“BURNING LASER”

PROJECT REPORT

Submitted for the course :Engineering physics (PHY1001)

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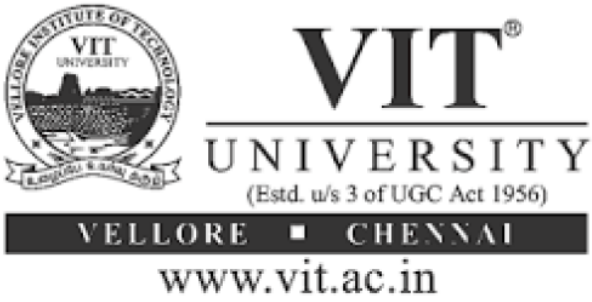

July-November (2016)

CERTIFICATE

This is to certify that the project work entitled "**Burning Laser** " that is being submitted by "**Anjali Sachdeva, Prakhar Jain, Neeraj Prabhu Kumar, Dharan R.S, Sanket N Nayak. Kunal Agarwal, Prateek Porwal, Akarsh Jain, Somnath Mishra, P.Varun, Jiten Dhingra**" for Engineering Physics (PHY1001) is a record of bonafide work done under my supervision. The contents of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Place : Vellore

Date : 06/11/2016

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ABSTRACT

Lasers are a type of technology which is extremely underused. They have several types, each with its own set of applications. One of these types is called the burning laser. It is named so because it can burn through several materials, depending on the power of the laser. A lower powered burning laser can set a match on fire or pop balloons, while slightly higher powered ones could burn through paper. We have decided to chose the topic of burning laser for our project because they have several applications while also being an interesting topic.

1. INTRODUCTION

1.1 Objectives and Goals:

The objective of the project is to study the components and various applications of a burning laser by studying the various components of the laser in depth and all technicalities. This laser can found its best usage in the fields of laser cutting, laser welding, laser drilling, laser cladding and many more.

1.2 What is a Laser?

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. The term "laser" originated as an acronym for "light amplification by stimulated emission of radiation

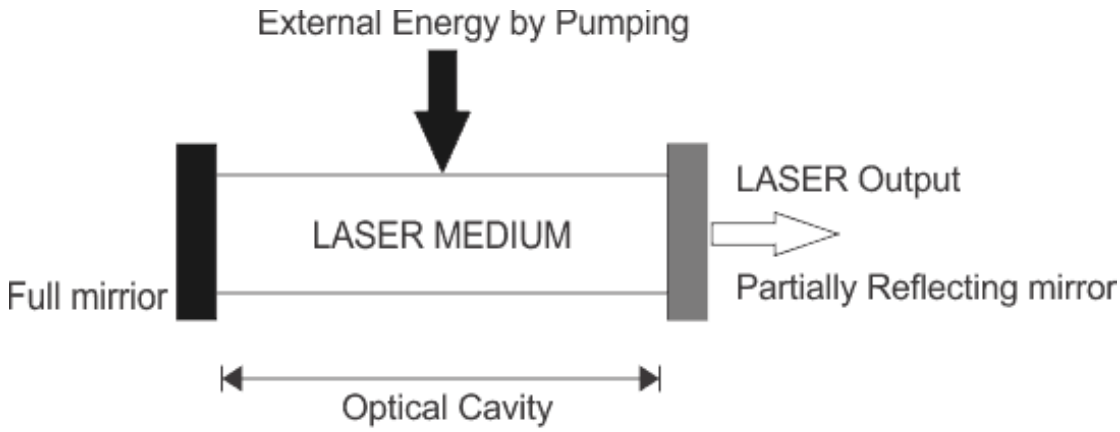
A laser differs from other sources of light in that it emits light *coherently*. Spatial coherence allows a laser to be focused to a tight spot, enabling applications such as laser cutting and lithography. Spatial coherence also allows a laser beam to stay narrow over great distances (collimation), enabling applications such as laser pointers. Lasers can also have high temporal coherence, which allows them to emit light with a

very narrow spectrum, i.e., they can emit a single color of light. Temporal coherence can be used to produce pulses of light as short as a femtosecond.

1.3 Components of LASER

Every LASER consists of three basic components. These are -

1. Lasing material or active medium.
2. External energy source.
3. Optical resonator.



Components of LASER

- The active medium is excited by the external energy source(pump source) to produce the population inversion. In the gain medium that spontaneous and stimulated emission of photons takes place, leading to the phenomenon of optical gain, or amplification. Semiconductors, organic dyes, gases (He, Ne, CO_2, etc), solid materials (YAG, sapphire (ruby) etc.) are usually used as lasing materials and often LASERs are named for the ingredients used as a medium.
- The excitation source, pump source provides energy which is needed for the population inversion and stimulated emission to the system. Pumping can be done in two ways - electrical discharge method and optical method. Examples of pump sources are electrical discharges, flash lamps, arc lamps, light from another laser, chemical reactions etc.

- Resonator guide basically provides the guidance about the simulated emission process. It is induced by high-speed photons. Finally, a laser beam will be generated.

1. METHODOLOGY

- Firstly,the main idea for the project was selected ,information was collected and brainstorming was done on the chosen topic.
- Dividing the resposibilties was the next task.
- Then we visited the VIT library to collect information regarding the project.
- The Chitur Bus stand was the next station to collect the parts required to build the burning laser.
- The finished burning laser was then tested in the physics lab and thus approved.

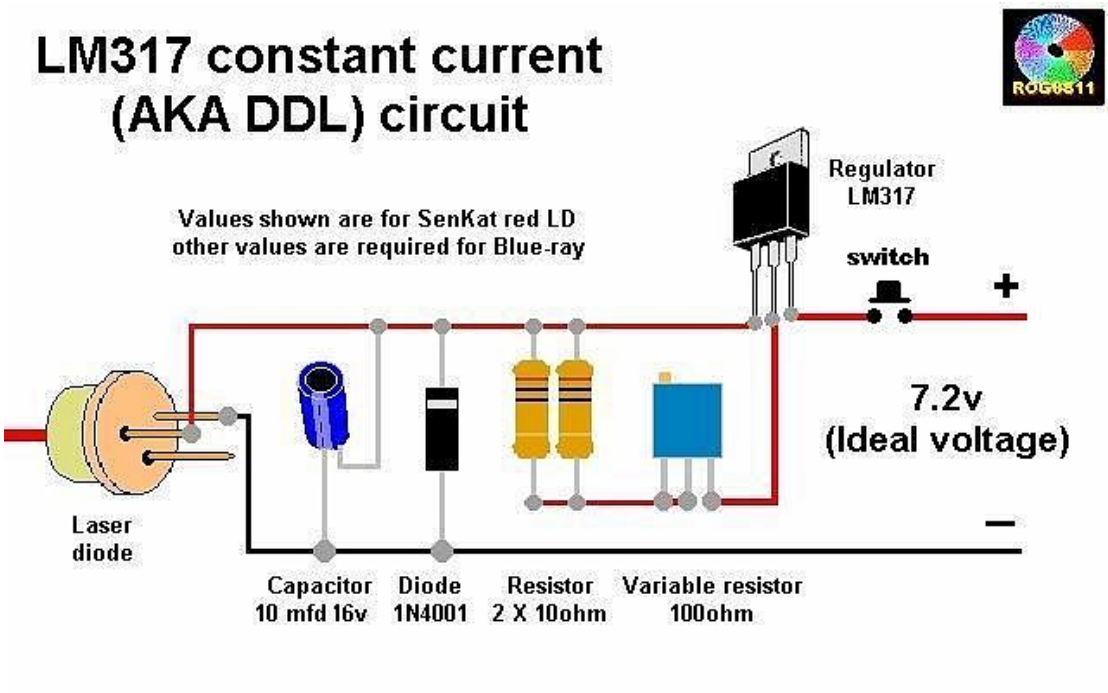
2.1 Burning Laser: The design

2.1.1 Components:

- 9 v Battery
- 100 ohms variable resistor
- Capacitor 10mfd 16V
- Diode 1N4001
- 2 10 ohm resistors
- Regulator – LM317T

- Laser diode-808nm 300mW High Power Burning Infrared Laser Diode
- Soldering 101
- PCB Board

2.1.2 Circuit diagram :



2.1.3 Working

Basically the working is based on the **semiconductor lasers.**

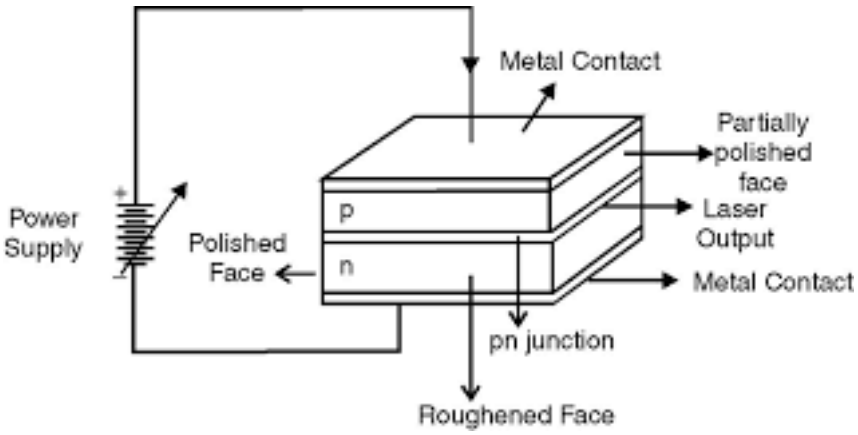
This resource gives the construction, application and working of Gallium Arsenide (GaAs) semiconductor laser. These semiconductor lasers are widely used in optical communication. It works at threshold voltage condition resulting in laser gain at 9000 Angstrom wavelength.

PN-junction Laser:

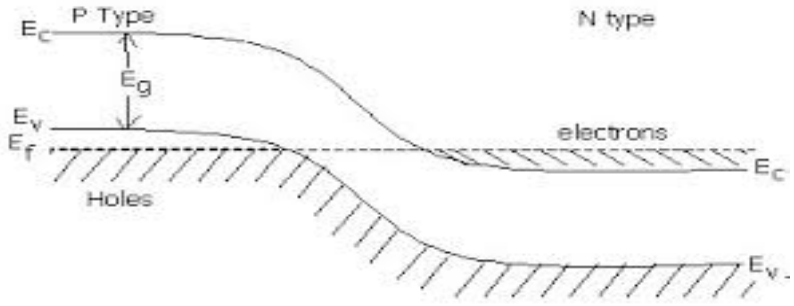
A semiconductor laser is a specially fabricated pn junction device (both the p and n regions are highly doped) which emits coherent light when it is forward biased. It is made from Gallium Arsenide (GaAs) which operated at low temperature and emits light in near IR region. Now the semiconductor lasers are also made to emit light almost in the spectrum from UV to IR using different semiconductor materials. They are of very small size (0.1 mm long), efficient, portable and operate at low power. These are widely used in Optical fibre communications, in CD players, CD-ROM Drives, optical reading, laser printing etc.

p and n regions are made from same semiconductor material (GaAs). A p type region

is formed on the n type by doping zinc atoms. The diode chip is about 500 micrometer long and 100 micrometer wide and thick. the top and bottom faces has metal contacts to pass the current. the front and rare faces are polished to constitute the resonator

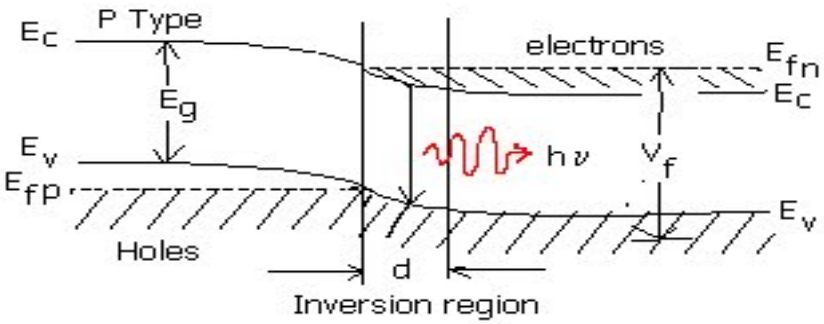


When high doped p and n regions are joined at the atomic level to form pn-junction, the equilibrium is attained only when the equalization of fermi level takes place in this case the fermi level is pushed inside the conduction band in n type and the level pushed inside the valence band in the p type



When the junction is forward biased, at low voltage the electron and hole recombine and cause spontaneous emission. But when the forward voltage reaches a threshold value the carrier concentration rises to very high value. As a result the region "d" contains large number of electrons in the conduction band and at the same time large number of holes in the valence band. Thus the upper energy level has large number of electrons and the lower energy level has large number of vacancy, thus population

inversion is achieved. The recombination of electron and hole leads to spontaneous emission and it stimulate the others to emit radiation



Inside parts of the laser diode used:

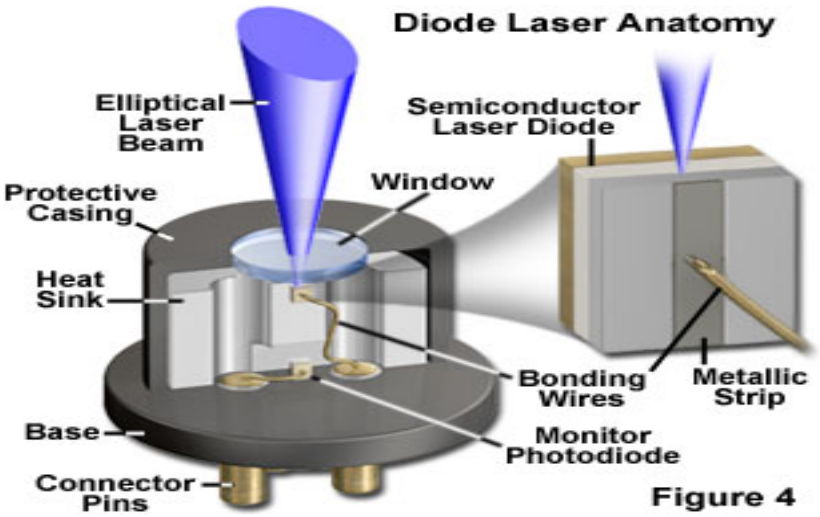


Figure 4

2. CONCLUSION:

Our projects aim is to just give us a glimpse of what science and technology enables us to do today. Burning lasers are one of the most useful applications of lasers and the

truth is lasers are an underused technology. There are doubtlessly important applications waiting to be discovered, be it for science, industry, healthcare, et cetera. Those discoveries won't come about in a faraway laboratory- the smart money is on the amateur enthusiasts like the students of this college who come up with germs of ideas when they think about various and innovative ways to use lasers. Hopefully our project has given an insight into the importance and endless possibilities of the usage of lasers.

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