Introduction
The Centre for Advanced Studies in Physics (CASP) has emerged, in recent years, as hub for research and development (R&D) activities at GC University Lahore. The Centre aims at achieving high quality R & D activities in experimental physics by imparting training to researchers in high tech equipment. Establishment of new research laboratories equipped with sophisticated machinery like Pelletron Accelerator, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Scanning Probe Microscope (SPM), Lasers, Universal Material Testing Machine and RF Induction Furnace have made the Centre distinct among other Departments of the University.

The Centre began as the “High Tension Laboratory” in 1954 which was established by Dr. Rafi Muhammad Chaudhry (Sitara-e-Khidmat, Sitara-e-Imtiiaz, and Hilal-e-Imtiiaz) for carrying out research in Atomic and Nuclear Physics. Intensive research was carried out in this laboratory by Dr. R. M. Chaudhry, his students and colleagues. This laboratory had among other facilities, a 1.2 million Volts Cockcroft-Walton particle accelerator for conducting experiments in Atomic and Nuclear Physics. In 1967, the first student of the Centre, Mr. Mustafa Yar Khan, was awarded the PhD Degree.

Dr. Samar Mubarakmand, an Old Ravian remained Director Nuclear Research Laboratory from 1974 to 1977. Research activities during his tenure were re-initiated under his dynamic leadership. In recognition of his meritorious services and outstanding contribution in the field of Nuclear Physics, Dr. Mubarakmand was awarded Sitar-e-Imtiiaz (1993), Hilal-e-Imtiiaz (1998) and Nishane-Imtiiaz (2003).

In 1986, Dr. Muhammad Zakria Butt was instrumental in establishing the Metal Research Laboratories, equipped with a microprocessor controlled Universal Materials Testing Machine (100 KN capacity) along with other equipment to study mechanical properties of crystals and their relationship with microstructure. The Laser Physics Laboratory was also set up with carbon dioxide laser to carry out research in laser induced

In 1991, the Board of Governors of Government College Lahore amalgamated all these laboratories and renamed it as Centre for Advanced Studies in Physics (CASP) and a new building was constructed for the same. Major advancements were made in research facilities and infrastructure during 2002-2008. Degree awarding academic Programmes, at both Undergraduate and Postgraduate levels were launched in Electronics and Telecommunications. Both the programmes got nation-wide recognition and now these programmes have successfully been shifted under a separate /independent Faculty of Engineering.


Keeping in view the tremendous advancements in science and technology, the Higher Education Commission (HEC) of Pakistan was approached in 2002 for the provision of funds. Grants of Rs. 190 millions were obtained from the HEC for revamping the existing facilities and for establishing new research laboratories. A new multi-story building was constructed to house these state of the art laboratories.

Research Groups
The CASP has been divided into four major research groups:
1. Materials Science Research Group
2. Accelerator Research Group
3. Laser Research Group
4. Plasma Processing of Materials Group
These groups are carrying out extensive research work on different research projects. A number of research papers are being published by these groups in the journals of international repute every year. Conducting of workshops, Conferences and Seminars is a regular activity arranged by these working groups.
Research Facilities at CASP

Scanning Electron Microscope (SEM)
It can provide topographical, morphological, compositional and crystallographic information of materials. It can also be used for quality assurance assessment, detection of corrosion in metals and to perform qualitative & semi-quantitative elemental analyses.

Transmission Electron Microscope (TEM)
The TEM is highly sophisticated state of the art instrument capable of carrying out micro-structural study of almost every kind of material including biological, metallic, polymer, and ceramic samples at an atomic level. It has a magnifying range of 1000-600,000 times with a very high resolution of 4 Å (i.e. 4 x 10^-10 m). The Transmission Electron Microscope installed at CASP is equipped with EDX system for X-ray micro analyses of the samples.

Pelletron Accelerator
GCU has the honour to have this kind of accelerator for the first time in the country. Pelletron accelerator has two active beam lines; one beam line is being effectively used for Proton Induced X-Ray Emission Spectroscopy (PIXE) analysis of materials by different science departments of the university. The second beam line is used for irradiation of materials. Thus numerous research projects can be carried out by utilizing ions of different energies up to 4 MeV for characterization and modification of materials.

RF-Induction Furnace
The furnace can be used for indigenous fabrication of different alloys of both ferrous and non-ferrous metals, to be used for advanced materials research and development activities.

Universal Testing Machine
The machine can be used to perform tensile tests of metals and alloys in the temperature range -180°C to 600°C. The tensile parameters like yield stress, ultimate tensile strength, percentage elongation, fracture toughness etc. can be determined using the computerized analytical facilities attached with the machine.

Scanning Probe Microscope
Scanning Probe Microscope (SPM) is used for surface morphology of almost all materials i.e. biological, metallic, polymers and ceramic samples at the atomic level with a three dimensional view.

Micro-hardness Tester
The hardness tester is used to determine the hardness of different metals, alloys and polymers etc.

Metallurgical Microscope
This Microscope is suitable for micro-structural study of all kind of samples. The CCD camera attached with the scope can capture images magnified in the range 50 to 1000 times.

Nd:YAG Laser
This special type of laser is used for material modification, plasma formation and pulsed laser deposition of thin films.

Excimer Laser
Laser Ablation and pulsed laser deposition for fabrication of thin films are the major uses of Excimer laser.

Laser-induced breakdown spectrometer
Laser-induced breakdown spectroscopy and elemental analysis under different ambient environments are the major uses of this spectrometer.

Ti-Sapphire Laser
This is a state of the art laser and is widely used for ultrashot laser-matter interaction processes, femtosecond laser induced spectroscopy and pulsed laser deposition of thin films.

Plasma Technology Lab
The plasma technology lab contains dense plasma focus and cold plasma devices. Plasma diagnostics are being done using Langmuir probe and optical emission spectroscopy (OES). These devices are also used to deposit the various films on substrates.

Sample Preparation Facilities
Sample preparation lab is equipped with a number of different machines which can prepare samples according to the requirements of different High Tech Labs.

The research activities at CASP are aimed at exploring scientific facts primarily related to materials analysis and modification with intent to tailor properties of materials, to check archeological samples for applications in medicine and to help plan environmental improvement methods using high tech research equipment of the centre. CASP has produced scientists who have made their mark in prestigious research organizations like the Pakistan Atomic Energy Commission (PAEC), A.Q. Khan Research Laboratories, the National Engineering and Scientific Commission (NESCOM), the Karachi
Nuclear Power Plant (KANUPP) and the National Institute of Silicon Technology (NIST). The outgoing graduates of the Centre are in a great demand at R & D organizations of the country.

**Rafi M. Chaudhry Chair**
The Rafi M. Chaudhry Chair in Experimental Physics has been established at CASP to pay homage to its founder, Dr. Rafi M. Chaudhry, and to ensure that his tradition of research continues to burgeon. Dr. Shoaib Ahmad has been appointed as Rafi M. Chaudhry Professor in Experimental Physics.

**CASP Library**
The CASP Library provides a collection of information resources for researchers. A number of computers are also provided for students to connect to the Internet and access electronic catalogues.

**E-mail and Internet Access**
Students have access to high speed Internet which provides email and internet services to the students. This enables them to subscribe to news groups and conferences on areas of their interest. Moreover it also provides them the access to the HEC digital library facilities. It covers virtually every conceivable area of knowledge.

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**Faculty**

**Director**
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Nawaz Muhammad (On Study Leave)
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Dr. Rafi M. Chaudhry Chair
Prof. Dr. Shoaib Ahmad