Report on Industrial visit at

SOCIETY FOR APPLIED MICROWAVE ELECTRONICS ENGINEERING AND RESEARCH (SAMEER)

CBD Belapur, Navi Mumbai

27th September 2019

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2019-2020

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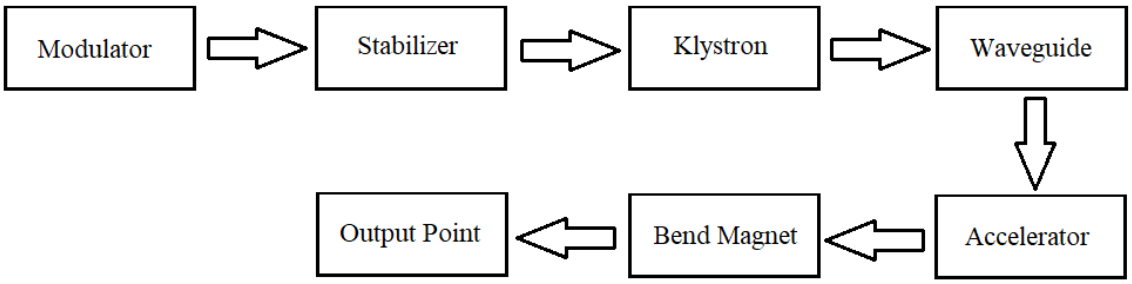
SAMEER was set up as an autonomous R & D laboratory at Mumbai under the then Department of Electronics, Government of India with a broad mandate to undertake R & D work in the areas of Microwave Engineering and Electromagnetic Engineering Technology**.** The EMI/EMC division has expertise in the field of EMC testing for commercial electronic products as well as electronics required for defence and space applications (MIL STD products). It provides Test, Measurement and Design Consultancy services to customers for their satisfaction in achieving Electromagnetic Compatibility in electronic products to comply with National/International EMC Standards. It has ISO/IEC 17025:2005 and ISO 9001:2008. The NABL accredited EMI/EMC Test facility is located at CBD Belapur, Navi Mumbai. EMC testing is done as per various civilian and military standards like CISPR 11, CISPR 22, CISPR 24, IEC 61000-4, MIL-STD-461C/D/E. Design Consultancy and solutions are also offered to customers for making their products compliant with various EMC standards. The test and consultancy service is routinely made available to customers desirous of obtaining CE marking and exporting their products. Details for the EMC services are available in the Services Offered section of the site.

The division undertakes both research and test, design consultancy activities. in the area of Electromagnetic Interference and Compatibility The division also has the necessary experience and expertise for undertaking projects for high pulsed power applications viz. High Power Pulsed Radar Transmitters.

The introduction at SAMEER was given to us by Dr.Sharad Chavan. He briefed us about the layout of SAMEER. The Mumbai Centre specializes in the area of Linear Accelerator Technology for Cancer Therapy, Opto-Electronics, Microwave and Radio Frequency Systems and Sub-Systems and Components. It undertakes and executes sponsored projects for various Government agencies, Public Sector Undertakings and Industries.

After this we were divided into two groups. We were first taken to the place where the Medical Electron Accelerator was kept. There we were introduce to Mr.Vignesh who briefed us as to why the room had such thick walls made of lead, this was solely to make sure that the radiations stay inside the room. Then we were taken inside the room where the medical electron accelerator was kept. The purpose of this instrument is to eradicate the tumour present in the bodies of cancer patients.

The system consists of a modulator then a stabiliser. Then it had the klystron which gives the RF supply. There is an accelerator which accelerates the electrons before getting orthogonally deviated using magnetic forces. The modulator gives an output power of 12MW; there is a magnet of 1.3 Tesla which bends the electron beam. This beam is directed on the tumour which is exposed from different angles. The gantry can rotate 270 degrees. The entire room has walls of thickness 1.2m covered with lead. Lamps are installed in the room and areas outside the room to indicate when the machine is operating.



Then we were taken to the control room where Mr.Vignesh was going to explain us how each and everything inside the room where the MEC is located is controlled and monitored. The system is controlled by FPGA. The UI displays the system features like input power, vacuum power, fault system detection, dose frequency. On the UI, the systems which are on are displayed in green and which are off in red. The Beam fault was in red at the start. The beam fault was switched on using a key and pressing the ON button. The system tuned on and the output graph was seen on the DSO and the Mixed Signal Oscilloscope. The entire system is designed giving safety the highest priority. There are sensors and alarms everywhere inside the room to make sure that no one is present inside when the MEC is operated.

After this we were taken to the building where we had our introductory briefing. It was time to see the workshop and understand the mechanical intricacies behind the making of the LINAC and eventually the MEC.

First we were taken to the fitting lab where we were shown radius Drilling Machine, it has a circular drill used to drill into objects. This instrument has two degree of freedom. There was an impulse force machine in which the horizontal blade cuts objects by use of impulse for a clean smooth cut. There was another similar machine with vertical blade to cut cylindrical parts. There was a manual hardpress machine which cuts objects into parts.

Then we were taken to the milling section. This is where the mechanical drawings are translated into a physical model. The cavities are made by manually controlling the machine. It has a digital display which shows the x-y-z axis for precision.

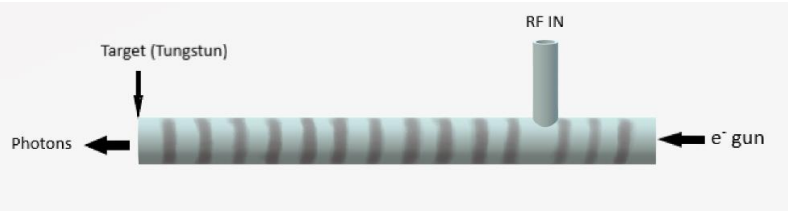
The next room where we went was the turning section. In case of the milling section the tool remains constant and the job is moving, whereas in the turning section the job remains constant and the tool keeps moving in the lather machine.

We were now taken to the CNC section. The CNC machine is a machine made by Siemens which uses M & G codes to operate. The machine can be programmed by uploading a sketch directly. The sketch is made using CAM software where the design of the workpiece is made with required specifications. Once uploaded, the machine will automatically make the desired design.

The CNC section room has a DMG machine for precise work and the cutting is done using a tool with industrial diamond tip. It has a single point cutting with 20 micron radius. The workpiece in the machine is constantly cooled using a coolant which consist of 80% water and 20% coolant. This is done to increase the efficiency of the diamond tip. All the jobs are designed and done for a specific frequency.

The rooms that we were taken to now onwards were really interesting. We were first taken to the Vacuum furnace room .The High vacuum brazing/annealing furnace- operates at $18^{o}C$ with a vacuum of -6. The job is brazed in Hydrogen to avoid rusting and give it a good shine. Then in the Baking oven, the final stage of the workpiece where it is kept at -9 vacuum at $250^{o}C$ for a period of 1 month.

We were now shown a dummy LINAC which consisted of 25 full pieces and 12 half pieces. The frequency of operation depends on the radius of curvature of the part. A VNA is used to measure and test the frequency of operation.



The chemical room has an Ultrasonic machine which uses acetone and propanol and is used to clean the oil and other residual matter which may form on the workpiece. This is done because the slightest of impurities can cause deviation and impart huge losses which affect the efficiency of the LINAC. The Vapour degreasing method is used in cleaning the residuals. In the cleaning process, plating is also included which brings out the shine of the object. To remove oxides from the tool, first it is cleaned using acid. Water is then used to clean the surface removing the residual acid. Then it is cleaned with methanol to remove any residual which may have not been cleaned with acid.

The final room was the Hydrogen furnace hall where the workpiece is kept in the furnace for a duration of 8 hrs. Hydrogen is used as it is a strong reducing agent. This makes sure that any kind of impurity if present is totally eliminated. A set of 8 pieces can undergo this process at the same time. In this nitrogen oxide is passed through the tube so that if any oxygen is present in the tube it is pushed out. After this Hydrogen is released into the tube, the entire process of reduction is monitored using PID. The controlling system is taken care by using PLC.

After this both the groups came together, tea was organised for the students and faculty who were finally at rest.

The entire visit was highly interactive, intriguing and informative. The application and scope of Microwave Engineering was realised by the students. The entire experience was a worthy and a memorable one.

Although we weren't allowed to click photos of the products and the technologies inside SAMEER but we were allowed to take a group photo along with our faculty and SAMEER staff who showed us around their campus.