

Centre for Advanced Studies in Physics (CASP)

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 teaching and research in applied physics by imparting knowledge to researchers by employing 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), Nano and femtosecond Lasers, Laser induced breakdown spectroscopy, Plasma Devices, 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 Prof. Dr. Rafi Mohammad Chaudhri (Sitara-e-Khidmat, Sitara-e-Imtiaz and Hilal-e-Imtiaz) for carrying out research in Atomic and Nuclear Physics. Intensive research was carried out in this laboratory by Dr. R. M. Chaudhri, his students and colleagues. This laboratory had a 1.2 million Volts Cockcroft-Walton particle accelerator for conducting experiments in Atomic and Nuclear Physics along with other facilities. 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 of 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 Sitara-e Imtiaz (1993), Hilal-e-Imtiaz (1998) and Nishan-e Imtiaz (2003). In 1986, Dr. Muhammad Zakria Butt established 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. In recognition of his meritorious services, he was awarded Tamgha-i-Imtiaz (T.I) in 1997. The Laser Physics Laboratory was also set up with induction of carbon di-oxide laser to carry out research in laser induced plasma.

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. Now, these programmes have successfully been shifted under Faculty of Engineering. In 2012 Centre started MPhil (Applied Physics) and PhD (Physics) programmes. These programmes got nationwide recognition. The graduates of CASP are getting good jobs in public sector universities as well as in other educational and research organizations. They are getting scholarships for doing PhD abroad in good reputed international universities. CASP has published 80 research publications with impact factor 97 during 2015-2016 in international refereed journals.

Centre is privileged to have Eminent Scientists like Dr. Rafi Mohammad Chaudhri (1954-1965), Dr. Tahir Hussain (1965-

1968), Nasir Ahmad Qureshi (1968-1969), Dr. Mannan Yaseen (1969-1972), Dr. Mustafa Yar Khan (1972-1974), Dr. Samar Mubarakmand (1974-1977), Sh. Aftab Ahmad (1977-1979), Nur Muhammad Chaudhri (1979-1985), Dr. Muhammad Zakria Butt (1985-1997, 1998-2000), Dr. Shujaat Mahmood Khalid (1997-1998), Dr. Ijaz Mujtaba Ghauri (2000-2011), Dr. Riaz Ahmad (2011 to date). Keeping in view the tremendous advancements in the field of Physics, the Higher Education Commission (HEC) of Pakistan released generous grants for the establishment of high tech Laboratories.

Research Groups

The CASP has been divided into five major research groups:

1. Materials Science Group
2. Accelerator Group
3. Laser Group
4. Plasma Processing of Materials Group
5. Condensed Matter Physics Group

These groups are carrying out intensive research work on different 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)

SEM provides 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)

TEM is highly sophisticated and state of the art instrument capable of carrying out micro/nanostructural 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. 4×10^{-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. The second beam line is used for irradiation of materials. Thus numerous research projects can be carried out by utilizing ions of different doses and energies up to 2 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, pulsed laser deposition of thin films and generation of ions from laser-induced plasma 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 ultra-shot laser-matter interaction processes, femtosecond laser induced spectroscopy and nanostructuring of materials.

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.

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). Students of the Centre are in a great demand at various Colleges, Universities as well as R&D organizations of the country.

Rafi M. Chaudhri Chair

The Rafi M. Chaudhri Chair in Experimental Physics has been established at CASP to pay homage to its founder, Dr. Rafi M. Chaudhri, and to ensure that his tradition of research continues to flourish. So far Dr. Nisar Ahmad (2008-2010), Dr. Shoaib Ahmad (2010-2012), Dr. Muhammad Zakria Butt (2013-2017) have been appointed as Rafi M. Chaudhri Chair Professors 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 resources of the Higher Education Commission (HEC).

MPhil Applied Physics		
Year-I		
Semester- I		
Course Code	Course Title	Credit Hours
AP-PHY-7101	Physics of materials	3
AP-PHY-7102	Laser Physics	3
AP-PHY-7105	Experimental Plasma Physics	3
AP-PHY--7106	Experimental Techniques	3
Semester-II		
Note: Four courses will be selected from the table given below.		
Course Code	Course Title	Credit Hours
AP-PHY-7103	Laser Matter Interaction	3
AP-PHY-7104	Applied Optics	3
AP-PHY-7107	Accelerator Physics	3
AP-PHY-7108	Laboratory work	3
AP-PHY-7109	Advanced Magnetic Materials and Devices Theory	3
AP-PHY-7110	Semiconductor Physics	3
AP-PHY-7111	Electrodynamics	3
AP-PHY-7112	Nanomaterials and Renewable Energy	3
Year-2		
Semester III & IV		
Course Code	Course Title	Credit Hours
AP-PHY-7499	Thesis	12
PhD Applied Physics (Year- I)		
Semester I		
Course Code	Course Title	Credit Hours
AP-PHY-7113	Transmission Electron Microscopy for Materials Science	3
AP-PHY-7114	Soft Condensed Matter Physics	3
AP-PHY-7115	Some Essential Techniques used in Materials Sciences	3
Note: Other courses can be opted from department of Physics GCU Lahore		

Faculty

**Centre for Advanced Studies
in Physics (CASP)**

Director

Prof. Dr. Riaz Ahmad

Professor

Prof. Dr. Shazia Bashir

Assistant Professor

Syed Tahir Abbas

Athar Naeem Akhtar

Shahzad Saadat

Dr. Nawaz Muhammad

Dr. Naveed Afzal

Dr. Tousif Hussain

Khaliq Mahmood

Dr. Ghulam Muratza

Dr. Mohsin Rafique

Lecturer

Mahreen Akram

Asthma Hayat

Sobia Saheer

Rana M. Ayub

Farrukh Ehtesham Mubarik

M. Ahsan Shafique

M. Shahnawaz

M. Sabtain Abbas

Zeeshan Zaheer

Sajjad Ahmad

