S.G.V.C. VIDYA PRASARK TRUST'S

M.G.V.C.ARTS, COMMERCE AND SCIENCE COLLEGE MUDDEBIHAL

IQAC AND DEPARTMENT OF PHYSICS

ORGANISED

SPECIAL GUEST LECTURE

ON

"LASER PHYSICS" (2023-24)

PRINCIPAL,
..V.C. Arts, Commerce & Science College
MUDDEBIHAL-586212. Dist: Vijayapur.

S. G. V. C. Vidya Prasarak Trust's,
Matoshri Gangamma Veerappa Chiniwar Arts, Commerce & Science College,
MUDDEBIHAL-586212. Dist. Vijayapur (Karnataka)
(Accredited with CGPA of 3.31 on seven point scale at 'A+' Grade)
✆ : 08356220329
FAX : 08356220329
• email : princmgvc@gmail.com • www.mgvcmbl.in •

Ref. No. : .... Date : ....

NOTICE

IQAC and Department of Physics organized Special Guest Lecture topic is "LASER PHYSICS" by Prof. M.M.Dannur M.G.V.C Arts, science and commerce PU College Muddebihal. on 05.01.2024 at 10.30.am Hence all the teaching, non teaching staff members and students are here by informed to attend the function.

Principal
PRINCIPAL,
.V.C. Arts, Commerce & Science College
UDDEBIHAL-586212. Dist: Vijayapur.

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IQAC AND DEPARTMENT OF PHYSICS

ORGANISED

SPECIAL GUEST LECTURE

ON

"LASER PHYSICS"

REPORT

IQAC and DEPARTMENT OF PHYSICS organized Special Guest Lecture topic is "LASER PHYSICS" by Prof. M.M. Dannur M.G.V.C Arts, science and commerce PU College Muddebihal on 05.01.2024 at 10.30.am in Conference Prof. S.N. Poleshi Principal presided over the function. Prof. M.I. Biradar IQAC Coordinator. Prof. S.M. Nimbalagundi and all other teaching and non teaching staff members graced the occasion. Prof. A.I. Akki proposed vote of thanks.

Principal

PRINCIPAL,
.G.V.C. Arts, Commerce & Science College
MUDDEBIHAL-586212. Dist: Vijayapur.

Block No. .... Room No : ....

S. G. V. C. Vidya Prasarak Trust's,

MATOSHRI GANGAMMA VEERAPPA CHINIWAR
ARTS, COMMERCE & SCIENCE COLLEGE, MUDDEBIHAL.

Subject : .... Date : 05/01/2024 Time : ....

Class : I Sem **ATTENDANCE REPORT** Jr. Supervisor : ....

DEGREE ______ SEMESTER EXAMINATION 202 - 202

Roll No.	University Seat No.	Name of the Candidate	Signature
01	U15NU21S0037	Anuradha P Mulinjani	Anupaf
02	" 0092	Shahin L N	Shahin
03	56	Swati. S. Mathad	[illegible]
04	21	Aishwarya P Kodabagi	Aishwarya PK
05	" 061	Ranjita Pattar	R. K. pattar
06	" 026	Daneshwari Talwar	[illegible]
07	" 059	Bhagyashree G.H	B.G.Hadapad
08	. 053	Aishwarya Dodamani	[illegible]
09	" 033	Bhavana Ganachari	[illegible]
10	068	Afreen Sagar	Sagar
11	044	Mubark Teggi	[illegible]
12	" 010	Rajiya. B. Bagwan	[illegible]
13	" 009	Nazmin. Beringid	[illegible]
14	U15NU23S0044	Shrinidhi	[illegible]
15	U15NU23S0043	Amruta. S. Patil	A.S.Patil
16	" 049	Prema. M. Chavan	P. M Chavan
17	" 032	Neha K. Lamani	N. K. Lamani
18	" 069	Suchitra. S. Jalhod	S. S. Jalhod
19	" 097	Bhagya. M	Bhagya. M
	" 071	Jyoti. Vastrad	R Vastrad
	" 030	Muskan. B. Kalur BSC-I	[illegible]
	" 009	Mubeena. Mulla - BSC I	Mulla:
	08	Gouramma. K Singanagutti BSC-I)	G.K.S
	28	Nisarga G	[illegible]

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P.T.O.

Block No. .... Room No : ....

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Subject : .... Date : 05/01/2024 Time : ....

Class : Bs V sem ATTENDANCE REPORT Jr. Supervisor : ....

DEGREE ______ SEMESTER EXAMINATION 202 - 202

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	U15NU21S0073	Mahammad Yusuf Shirol	Shirol
	U15NU21S0008	Pradeep Hiremath	Pradeep
	U15NU21S0048	Manjunath Kuri	[illegible]
	U15NU21S0037	Nandakumar Sajjan	Sajjan
	U15NU21S0075	Veeresh Pattar	Pattar
	U15NU21S0017	Basavaraj . meti	[illegible]
	" " " 20	Shravankumar Biradar	[illegible]
	U15NU21S0003	Mohammad Sabir Uunibhavi	[illegible]
	U15NU21S0030	Gururaj. Bhajanthri	[illegible]
	" " " 29	Basavaraj. Khaodri	[illegible]
	" " " 22	Darshan. Patil	[illegible]
	" " " 45	Rahul Bidnalmath	[illegible]
	" " " 12	Vinay Teggimani	[illegible]
	" " " 39	Yuvaraj Naluvade	[illegible]
	18	Vishwanath Yalawar	[illegible]
	" " " 80	Praveen Badiger	[illegible]
	" " 64	Sagar Chavhan	[illegible]
	" " 01	Sabanna Chalvade	[illegible]
	" " 013	Jafarali Naykodi	[illegible]
	" " 28	Manjunath Upparal	[illegible]
	" " 76	Sanju. Hachareddy	[illegible]
I	U15NU23S0013	vinod S. Angadi	[illegible]
	0033	Pooja. K. Gaded	P.K. Gaded.
	0027	Netravati. B. Padashetti	[illegible]
	91	Shriraksha. R. Ghatage	[illegible]
	U15NU23S0055	Pallavi S. Angadi	[illegible]

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Laser Physics

Introduction

LASER stands for Light Amplification by Stimulated Emission of Radiation. Laser is a device which emits a powerful, monochromatic collimated beam of light. The emitted light waves are coherent in nature. The first laser, ruby laser was invented by Dr.T.H. Maiman in the year 1960. Since then, the development of lasers is extremely rapid. The laser action is being demonstrated in many solids, liquids, gases and semiconductor.

CHARACTERISTICS OF LASER:

Laser is basically a light source. Laser light has the following important characteristics

High Directionality

High Intensity

Highly Monochromatic

Highly Coherence

Directionality

Ordinary light spreads in all directions and its angular spread is 1m/m. Directionality property of Laser But it is found that laser is highly directional and is angular spread is 1mm/m. For example, the laser beam can be focused to very long distance with a few divergence or angular spread

Intensity

Since an ordinary light spreads in all directions, the intensity reaching the target is very less. But in the case of laser, due to high directionality, the intensity of laser beam reaching the target is of high intense beam. For example, 1 mill watt power of He-Ne laser appears to be brighter than the sunlight

Monochromatic

Laser beam is highly monochromatic; the wavelength is single, whereas in ordinary light like mercury vapour lamp, many wavelengths of light are emitted.

Coherence

It is an important characteristic of laser beam. In lasers the wave trains of same frequency are in phase, the radiation given out is in mutual agreement not only in phase but also in the direction of emission and polarization. Thus it is a coherent beam. Due to high coherence it results in an extremely high power.

Differences between ordinary light and Laser beam

	Ordinary light	Laser Beam
1	In ordinary light the angular spread is more	In ordinary light the angular spread is less
2	They are not directional.	They are highly directional
3	It is less intense	It is highly intense
4	It is not a coherent beam and It is a not is in phase	It is in a coherent beam and it is in phase
5	The radiation are polychromatic The radiations are monochromatic **Example:** Sun light, Mercury vapor lamp	The radiations are monochromatic **Example:** He- Ne Laser, Co2 laser

STIMULATED ABSORPTION, SPONTANEOUS EMISSION AND STIMULATED EMISSION

Process 1 - Stimulated absorption

An atom in the lower energy level or ground state energy level E1 absorbs the incident photon radiation of energy and goes to the higher energy level or excited level E2 . This process is called absorption. Absorption and emission process in Laser

Process 2- Spontaneous Emission

The atom in the excited state returns to the ground state by emitting a photon of energy E = (E2 – E1) = spontaneously without any external triggering as shown in the figure. This process is known as spontaneous emission. Such an emission is random and is independent of incident radiation.

Process 3 - Stimulated Emission

The atom in the excited state can also return to the ground state by external triggering or inducement of photon thereby emitting a photon of energy equal to the energy of the incident photon, known as stimulated emission. Thus results in two photons of same energy, phase difference and of same directionality.

POPULATION INVERSION

Population Inversion creates a situation in which the number of atoms in higher energy state is more than that in the lower energy state. Usually at thermal equilibrium, the number of atoms N2 i.e., the population of atoms at higher energy state is much lesser than the population of the atoms at lower energy state N1 that is N1>N2. The Phenomenon of making N2> N1 is know as population inversion.

Population Inversion Condition

1. There must be at least two energy levels E2> E1.

2. There must be a source to supply the energy to the medium.

3. The atoms must be continuously raised to the excited state.

Application of Lasers:

1.Spectroscopy

Most types of laser are an inherently pure source of light; they emit near-monochromatic light with a very well defined range of wavelengths. By careful design of the laser components, the purity of the laser light (measured as the "linewidth") can be improved more than the purity of any other light source. This makes the laser a very useful source for spectroscopy. The high intensity of light that can be achieved in a small, well collimated beam can also be used to induce a nonlinear optical effect in a sample, which makes techniques such as Raman spectroscopy possible. Other spectroscopic techniques based on lasers can be used to make extremely sensitive detectors of various molecules, able to measure molecular concentrations in the parts-per-10^{12} (ppt) level. Due to the high power densities achievable by lasers, beam-induced atomic emission is possible: this technique is termed Laser induced breakdown spectroscopy (LIBS).

Heat treatment

Heat treating with the lasers allows selective surface hardening against wear with little or no distortion of the component. Because this eliminates much part reworking that is currently done, the laser system's capital cost is recovered in a short time. An inert, absorbent coating for laser heat treatment has also been developed that eliminates the fumes generated by conventional paint coatings during the heat-treating process with CO_2 laser beams.

One consideration crucial to the success of a heat treatment operation is control of the laser beam irradiance on the part surface. The optimal irradiance distribution is driven by the thermodynamics of the laser-material interaction and by the part geometry.

Typically, irradiances between 500 and 5000 W/cm^2 satisfy the thermodynamic constraints and allow the rapid surface heating and minimal total heat input required. For general heat treatment, a uniform square or rectangular beam is one of the best options. For some special applications or applications where the heat treatment is done on an edge or corner of the part, it may be better to have the irradiance decrease near the edge to prevent melting.

Weather

Research shows that scientists may one day be able to induce rain and lightning storms (as well as micro-manipulating some other weather phenomena) using high energy lasers. Such a breakthrough could potentially eradicate droughts, help alleviate weather related catastrophes, and allocate weather resources to areas in need.[126]

Lunar laser ranging

When the Apollo astronauts visited the Moon, they planted retroreflector arrays to make possible the Lunar Laser Ranging Experiment. Laser beams are focused through large telescopes on Earth aimed toward the arrays, and the time taken for the beam to be reflected back to Earth measured to determine the distance between the Earth and Moon with high accuracy.

Photochemistry

Some laser systems, through the process of mode locking, can produce extremely brief pulses of light - as short as picoseconds or femtoseconds (10^{-12} - 10^{-15} seconds). Such pulses can be used to initiate and analyze chemical reactions, a technique known as *photochemistry*. The short pulses can be used to probe the process of the reaction at a very high temporal resolution, allowing the detection of short-lived intermediate molecules. This method is particularly useful in biochemistry, where it is used to analyse details of protein folding and function.

Laser scanner

Laser barcode scanners are ideal for applications that require high speed reading of linear codes or stacked symbols.

Laser cooling

A technique that has recent success is *laser cooling*. This involves atom trapping, a method where a number of atoms are confined in a specially shaped arrangement of electric and magnetic fields. Shining particular wavelengths of light at the ions or atoms slows them down, thus *cooling* them. As this process is continued, they all are slowed and have the same energy level, forming an unusual arrangement of matter known as a Bose–Einstein condensate.

Nuclear fusion

Some of the world's most powerful and complex arrangements of multiple lasers and optical amplifiers are used to produce extremely high intensity pulses of light of extremely short duration, e.g. laboratory for laser energetics, National Ignition Facility, GEKKO XII, Nike laser, Laser Mégajoule, HiPER. These pulses are arranged such that they impact pellets of tritium–deuterium simultaneously from all directions, hoping that the squeezing effect of the impacts will induce atomic fusion in the pellets. This technique, known as "inertial confinement fusion", so far has not been able to achieve "breakeven", that is, so far the fusion reaction generates less power than is used to power the lasers, but research continues.

Particle acceleration

Powerful lasers producing ultra-short (in the tens of femtoseconds) and ultra-intense (up to 10^{21} W/cm^2) laser pulses offer much greater acceleration gradients than that of conventional accelerators. This fact is exploited in several plasma acceleration techniques used for accelerating both electrons and charged ions to high energies.