical devices that use precisely focused light sources to treat or remove tissues . Because lasers can focus very accurately on tiny areas, they can be used for very precise surgical work or for cutting through tissue (in place of a scalpel

Lasers are used in many types of surgical procedures. Some examples include

●Cosmetic surgery (to remove tattoos, scars, stretch marks, sunspots, wrinkles, birthmarks, spider veins or hair)

● Refractive eye surgery (to reshape the cornea in order to correct or improve vision as in LASIK or PRK)

●Dental procedures (such as endodontic/periodontic procedures, tooth whitening, and oral surgery)

●General surgery (such as tumor removal, cataract removal, breast surgery, plastic surgery and most other surgical procedures)

2.2 type of laser in midical field :-

1. **CO2 lasers**
2. **diode lasers**
3. **dye lasers**
4. **excimer lasers**
5. **fiber lasers**
6. **gas CO2 laser**
7. **semiconductor diode laser**

2.2.1 CO2 laser :-

A. CO2 lasers was one of the first gas lasers to be created and is still a powerful laser.

B. CO2 lasers are the highest-power continuous wave lasers available. They are quite efficient, too.

C. The CO2 laser produces an infrared beam that has wavelengths centered around 9.6 and 10.6 µm.

Due to water's ability to absorb this light frequency, CO2 lasers have been helpful in surgical operations. Medical examples include laser surgery and skin resurfacing. It's the best laser for soft tissue with the ability to cut and to control bleeding. photo-thermally CO2 lasers may replace a scalpel for most operations, and they're even utilized in sensitive regions where mechanical stress might harm the surgical site.

Applications range from gynecology to dentistry, as well as others

2.2.2 diode laser :-

A. Diode lasers are semiconductor devices like light-emitting diodes, except that diode lasers are pumped directly with electrical current.

B. Laser diodes can transform electrical energy into light.

C. Diode lasers are finding new applications in dentistry and medicine.

--They are more appealing to doctors because to their decreased size and price, while also providing increased user friendliness. The wavelengths of diodes vary from 810 to 1,100 nm and are weakly absorbed by soft tissue. Soft tissue is not sliced by the laser's Beam but instead cut by touching a hot charred glass point.

is Laser irradiation is very well absorbed at the tip's distal end, heating it to between 500°C and 900°C. The tip is so hot that it may be used to cut delicate tissue and even cauterize or carbonize tissue.

Diode lasers may harm the surrounding tissue if used on soft tissue

2.2.3 dye lasers :-

A. Dye lasers utilize an organic dye solution as the lasing medium, typically as a liquid.

B. Dye lasing medium typically allows the use of a considerably broader range of wavelengths, which may cover 50 to 100 nanometers or more . Dye lasers has many applications in medicine, including dermatology, where they are used

to level skin tone. The large wavelength range enables an accurate match to specific tissue spectra, such as melanin or hemoglobin, but the narrow bandwidth makes the surrounding tissue less susceptible to harm.

Port-wine stains, scars, and kidney stones are often treated with these kind of lasers.

They are also often used for tattoosremoval and in many other purposes.

2.2.4 excimer laser :-

Excimer laser photorefractive keratectomy and excimer laser in situ keratomileusis are relatively new treatment modalities that can be used to correct refractive errors of the eye. They are most commonly used to correct myopia (nearsightedness) but can also be used to correct hyperopia (farsightedness) and astigmatism. The excimer laser alters the refractive state of the eye by removing tissue from the anterior cornea through a process known as photoablative decomposition. This process uses ultraviolet energy from the excimer laser to disrupt chemical bonds in the cornea without causing any thermal damage to surrounding tissue. The modified anterior corneal surface enables light to be focused on the retina, thereby reducing or eliminating the dependence on glasses and contact lenses.

2.2.5 faber laser :-

Fiber lasers in medicine—one of the most meaningful applications of fiber laser technology.

The great versatility of fiber lasers make them very effective for both surgery and diagnostic imaging, providing a high level of accuracy, precision and safety. The main advantage of fiber lasers is their contactless process, but their compactness, high efficiency and ease of use are also essential benefits for medical applications.

Optical fiber can also be combined with catheters in order to provide an imaging diagnostic of an artery when bypass surgery is performed.

Skin resurfacing and tattoo removal are medical procedures requiring high energy lasers. Although CO_2 lasers are mostly used for these types of applications, recent advances are demonstrating the efficiency of 2 µm based fiber lasers in non-invasive skin ablation. For soft tissue ablation, 1064 nm fiber lasers can also be used .

2.2.6 gas CO2 laser :-_

Lasers are becoming more and more prevalent in the surgical community because they are a less intrusive and more precise option for patients and surgeons. Medical Laser Gas Mixtures are produced for carbon dioxide lasers. These lasers are not only more precise and less intrusive, they also provide an efficient method of performing surgeries that are highly sterile or have expectations of significant blood loss. The CO2 laser produce intensive infrared radiation, this can be focused to vaporize tissue smaller than a millimeter. This is done by exciting the molecules in the Medical Laser Gas Mixture, a combination of carbon dioxide, helium, and nitrogen, in a discharge tube which then converts the electrical energy into optical energy. The laser beam is then transferred optically to either a hand piece or a microscope. Nitrogen gas is used to cool the laser equipment and to remove debris from surgery

Medical Laser Gas Mixtures / Chemical Composition

4.5% Carbon Dioxide, 13.5% Nitrogen, 82% Helium

6% Carbon Dioxide, 14% Nitrogen, 80% Helium

7% Carbon Dioxide, 14% Nitrogen, 79% Helium

9% Carbon Dioxide, 15% Nitrogen, 76% Helium

9.4% Carbon Dioxide, 19.2% Nitrogen, 71.8% Helium

2.2.7 semiconductor diode laser :-

Advances in semiconductor diode laser sources are facilitating the migration of medical and aesthetic lasers to consumer markets. Semiconductor diode lasers offer advantages over other light sources for applications in dermatology, dentistry, and more -- and continued advancemen

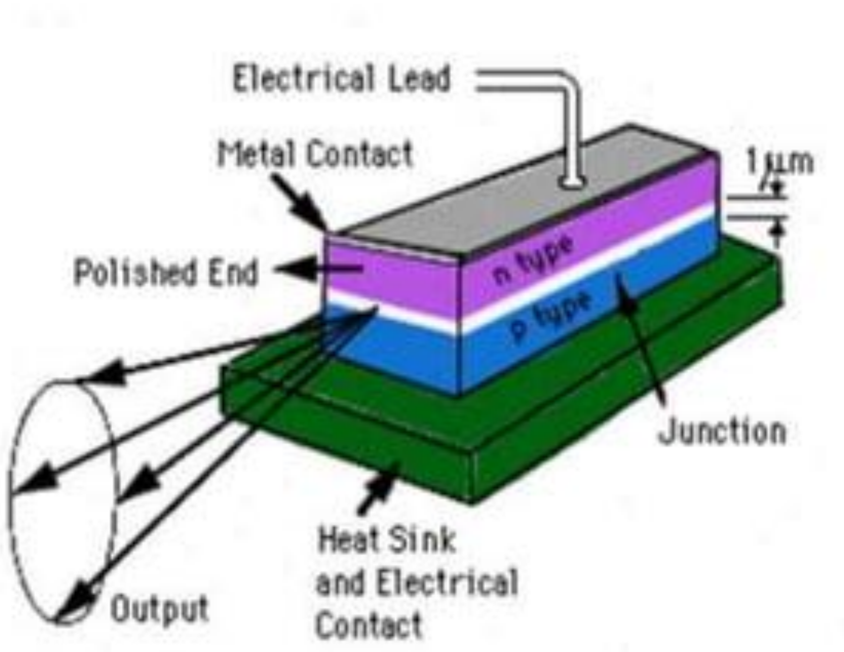


Diagram of Semiconductor Laser

2.3 LASER interaction with biological tissue :-

A laser beam is created and directed towards tissue to accomplish a particular job.

When energy hits the biological contact, it will interact in one of four ways: reflection, transmission, scattering, or absorption.

• Absorption - Photons are absorbed by certain molecules in the tissue known as

chromophores. To do function, the light energy is transformed into various kinds of energy.

• Reflection occurs when the laser beam bounces off the surface without any penetration or

contact. Reflection is often an undesirable result, however a beneficial example of

reflection may be seen when Erbium lasers reflect off titanium, allowing for safe gingiva cutting around implant abutments.

• Transmission is the ability of laser energy to penetrate through superficial tissues and

interact with deeper regions. Retinal surgery is an example; the laser treats the retina by

passing through the lens.

Tissue transmission may also be observed in the deeper penetration achieved with diode lasers

2.4.1 LASER effects on biological tissue :-

The thermal effect of lasers on biological tissue is a complex process resulting from three

distinct phenomena;

1. conversion of light to heat,

2. transfer of heat

3. and the tissue reaction, which is related to the temperature and the heating time .

This interaction leads to denaturation or to the destruction of tissue. The known factors are the parameters of the laser (wavelength, power, time and mode of emission, beam profile and spot size) and the tissue being treated (optical coefficients, thermal parameters and coefficients of the reaction of thermal denaturation).

2.4.2 LASER effects on biological tissue :-

Laser absorbed by tissue may causes;(Thermal effects).

1. Homeostasis: Any procedure that stop bleeding.

2. Photocoagulation: Heating a blood vessel to point where the blood coagulates and blocks the vessel.

3. Photo Vaporization: To make incisions and vaporize tissue.

4. Sonic: Membrane disruption

Chapter three

(Application of laser in medical filed)

3.1 introduction

Soon after the invention of laser in 1960, scientists started exploring the possibilities of using them for medical applications. Lasers were first used for medical applications in 1961 for treatment of skin discoloration and detached retinas. Presently lasers are being widely used for numerous medical applications. These include surgery, ophthalmology, dermatology, angioplasty, cancer treatment, urology, cosmetic applications such as laser hair removal, tattoo removal and liposuction etc. Some of these important applications are discussed here in brief.

When laser radiation falls on human tissues, different phenomenon may take place like reflection, transmission, scattering, re-emission and absorption. It is the absorption phenomenon, which is most important.

3.2 Medical applications of LASER

1. Ophthalmology:

a. In ophthalmology lasers are primarily used for photocoagulation of the retina.

b. The amount of laser energy needed for photocoagulation depends on the spot size used.

In general; The minimum amount of laser energy that will do observable damage to the

retina is called the Minimal Reactive Dose(MRD).

• Photocoagulation is useful for;

I. Repairing retinal tears or holes.

II. Diabetic retinopathy. (Complication of diabetes that effects the retina)

2. Dermatology:

a. Skin tumor therapy has been attempted by using high energy Focused laser beam.

b. Tattoos removal.

3. Dentistry:

a. Repairing the teeth decays.

b. Bleeding of gums.

c. Ulcers of the gums

4. Surgery:

a. Its used continuous lasers of high power.

Example: In Vascular organs such as the liver normal surgery produces a large amount of

bleeding. The focused beam of light from laser tends to seal of the vessels and very much less bleeding occurs.

b. Lasers may be combined with fiber optics for some kinds of internal treatment.

Example: Lasers are used through gastroscopy in treating stomach ulcers and bleeding

3.3 Advantages of LASER Surgery

Advantages of LASER Surgery

1. No-touch technique.

2. Dry surgical field.

3. Reduced blood loss.

4. Reduced edema.

5. Limited fibrosis and stenosis.

6. Precision**.**

7. Reduced post-operative pain.

8. It is effective, fast, safe.

9. Painless during its use especially when it is used in eye and dental treatment.

10. Anesthesia is not indicated in eye or dental or some other treatments

3.4 Conclusion

As a result of this research, I came to the conclusion that laser has many benefits, especially in the medical field that makes it much easier for us in the field of surgery, dermatology, dentistry and ophthalmology. Each is used in different medical fields and has its own characteristics such as CO2 lasers, diode lasers ,dye lasers, excimer lasers, fiber lasers ,gas CO2 laser ,semiconductor diode laser . Laser beam has several properties such as Monochromatic ,Coherence ,Directionality ,Highly Intense or Brightness ,high energy that interacts with biological tissues through reflection, transmission, scattering, or absorption.

The use of lasers in medicine has several benefits for us No-touch technique, Dry surgical field , Reduced blood loss , Reduced edema , Limited fibrosis and stenosis , Precision , Reduced post-operative pain , It is effective, fast, safe ,Painless during its use especially when it is used in eye and dental treatment , Anesthesia is not indicated in eye or dental or some other treatments .

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