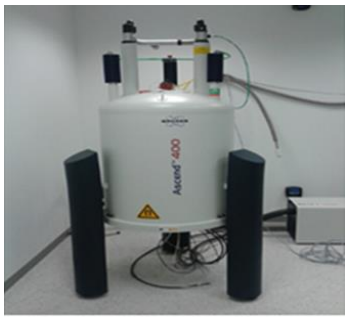
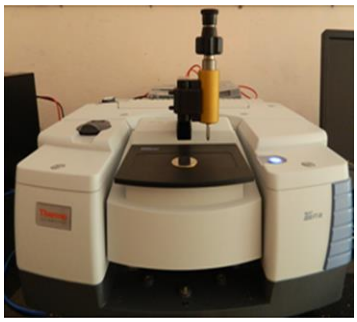
Scientific Infrastructure in University of Kerala






Internal Quality Assurance Cell (IQAC)
University of Kerala
2016

Scientific Infrastructure in University of Kerala

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IQAC of University of Kerala is engaged in documenting various facilities and systems of the University that helps the stake holders of the University to understand different facets of the University system in contrast to local & global peers. This documentation is one of them.

Compiled by the IQAC, University of Kerala, 2016

Preface

To enable the stakeholders of the University to understand it better and to utilize its facilities better, IQAC has been documenting various facets of University system. This booklet compiles the scientific infrastructure available in University of Kerala to enable its effective utilization by faculty and research scholars. With recent establishment of Sophisticated Instrumentation and Computation Centre (SICC) and Phase-II funding by RUSA to the tune of Rs 7.5 crores, the facilities are undergoing a major expansion.

The information is organized in two sections, common facilities and Department-wise facilities. Science & Technology Departments are only included in this.

Contents

A.1. High Performance Computing Centre

The high performance computing facility of University of Kerala is a part of the Campus Computing Facility at Karyavattom Campus and is set up under PURSE project.

Cluster Architecture: A Rocks cluster (Rocks version 6.2 with Cent OS 6.6-64 bit version) which is an implementation of "Beowulf" cluster, running Sun Grid scheduler for job submissions. It has 10 nodes: - a master node with 64GB of RAM, five IBM compute nodes with 8 GB RAM each and four Dell compute nodes with 64GB RAM . Each node is a dual six-core Intel®XeonE5645 series 2.40GHz rack server, thus achieving a theoretical performance of 1 GigaFlops

Front End Node (master**):** Front end nodes are where users login in, submit jobs, compile code, etc. These nodes can also act as a router for other cluster nodes by using network address translation (NAT).

Disk: 2 TB
Memory Capacity: 64GB
Ethernet: 2 physical ports, one public, one private

Compute Nodes: These are the workhorse nodes. Rocks management scheme allows the complete OS to be reinstalled on every compute node in a short amount of time (~10 minutes). These nodes are not seen on the public Internet.

Disk Capacity: 300 GB
Memory Capacity: 8 GB

Ethernet: All compute nodes are connected with Ethernet on the private network. This network is used for administration, monitoring, and basic file sharing.

Computational work is submitted from the login/master node to the compute nodes by users via a batch system. The cluster is accessed remotely *via* SSH. Users authenticate (i.e., login) using an

SSH client; after successful authentication a command-line interface is presented. This can be used to submit computational jobs to the *batch system queue.*

MPI Interconnects: The network transport used for MPI messages will depend on the hardware provided with the HPC cluster. This cluster uses gigabit Ethernet networks for MPI traffic. This network is especially designed to provide the fastest message passing systems available at bandwidths of multiple gigabytes per second.

Shared Data Stroage: By using share, the management overhead of a large cluster is significantly reduced as there is no need to copy data to every node in the cluster for running jobs. By default, the following shared storage areas are typically configured on the cluster.

Storage mount point on nodes	**File server**	**Purpose**
Home/username	Master node	Shared storage area for users
State/partition 1	Compute node	Temporary storage area
Share/apps	Master node	Shared Application

Chemistry related softwares

- Turbomole 6.4 for quantum chemical application
- NWChem 6.0 ab initio computational chemistry software
- Tinker 6.1 molecular modeling package for molecular mechanics and dynamics
- GROMACS (GROningen MAchine for Chemical Simulations) is a molecular dynamics package primarily designed for simulations of proteins lipids and nucleic acids
- VMD
- Desmond
  High-performance molecular dynamics simulations for bimolecular systems

Bio-informatics applications

- HMMER
- NCBI BLAST
- MpiBLAST
- Biopython
- ClustalW
- MrBayes
- T_Coffee
- Emboss
- Phylip
- Fasta
- Glimmer
- Perl-bioperl

Parallel computing MPI libraries

- OpenMPI
- MPICH
- PVM

Compilers
- C
- C++
- FIRTRAB
- Perl
- Python 2.7 and ipython 0.10 interactive shell for python programming

Statistical Analysis
- IBM SPSS 20
- pspp 0.6.2

Remote Access and Virtual Desktop
- FreeNx for ssh based remote login
- OpenSSH

Statistical computing and Graphics
- R 2.25.2 for Statistical computing and Graphics
- Gnuplot 4.2.6 for 2D and 3D plots
- Python-matplotlib 0.99 2D plotting library

Mathematical and Numerical Computation
- Blas 3.2, Atlas 3.8, GotoBlas2, Openblas linear algebra library
- Scilab 5.4.0 for numerical numerical computation
- Scipy 0.7.2 and numpy 1.4.1 mathematical and scientific computing library

Job Queuing system
- SGE6.2 Sun Grid Engine (Open Grid Scheduler)
- Condor High Throughput Computing environment

Cluster monitoring system
- Ganglia

Web server
- Apache

A2. Sophisticated Instrumentation and Computation Centre (SICC)

The Sophisticate Instrumentation and Computation Centre (SICC) was established in 2016 under PURSE project. The high performance computation facility is maintained in CCF (See A.1) and scientific instrumentation is based in separate premises of SICC.

1. Inductively Coupled Plasma Mass Spectrometry [ICP-MS]

Thermo Scientific iCAP Qc ICP-MS

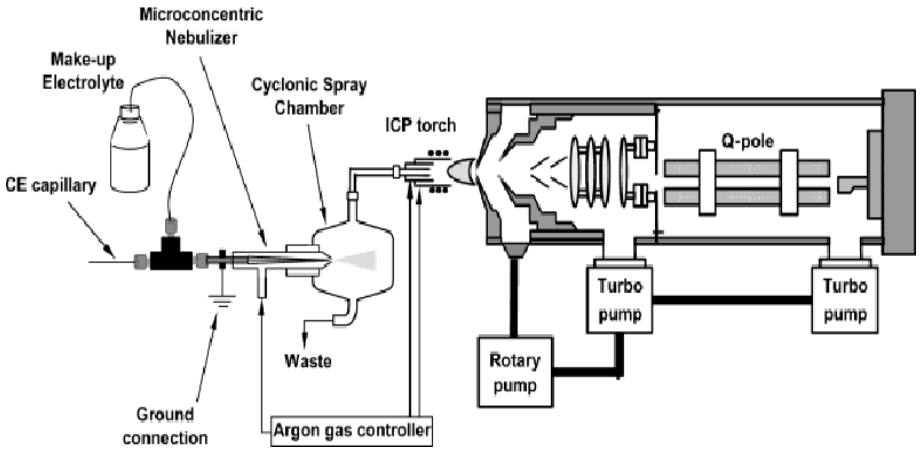
Coupling possible with
- GC (Gas Chromatography)
- HPLC (High performance Liquid Chromatography)
- IC (Ion chromatography)

Charges for using the Facility at SICC
University Departments – Standard analysis - 500/-
KED/CCT/Sensitivity Modes – 750/-

[Thermo Scientific iCAP Qc ICP-MS] ***Coupling possible with GC (Gas Chromatography)/ HPLC (High performance Liquid Chromatography)/ C (Ion chromatography)***

Principle and Theory:

- ICP-MS is a trace element (<1000ppm) analysis technique
- It is used for multiple element determination, isotopic determination and speciation studies.
- The technique involves ionising the sample using inductively coupled Argon Plasma as source and analysing the separated, selectively transmitted ions on the basis of mass/charge ratio using a quadrapole mass spectrometer.



Application

- Metal content of proteins/enzymes
- Trace metal analysis in bones/ tissues/ urine/ blood
- Trace metal analysis in food, water, beverages, canned products etc.
- Monitoring and control of metal impurities in medicinal preparations, Ayurvedic preparations

Advantage

- Supersedes other similar techniques like AAS, Optical emission spectroscopy or ICP atomic emission spectroscopy, used for similar analysis in precision, accuracy, speed
- Wide elemental coverage – most metals with first ionisation potential below that of Argon can be analysed.
- Capable of isotope ratio measurement
- Helps determine chemical form of the element in a sample (speciation studies)
- Laser ablation coupled ICP-MS possible for samples like bone/nails etc.

Charges for using the Facility at SICC

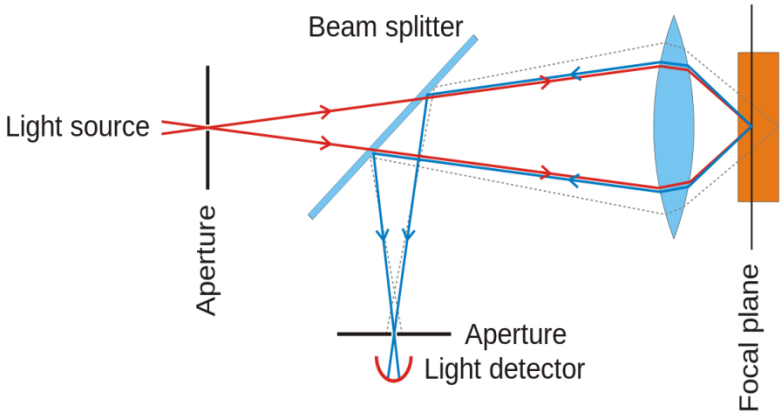
- University Departments – Standard analysis - 500/-
  KED/CCT/Sensitivity Modes – 750/-

2. Laser Scanning Spectral Confocal Microscope: [Leica TCS SP8]

Leica TCS SP8

Principle and Theory:

- Confocal microscope is a special type of fluorescence microscope to give 3D image of a sample with good spatial resolution.
- The laser source enables to chose fluorescent light of specific wavelength which is focussed specifically to a small region on the fluorescently labelled sample using a pinhole.
- The emitted light from the fluorescent molecules (flurophores) if present in the region is detected.
- The sample or the light beam is moved to scan the surface of the sample and record the emitted light
- A 2D image at a given height is first constructed.
- Then the surface/beam is moved vertically to obtain images at different height so that a 3D image is generated



Application

- Widely applicable in cell biology, microbiology, developmental biology
- Imaging, quantitative and qualitative analysis of cells, tissues, fungal elements etc.
- Already in use for evaluation of eye diseases, endoscopic procedures etc.
- To study cellular localisation of ions, macromolecules (DNA, RNA, proteins), cytoskeletal elements, cell organelles etc.

Advantage

- Imaging live cells and capturing their dynamics is possible.
- Image of whole tissues/organs at maximum depth possible at highest resolution

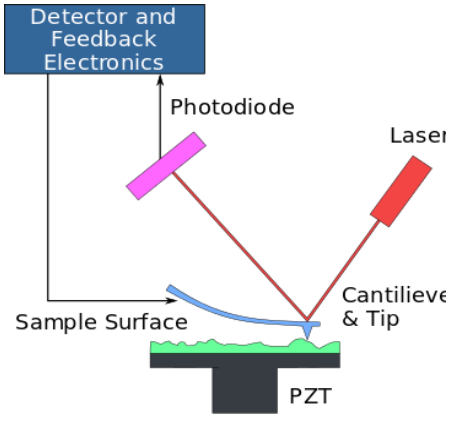
3. Scanning Probe Microscopy [SPM]

Bruker - Dimension Edge with ScanAsyst
Includes
- Atomic Force Microscopy [AFM]
- Conductive Atomic Force Microscopy [CAFM]
- Magnetic Force Microscopy [MFM]
- Scanning Tunnelling Microscopy [STM]
- Scanning Near-Field optical Microscopy[SNOM]
- Electrostatic Force Microscopy [EFM] Thermo Scientific iCAP Qc ICP-MS]

Charges for using the Facility at SICC
University Departments – 300/- for AFM imaging
University Departments – 500/- for all modes other than AFM

Principle and Theory:

- AFM is a device for surface characterisation at a nano-scale/ atomic scale
- It generates image of the three-dimensional shape (topography) of a sample surface at a high resolution.
- AFM relies on the atomic forces acting between the cantilever tip and sample which impact the surface image.
- The force is not measured directly, but is calculated by measuring the deflection of the lever
- Other techniques like



Application:

- Cell studies (cancer, infectious disease)-
- Distinguish cancer cells and normal cells based on a hardness of cells
- To evaluate interactions between a specific cell and its neighbouring cells in a competitive culture system.
- Protein imaging and crystallisation, Protein/peptide interaction
- Virus detection, Bacterial imaging
- Studying dissolution rates of crystalline drugs
- Identifying drug-excipient interactions
- To determine encapsulation efficiency of liposomes

Advantage

- AFM is comparable to SEM for the fact that both are used to analyse surface topography, but AFM is superior to SEM as a 3D image of surface is possible with SPM
- SPM can be used on light-atom (biological or organic) samples without special preparation, which is not possible with SEM (they need conductive surfaces - metallic or at least metal or semi-metal compounds such as oxides).
- AFM can even be used on surfaces under liquid. The resolution limit therefore is solely defined by the sharpness of the tip, that can be in the range of single atoms. Furthermore, the tip can be modified or functionalized with special molecules to really measure different inter-molecular or inter-atomic interactions. (Only dry samples are accepted at our facility).

Charges for using the Facility at SICC

- University Departments – 300/- for AFM imaging
- University Departments – 500/- for all modes other than AFM

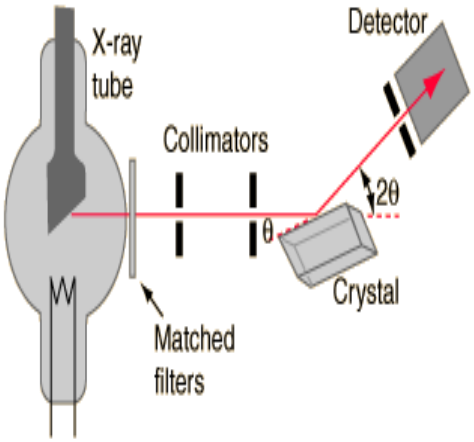
4. X-Ray Diffractometer [Bruker D8 ADVANCE with DAVINCI design]

Bruker D8 ADVANCE with DAVINCI design
Includes
-Powder X-ray Diffraction (Powder XRD)
-Grazing Incidence X-ray Diffraction
-(GI XRD)

Charges for using the Facility at SICC
Powder XRD: 300/- for University Departments
GI XRD: 500/- for University Departments

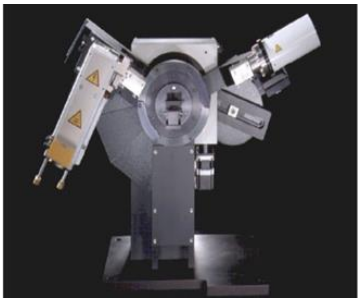
Principle and Theory:

- X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed towards a sample.
- Interaction of the incident rays with the sample produces constructive interference (and a diffracted ray) when conditions satisfy Bragg's law.
- This law relates the wavelength of electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample.
- Crystalline substances act as three-dimensional diffraction gratings for X-ray wavelengths.
- These diffracted X-rays are then detected and corresponding lattice spacing calculated and processed to provide the structure.



Application:

- Proteomics – Protein identification and characterisation, Determination f crystal structure of proteins, study of protein-protein interaction, Glycopeptide analysis.
- Metabolomics – Protein- metabolite interaction
- Structural Biology



Advantage

- Depth profiling of compositional and phase changes within layered materials possible by Grazing Incidence XRD
- Wide range of samples lime inorganic complexes, organic compounds, fibers, polymers pharmaceuticals and nanoparticles can be analysed

Charges for using the Facility at SICC

- Powder XRD: 300/- for University Departments
- GI XRD: 500/- for University Departments

5. Scanning Electron Microscopy [SEM][Carl-Zeiss]

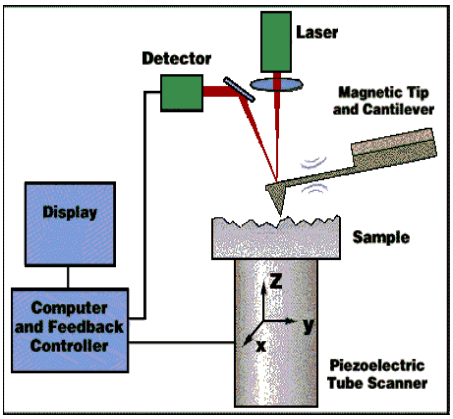
Includes Energy Dispersive X-Ray Analyser [EDX]

Carl-Zeiss
Includes
:Energy Dispersive X-Ray Analyse
[EDX]

Charges for using the Facility at SICC
Powder XRD: 300/- for University Departments
GI XRD: 500/- for University Departments

Principle and Theory:

- The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid sample.
- The signals that are derived from electron-sample interactions reveal information about the sample including external morphology (texture), chemical composition, and crystalline structure and orientation of materials making up the sample.
- Signals are collected over a selected area of the surface of the sample, and a 2-dimensional image is generated that displays spatial variations of sample.



Application:

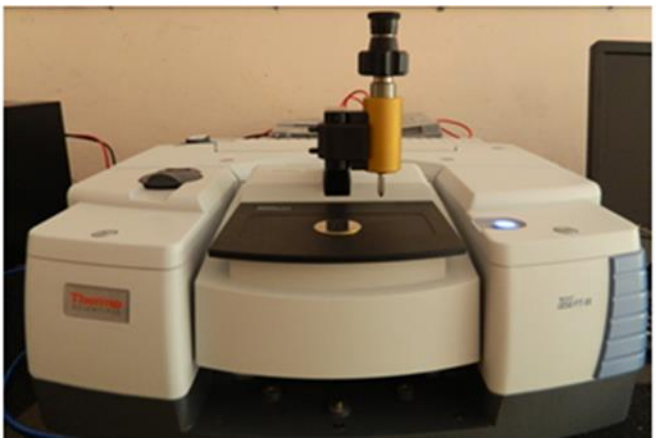
- Mainly for surface morphological studies, compositional and surface elemental analysis.
- To analyse continuity and thickness of thin films coated on substrate.
- Identify foreign materials.
- Generally unsuitable for wet samples and organic materials – however these can be studied in low vacuum mode or by coating with an electrically conductive coating.

Advantage:

- Fast and Easy to use.

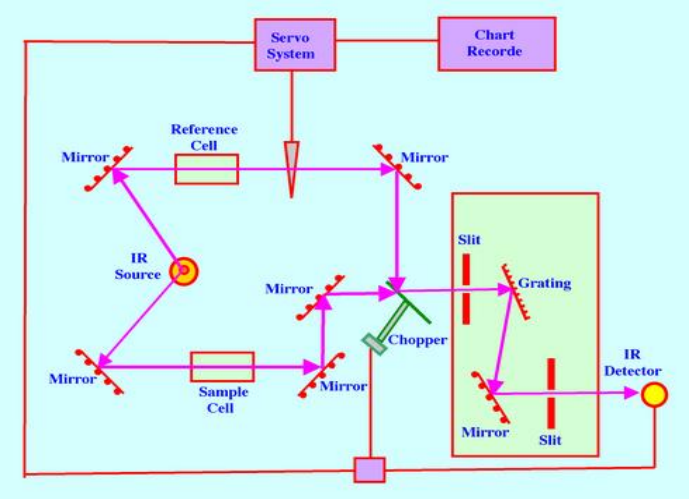
6. Fourier Transformed Infra-Red Spectrophotometer [FTIR including Near IR]

Thermo Scientific
NICOLET iS50 FTIR



Principle and Theory:

- The Infra-red spectrophotometer uses light in the Infra-red region of the electromagnetic spectrum to study vibrational and rotational-vibrational changes in the bonds of molecules.
- FTIR, uses an interferometer to vary the IR light over a range to collect spectral data of the sample simultaneously using a fourier transform algorithm.



Application:

- Identification of functional groups of samples-organic polymeric and plastics
- Contaminant identification
- Qualitative check of drugs, polymers, rubber, thin films, coatings, fabrics etc.
- Monitoring automotive smoke emissions
- Molecular degradation assessment
- To check similarities of samples.

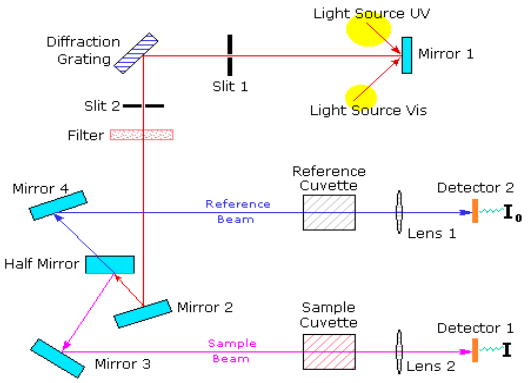
7. Ultra Violet-Visible Spectrophotometer [UV-Vis]

Agilent Technologies
Cary Series

Principle and Theory:

UV-Vis Spectrophotometer uses light of wavelength in visible, near UV and Near Infra-red ranges to induce electronic transitions in atoms and molecules.

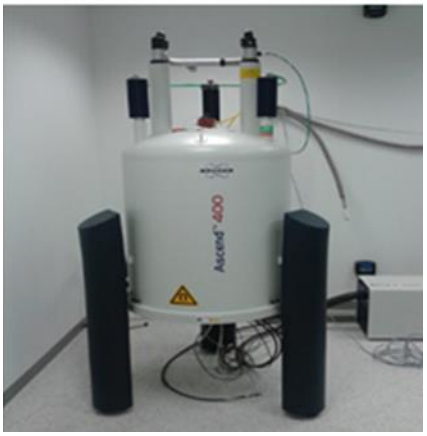
Generally molecules with π −electrons or non-bonding electrons show absorption in this region to undergo π-π*, n-π*, σ-σ*, n-σ* transitions.



Application:

- Quantitative determination of transition metal ions, organic compounds with high degree of conjugation and biological macromolecules
- Determination of kinetics or rate constant of chemical/biological reaction.

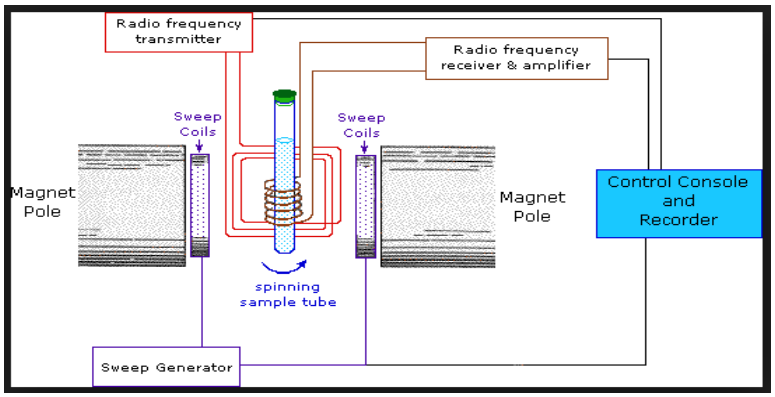
8. Nuclear Magnetic Resonance Spectrometer [NMR including 1H and 13 C NMR]



BRUKER AVANCE 400 MH_2 FT-NMR Spectrometer
ORDER PLACED
Includes
=^{1}H or Proton NMR (PMR)
=^{13}C NMR ^{19}F, ^{15}N, ^{31}P can also be analtsed
=2D COSY
=2D HETCOR
=NOESY
=HMBC
=HMQC
=DEIT

Principle and Theory:

- NMR spectrometer is used to detect structure of organic molecules based on the atoms with half integral nuclear spin like $_1H^1$, $_6C^{13}$, $_9F^{19}$, $_{15}P^{31}$ that possess an inherent electric and magnetic field.
- When such a sample is subjected to an external magnetic field and radiofrequency waves, the energy of the nuclei increases from ground state to an excited state.
- The amount of magnetic field/ radio frequency needed to adjust the nuclei back to its ground energy state, gives an indication of the chemical environment of the nucleus based on which the structure of the molecule is determined.



Application:

- Standard instrument for structure determination, qualitative and quantitative analysis of organic molecules.
- Only method for atomic resolution of bio macromolecules in aqueous solutions
- Used widely in chemical, food, pharmaceutical and polymer industries.

A3. Service and Instrumentation Centre

USIC was established in 1977 as per the guideline of UGC. This center was upgraded to level II in 1981. USIC is a Non Vocational academic Department. The USIC is now subsumed by Sophisticated Instrumentation and Computation Center (See A2). In additions, Mechanical Laboratory, Electronics Repairing Unit and Computer Repairing Unit are there. The Major aim of this center is to provide the support to various departments in procurement and fabrication of the scientific equipments, teaching aids, provide training to teachers, staff, central testing and computation facility, development of campus networks and its maintenance. The activities of this center are:

Repair of: Electronic equipments - such as Water bath, Heating Mantle, Magneticstirrer, pH meter, Spectrophotometer, Centrifuges, Ovens, Distillation units, Monitor, CRO, UPS, Inverters, Stabilizer, Printers. Mechanical machines - such as Vacuum pumps, Sieving machines, Hot water bath shaker, Exhaust systems, rain gauges, Air compressors, Air conditioning AC units, Fridges, Deep freezers, Cold room etc. Computers and LAN:- Computers, Networks,

Maintenance of : Campus LAN:- maintenance and extension of CLAN comprising around 2000 computers. University Tower Clock. Observatory equipments. University Printing press, UITs and University Engineering Browsing facility in campus Library. Web server, Email server, Storage server, Authentication server etc.

Fabrication of :- Water infiltrometer, Observatory telescope, Under water sediment collector, Rain gauge, Scanning Electron microscope sample holder, Exhaust systems, Soil sample collector Sundial, molding die, Trolley for press, Sechi disc.

Purchase relative activities: In order to have a best practice in purchasing, this center provides support to various departments in purchasing of equipments by formulating and providing specifications, Negotiation and evaluation of quotation, Inspection for satisfactory operation of the instruments and certification.

Equipments that are no more useful are inspected by this center. These items are condemned and auctioned.

Implementation of: University CCTV Surveillance system, Bandwidth up gradation. Domain and and associated jobs extension of Campus LAN to the new extended building Provide uninterrupted 24 X 7 connections to the Departments in Kariavattom Campus.

A4. Computer Centre

1. Introduction

Computer Centre of the University of Kerala was setup in 1977 for providing computer facilities for the research activities in the university. Being the only centre in South India with mainframe computing facilities, it attracted researchers from far and wide. In the present IT era the centre took up new challenges in the field of IT enabling of University administration. The centre meticulously follows the principles of business process redesign as a prerequisite of IT enabling. The centre has repositioned itself as a software development centre catering to the needs of the higher education sector of the nation. University Computer Centre is located near the administration block in the Palayam campus. Computer Centre is handling many IT projects for the University.

1.1 History and Growth

Computer Centre started functioning on a moderate scale with an IBM-1620, a Second generation computer donated by Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram. VSSC had not only installed the system in the University office campus but also had provided with the staff to operate it. This new computer facility introduced the general student community to the use of computers and gradually the computer awareness started growing and the need of computer utilization showed a rising trend. In order to meet the growing needs of users, the University decided to go for new large modern system and to start its own full-fledged

department. With this in view, a third generation 16-bit machine TDC-316 manufactured by M/s Electronics Corporation of India Ltd, Hyderabad was acquired by the University with the grant sanctioned by the UGC and established a separate Computer Centre during March 1977. The TDC-316 Computer System had a configuration of Card Reader (600 cpm), Line Printer (600 lpm), two Magnetic Tape transports (37.5 IPS, 800BPI) and Disk Drive (7.25M Bytes). Later, a new building for Computer Centre was constructed. Computer Centre started functioning in the present building on September 10, 1984 and the functioning was inaugurated by the Hon. Vice Chancellor of the University Sri. Habib Mohammed. To meet the research and computing requirements at Karivattom campus, an extension centre of Computer Centre started functioning during October, 1988. To enhance the communication facilities, during January 1994, facility for e-mail was established through ERNET and this was the only e-mail facility available in the University. All the departments of the University made use of this facility for several years until the Internet became common. In September 1995, Post Graduate Diploma course in Computer Applications was launched at the centre. A website of the University was launched on a trial basis during 1997.

Apart from the different academic activities, Computer Centre was also able to undertake the different computerization activities to help the administration and finance activities. Development of software for the management of demand drafts received as fees from users was the initial step in this direction. Another major computerization activity undertaken by Computer Centre during this period was the computerization of Cash Counters at Palayam and Kariavattom Campuses. Computer Centre developed and installed customized software for cash receipts for different purposes and the University makes use of this software even after 14 years. Computer Centre successfully did development and running of software for B.Ed. admissions for different, Teacher Education Centres of the University located at different places for several years from its beginning.

As the demand for computerization increased, the University started the computerization of its regular activities from the year 2001 onwards. The examination computerization activities began by computerizing the degree preparation process by automating the process using custom built degree management software. University issues special hologram embedded degree forms with several visible and hidden security features and Computer Centre manages the system since its beginning from the year 2001.

The second phase in examination computerization was the computerization of tabulation works. Tabulation sections of all examinations of the University make use of custom made software developed by Computer Centre. The Web applications developed by Computer Centre help different examinations sections to allow students register for examinations through ONLINE.

Computer Centre has designed and implemented an intranet in the University campus for use by different wings, for information sharing. The works for implementing WiFi networks for Palayam and Kariavattom campuses and modern Data Centre at Palayam are in progress and these will be commissioned soon. Steps for setting up of smart classrooms and Administrative Staff College for inter university activities are in progress.

1.2 Notable Features

Being a pioneering institution, the Computer Centre had many features and firsts to its credit.

- The first Computer Installation in Thiruvananthapuram, outside VSSC.

- The first University Computer Centre in Kerala State and neighboring states.
- At one time eight universities namely Kerala University, Cochin University, Calicut University, Kerala Agricultural University, Agricultural University - Tirupati, Sri Venkateswara University, Madurai Kamaraj University and Annamalai University were using the facility.
- Departments like Technical Education, Economics & Statistics, Small Industries, Entrance examinations, and organizations like PWD, Kerala Police, IRE, CSI, Planning Board, KSEB, KSFDC, KSCC, SCMC, LIC, IMG, LBSCST, NATPAC, KELTRON, ER&DC made use of the facilities of Computer Centre.
- For the first time, computer consultancy service was made available for educational, commercial, administrative applications.
- Catered the research and computing needs of the affiliated colleges of the University.
- Service to external users including the Government of Kerala was provided
- Computer Centre could earn revenue to the University by way of consultancy services.

1. 3 Our Major Services

Computer Centre was primarily established for academic and research needs of the University. But now the scope of activities has changed. The services provided by Computer Centre are

- Support for systems analysis, code development and computing services to users.
- Undertake projects for computerization of academic, administrative, examination and financial operations of the University.
- Organizing courses and training programmes for increasing computer literacy and developing skills.
- Computer Consultancy Service to other agencies.
- Act as a single point of contact for co-coordinating the activities for strengthening computing facility in the university.
- Technical evaluation and feasibility study of IT projects

As the activities of Computer Centre are wide and varied, the working of Computer Centre are mainly classified into three namely software, infrastructure and administrative.

B. Department-wise Facilities

B1. Department of Physics

- L.C.R Meter
- Photoluminescence spectrophotometer
- UV-Visible spectrophotometer
- Network Analyzer
- Source Meter
- Electrometer
- Electrical Conductivity Measurement in Vacuum and Desired Atmosphere
- High temperature Sample holder for Impedance Measurement
- Electrochemical Workstation
- Muffle furnaces
- Hot air Ovens and Microwave Oven
- Z-scan setup

B2. Department of Optoelectronics

- Deep Freezer
- Nd. YAG Laser with SHG setup
- Up gradation of triax nano chromator for Pl setup
- Field Emission Scanning Electron Microscope with EDX facility
- Micro Raman Spectrometer (with excitation wavelength of 514nm and 785nm available)
- UV Visible Spectrophotometer.
- Spectrofluorometer
- Impedance analyzer

B3. Department of Geology

- Automatic Absorption Spectrophotometer (GBC Australia-make)
- UV-Vis Spectrophotometer (Systronics)
- Olympus Polarizing Microscope with Camera & imaging software
- Anisotrophy of Magnetic susceptibility instrument
- Auto titration unit
- Resistivity Meter, Infiltrometer
- Remote sensing data products
- Proprietary and FOSS GIS labs
- Atomic Absorption Spectrometer (AAS) for elemental analyses of various media.
- Fume hood with HF – HNO3 based digestion and solution preparation of rocks, minerals and refractories – well equipped chemical lab to analyze rock and water samples – material characterisation.

B4. Department of Computer Science

- PG lab with 33 Nos. of Desktop PC's including Intel Core 2 Due, IBM, server etc.
- Digital Image Computing lab I – with 18 Nos. of High-end systems including Intel Core : 7 systems
- Digital Image Computing Lab II with 18 Nos. of systems including Intel Core i3, Intel Core 2 Due systems

- Embedded Systems lab with 10 Nos. of Intel Dual Core IBM systems
- Oracle Database lab with 30 Nos Dell Laptops and HP Server as Oracle Server
- Medical Image Processing (MIP) Research lab for Research scholars with 12 Nos. of High and Systems and workstation including Intel Core i7, Intel Xeon Workstation, HP Supercomputer with NVIDIA Tesla GPU

B5. Department of Demography

- Computer Lab
- Census Work station

B6. Department of Biochemistry

- Fluorescent Microscope
- Thermocycler (Semi quantitative)
- Real time thermocycler
- Lyophilizer
- Cold Centrifuge
- ELISA plate reader
- Gel DOC
- HPLC
- Sonicator
- UV-Visible Spectrophotometer
- FTIR
- Animal House facility
- Bioinformatics lab
- Electrophoresis
- Tissue culture facility
- Ultracentrifuge
- Refrigerated micro centrifuge
- Biophotometer
- Deep freezer -80 and -20
- Cold room
- Western Blotting apparatus
- Homogenizer
- Microbial culture facility

B7. Department of Chemistry

- Electrochemical Impedance Spectrometer SP 200
- Rotary Evaporator Heicdolph
- CARY 630 FTIR with PC, Printer, UPS
- HPC with 4 servers of Gaussian 09 software
- JASCO HPLC with PC
- HORIBA DLS with PC, Printer UPS
- Vacuum Oven
- Electro chemical work station
- UV-VIS spectrophotometer
- Spectrofluorometer

- AAS
- Muffle furnace
- Autoclave
- Sunning electrochemical
- Hydrogen GC microscope

B8. Department of Archaeology
- GIS Lab
- Archaeozoology and Archaeoicthyology Lab
- Total station – 1
- Munsell Rock Chart – 1
- GPS 12
- Weighing scale – 5
- Vernier caliper – 10
- Digital camera – 3
- Munsell soil colour chart – 1
- A3 Negative flat-bed scanner – 1

B9. Department of Environmental Sciences
- High Performance Liquid chromatography (Shimadzu)
- Water Testing Facility
- FRITSCH PULVERISETTE – 7
- Denaturing Gradient Gel Electrophoresis
- UV-Vis Spectrophotometer
- Random Analyzer-RAD7

B10. Department of Aquatic Biology & Fisheries
- HPLC
- PCR
- Ultra centrifuge
- Lyophiliser
- Compound Microscope with imaging facility (Purchased Double beam spectropholometer)

B11. Department of Botany
- High Speed Cooling Centrifuge
- UV-Vis spectrophotometer
- Stereo- Zoom Microscope
- Image Analyser
- Leica Image Analyser
- Cryotome
- Phase contract microscope
- Protein purification System & Fraction collector
- PCR HPLC, GC
- Real time PCR
- Gel Documentation System
- Deep Freezer – 80

- Elisa Reader
- Biophotometer
- Sonicator
- Deep Freezer – 40 – 2016
- Nitrogen Analyser
- Rotary evaporator
- Walk in Cold Room
- Herbarium
- Herbal Garden
- Green House
- Seed bank

B12. Biotechnology

- Animal Cell Culture Facility- Carbon Dioxide Incubator
- Inverted Microscope
- Inverted Fluorescent Microscope Fermenter
- Molecular Biology/ Biochemistry- Microbiology:Refrigerated centrifuges
- Refrigerated Micro centrifuge
- Protein Gel Electrophoresis
- Iso-electric Focusing (IEF),2D Gel Electrophoresis
- DNA Electrophoresis
- Gel documentation system
- Liquid Chromatography with fraction collector
- Fast Performance Liquid Chromatography
- Laboratory Fermenter/Bioreactor
- ELISA Reader
- UV-Vis Spectrophotometer
- Speed Vac Concentrator
- Cryocan for Liquid Nitrogen
- HPLC for purification of organic compounds
- PCR and RT PCR
- Facility for large scale cultivation of animal cell cultures.

B13. Dept. of Computational Biology & Bioinformatics

- Informatics Lab
- Drug discovery Lab
- Basic Molecular Biology lab
- Bio-electronics Lab.
- Drug Docking Station

Seed Bank in the Department of Botany

Department of Botany, University of Kerala has recently established a seed bank facility for the seed conservation of indigenous crops, vegetables, underutilized vegetables, fruits, and medicinal plants. The new initiative was established by the joint support of University of Kerala and Kerala State Biodiversity Board (KSBB, Govt. of Kerala). The seed bank was formally inaugurated by Prof. Oommen V. Oommen, Chairman, Kerala State Biodiversity Board on April 8, 2016. As a part of seed banking program, a massive effort to ensure the participation of all the research scholars and students in the Department to procure seeds of underutilized vegetables, fruits and medicinal plants are under taken. The program expected to yield results that enrich the collection of the Seed Bank in near future. Procuring seeds from traditional farmers in the state, home gardens are initiated especially for indigenous crops and underutilized crops, besides, ongoing seed collections from the wild. The collected seeds are duly dried and processed in the laboratory. They were tested for seed viability, germination and level of moisture (< 7%), prior to storing at 4°C in a walk-in-cold room or at -20°C in a deep freezer. Low temperature storage practice significantly extent seed viability especially in case of orthodox types of seeds.

Upon enrichment of the seed collection, the Seed Bank will serve as seed source for researchers and small / traditional growers. In order to gain momentum in seed collection and banking activities, University has recently signed a tripartite MoU with Jawaharlal Nehru Botanic Garden & Research Institute and Kerala Forest Research Institute on 'Seed Bank maintenance and enrichment' with Department of Botany as implementing agency. Hope that facility will develop in to a full-fledged seed bank that serve as repository of seeds of rare, endangered, threatened (RET) plants, wild relatives of crop plants, and underutilized plants in the state, thus boost conservation activities in accordance to Global Strategy for Plant Conservation (GSPC) of Botanic Garden Conservation International.

Inaugurating the Seed Bank by Dr. Oommen V Oommen, Chairman, Kerala State Biodiversity Board

Seed Bank facility established in the Department of Botany

Seed collections exhibited in the seed bank

Kerala University Botany Herbarium

Kerala University Botany Herbarium (KUBH) was established in the year 1989. It has been Registered in Index Herbariorum, New York: 20th February 2016 with an Acronym – KUBH. Just like in the library, here the dried plant specimens are arranged in systematic order by plant family according to Bentham and Hooker, 1876 & Smith *et al*., 2006 systems of classification. The collections of KUBH includes Angiosperms (5291), Gymnosperms (21) Pteridophytes (2000) Bryophytes (10) Lichen, Fungi and Algae (40) and type specimens (50)] totalling over 7362 More than 3000 specimens are yet to be identified and several new specimens are arriving periodically in the herbaria.

The Kerala University Botany Herbarium (KUBH) supports the correct identification of plant specimens (ii) form the basis for research and preparation of Floras (iii) provide the comparative material essential for studies in taxonomy, systematics, ecology, anatomy, morphology, conservation biology, biodiversity, ethnobotany, paleobotany (iv) for teaching, for being used by the public and (iv) for the preservation of voucher specimens.

Rare collections of KUBH

- Rama Rao, Vencoba Rao/ Bourdillon and Gamble identified sheets
- Rare species of wild orchids and ferns from Western Ghats collected by the founder Prof. A. Abraham.
- Unique and best collections of Pteridophytes in South India
- *Ophioglossum reticulatum* (Highest chromosome number reported in (n=630) by Prof. (Dr.) C. A. Ninan, & Prof. (Dr.) A. Abraham, Former Heads of the Department)
- Wild species of *Oryza*
- Rich collection of members of the families Commelinaceae, Poaceae, Cyperaceae
- Endemic plants of Southern Western Ghats and collection of RET plants

Services to Researchers and Botanists rendered by staff members of KUBH

- Identification of plants for researchers and students of the Department of Botany as well as for the sister departments and other institutions
- Deposition of the voucher specimens and issuing voucher number and certificate of identification
- Giving Training in the preparation and maintenance of herbarium for the school students, researchers and to the general public
- Taking projects to identify the plants inside and outside the premises of various organizations, institutions and Government bodies.