

Fostering applied science—the Cochin University of Science and Technology

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Its emblem symbolizes the Cochin University of Science and Technology's basic concern—to be a centre of learning, of study and research in applied science and technology and of transfer of such knowledge for the betterment of humanity. A rising sun and a coconut palm in the emblem together represent the birth of a new centre of educational excellence in the land of Kerala. An open book represents learning, a factory its application, and a power transmission tower its dissemination. The basic philosophy and goals of the university find eloquent expression in the motto *Tejasvi navadhitamastu*, taken from the *Yajur Veda*, meaning 'May learning illumine us both [the teacher and the taught]'.
 Probably the first concrete step in the direction of the Kerala Government's commitment to the national plan of science and technology was the establishment of Cochin University in 1971 for the specific purpose of 'the development of higher education with particular emphasis on post-graduate studies and research in applied science, technology, industry and commerce'. The Cochin University was conceived as a science and technology university and was cast in the mould of a federal university, different from other, affiliating, universities. The erstwhile University of Cochin was upgraded and reorganized in February 1986 as the Cochin University of Science and Technology.

The campus

Located 15 kilometres north of Ernakulam city, on a campus of about 180 acres in Thrikkakara, the main campus is serene and beautiful. Rolling hills with patches of thick green and planted trees all over, and plenty of fresh air and sunshine lift the spirits of students, staff and faculty. The main administrative block is built in the traditional Kerala style with tiled roofs and is very functional. The campus houses 14 teaching and research departments, eight auxiliary institutions, a computer centre, the

central library, five hostels, a guest house, a visiting faculty complex, staff quarters, a health centre, a gymnasium, and a post office and a bank. Another campus of the university is located in Ernakulam, by the side of the sea, and houses the School of Marine Sciences, the School of Environmental Studies and the Department of Industrial Fisheries, and a men's hostel. Proximity to the sea and facilities like a jetty and several sea-going vessels provide an environment essential for marine science and related studies.

Recognized institutions

Even though the university (CUST) is not an affiliating type, its territorial jurisdiction extends all over the state of Kerala. There are ten recognized research institutions where candidates can carry out research and register for a Ph D degree in CUST. These are: the Naval Physical and

Oceanographic Laboratory, Cochin; the National Institute of Oceanography; the Regional Research Laboratory, Trivandrum; the Marine Products Export Development Authority, Cochin; the Integrated Fisheries Project, Cochin; the Centre for Earth Science Studies, Trivandrum; and the Kerala Forest Research Institute, Cochin.

Academic and administrative set-up

The university has a sanctioned strength of 200 faculty and a student body, including part-time students, of about 1800. Academic programmes of the university spread over eight faculties, including science, engineering, environmental studies, marine science, social science, humanities and law. There are 17 teaching and research departments/schools, the major science and technology departments being electronics, ship technology, computer science, applied



The administrative office—traditional Kerala architecture in a green campus.

chemistry, polymer science and rubber technology, environmental studies, marine science, technology, industrial fisheries, physics, and mathematics and statistics.

In addition to the central library, all the departments/schools have their own libraries. The total holding of books exceeds 176,000 and the number of journals subscribed exceeds 1000. Automation of the university library service is under way with special assistance under a project from the Ministry of Human Resource Development (MHRD). The university publishes the *Journal of Industrial Fisheries*, the *Journal of Marine Sciences*, and *Shiptechnic*.

There is a well-equipped Science Instrumentation Centre with facilities to support research-related fabrication and design, and testing of scientific equipment and components. The university also has a Centre for Sponsored Research and Consultancy, which helps in liaising with industry and outside organizations. The Centre has conducted several studies on a sponsorship basis.

CUST is supported by grants from the State Government, Central Government Departments, UGC and other organizations. Typically the support varies between 60 and 100 million rupees annually, depending upon the level of research and development activity.

Electronics and computer science

The Department of Electronics offers doctoral programmes in various applied areas. Research areas of special interest to the department are antennas, artificial intelligence, communications, computer science, digital signal processing, instrumentation, liquid crystal displays, micro-



Research students at work on a micro-processor development system.

processors, microwaves, radar cross-sections, solid state electronics and underwater acoustics. Major laboratory facilities available in the department include the Microwave Research Laboratory, the Centre for Research in Microprocessor Applications, the Electronic Instrumentation Research Laboratory, the Devices Laboratory and the Digital Laboratory. These laboratories have all the necessary equipment: microprocessor development systems, microcomputers, spectrum analyser, data acquisition units, analog/hybrid computer trainers, logic analysers, etc. A mobile radar unit (S-band) for training purposes has also been made available by the Defence Research and Development Organization (DRDO). UGC selected the department for its COSIST assistance in 1988.

The department has developed sophisticated microwave antenna systems using microstrip technique. Gap-coupled microstrip antennas were developed with considerable enhancement of impedance bandwidth. Non-destructive testing of non-metallic bodies using microwaves is another area in which the department has made a significant contribution. Microprocessor-based instrumentation for this has already been developed. The department has developed new modules for speech recognition using microprocessor-based systems. In underwater acoustics, PVDF-based transducers have been developed for sonar applications. These projects were funded by the Department of Electronics, Government of India (DOE), and MHRD. A new type of ferroelectric crystals for dynamic display have been synthesized and were characterized for optimum results.

An M Tech degree course in electronics, with specialization in digital electronics and microwaves, and radar electronics, and a post-B Sc diploma course in consumer electronics and TV technology are also conducted by the department. An M Sc course in electronics, with specialization in artificial intelligence and robotics, will be started from the 1990-91 academic year. This programme is sponsored jointly by UGC and DOE.

Started five years ago, the Department of Computer Science offers doctoral programmes in computer software, financial and corporate systems design, medical diagnostic systems and

artificial intelligence. Facilities include two 32-bit computers with 20 terminals, several PCs, two flat-bed plotters and a MicroVAX II workstation. Sponsored research projects undertaken by the department include work on a geographic information system based on data from the Resource Atlas of Kerala (prepared by the Centre for Earth Science Studies, Trivandrum) and a legal reasoning based on computers. The department also coordinates the Computer Literacy and Studies in Schools (CLASS) experiment sponsored by the Government of India.

The department offers an M Tech degree course in computer and information sciences designed to prepare graduates for careers as systems analysts, computer system designers, software engineers or communication specialists. An M Sc degree course in computer software, sponsored by DRDO, is also offered. Successful candidates are automatically absorbed by DRDO laboratories. Project work done as part of the courses in the department provides students opportunities to do research in areas of interest to them. Some of the widely appreciated student projects are (i) an expert system for localization of brain tumour, (ii) an expert system for accident claims, (iii) 'Travels of Marco Polo', and (iv) an automated system for piping layout for chemical projects.

Research in lasers

The Department of Physics offers M Sc, M Phil and Ph D courses. Recently the All India Council of Technical Education, through UGC, sanctioned an M Tech course in optoelectronics and laser technology and it is expected that the first batch of students will be admitted in 1990. Research activity is in three main streams, viz. lasers and optoelectronics, materials science and theoretical physics.

Research in lasers and their applications was started in the latter half of the seventies. During the early period the main efforts were in the direction of design and fabrication of indigenous laser systems of different categories. Pulsed nitrogen lasers, dye lasers, CO₂ laser and Nd-glass laser were fabricated locally and studies were made on their operating characteristics.

Programmes offered at CUST—emphasis on applied science, technology, industry and commerce

Department/School	Programme
Applied Chemistry	(a) MSc (Applied chemistry) (b) MSc (Biotechnology) (c) MPhil (d) Ph D
Computer Science	(a) MTech (Computer and information science) (b) MSc (Computer software) (c) Ph D
Electronics	(a) MTech (Electronics) (b) Post-BSc Diploma (Consumer electronics and TV technology) (c) Ph D
Industrial Fisheries	(a) MSc (Industrial fisheries) (b) Ph D
Marine Sciences	(a) MSc (Marine biology) (b) MSc (Marine geology) (c) MSc (Oceanography) (d) MSc (Meteorology) (e) MTech (Atmospheric sciences) (f) MPhil (g) Ph D
Mathematics and Statistics	(a) MSc (Mathematics) (b) MSc (Statistics) (c) MSc (Operations research and computer applications) (d) MPhil (e) Ph D
Physics	(a) MSc (Physics) (b) MPhil (c) Ph D
Polymer Science and Rubber Technology	(a) BTech (Polymer science and rubber technology) (b) MTech (Polymer technology) (c) Ph D
Ship Technology	BTech (Naval architecture and ship-building)
Environmental Studies	(a) MSc (Environmental studies) (b) Ph D
Technology	(a) MTech (Electrical engineering) (b) MTech (Civil engineering) (c) MTech (Mechanical engineering) (d) MTech (Chemical engineering)
CMFRI (Recognized institution)	(a) MSc (Mariculture) (b) Ph D

Substantial research grant during the second phase from different funding agencies stimulated a much faster growth and expansion of laser-related research. A major dye laser facility was set up with liberal financial assistance from the Department of Science and Technology, Government of India. This regional facility consists of a ring dye laser (Spectra Physics model 370 D) pumped by a 12 W argon ion laser (Spectra Physics model 171). With the help of 'stabilok' electronics the ring dye laser is capable of single-mode operation and the ultimate linewidth available from this is as low as 1 MHz. Several new experiments in high-resolution laser spectroscopy using the ring dye laser have been initiated. The ring dye laser is

one of two systems now operational in India.

A Q-switched Nd-YAG laser along with a second-harmonic generator (Quanta Ray DCR11) procured with financial assistance from MHRD is virtually the work-horse of the laser laboratory. Tunable high-power pulsed laser output is available from a dye laser (Quanta Ray PDL2) pumped by the frequency-doubled Nd-YAG laser. Many experiments in nonlinear optics have been carried out with this system.

The laser group at CUST has gained international recognition for studies in photoacoustics. In-depth investigations of photoacoustic phenomena in gases, liquids and solids have been made and many of the new results obtained have

been published in international journals. An indigenous photoacoustic laser power meter developed by the group has attracted world-wide attention because of its simplicity and effectiveness.

Laser-induced fluorescence, material damage under laser irradiation, thermal lens and optogalvanic spectroscopy, and laser-produced plasmas are other areas of study. The laser group has also developed nonlinear materials for effecting phase conjugation due to four-wave mixing using low-power laser beams*. Recently the group carried out a time-resolved study of the spectra of Nd-YAG laser-produced plasmas from the new high- T_c superconductors and came up with some surprising conclusions regarding the oxide species in the plasma. Fibre-optic technology is another subject currently being pursued. The main attention here is on the development of fibre-optic sensors. Sensors for the measurement of concentration, reflectance and displacement have been designed and fabricated.

Materials science research in the Department of Physics is in ferroelectric crystals, organic crystals, semiconducting crystals and metallic crystals. Studies include those on electrical properties of crystalline solids, development of semiconducting and polymer thin films, compound semiconducting thin films, thermal properties of chalcogenide glasses using photoacoustic effect, and phase transition in high-temperature superconductors using photoacoustic effect. In theoretical physics the research interests range from gravitation and gauge theories to high-temperature superconductivity.

In a nutshell, the physics department has produced more than 50 Ph D's and contributed more than 300 research papers in national and international journals. The current research activity has 12 ongoing schemes with an annual

*The previous issue of *Current Science* (10 January 1990) contained a paper by K. P. B. Moosad and V. P. N. Nampoori on optical phase conjugation (page 44). The picture on the cover of this issue shows an experiment in progress in the laser laboratory. This issue also contains a research paper from CUST ('Frustrated limit cycle and irregular behaviour in a nonlinear pendulum' by G. Ambika of Maharaja's College, Cochin, and V. M. Nandakumaran of CUST). —Ed.

extramural research grant exceeding ten million rupees.

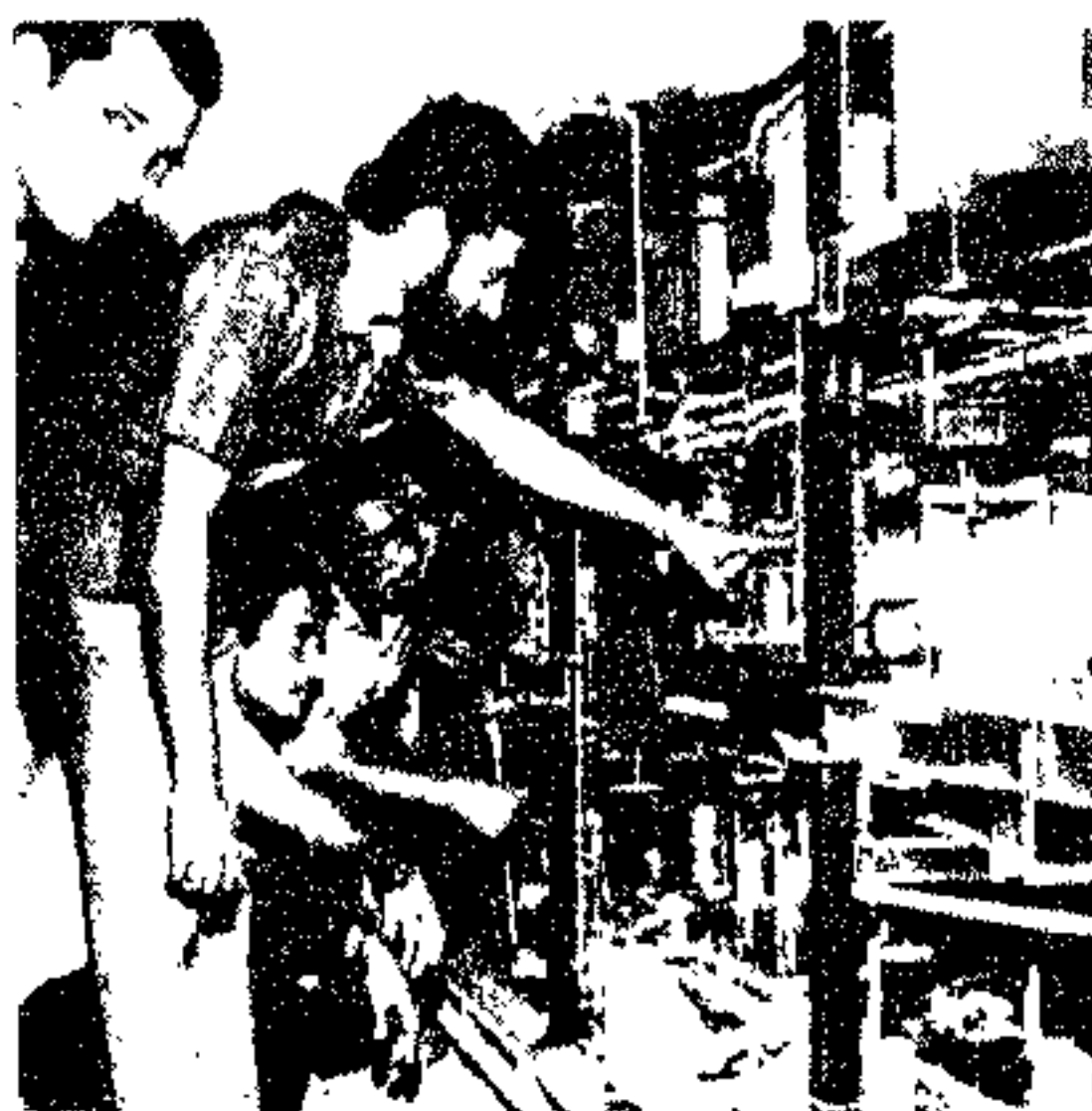
Collaborative ventures

CUST has taken particular interest in fostering collaborative ventures. The DRDO-Cochin University Computer Centre is an example. The computer procurement is funded by DRDO (Rs 12 million) while CUST has provided the building, air-conditioning, electricity and administrative support. Technical administration of the Centre, including operation and maintenance of the computer, is by DRDO.

The Computer Centre, with a Cyber 180/830 mainframe computer, is intended to provide major computational facilities for teaching and research programmes in the various departments of CUST and to foster greater interaction between the university and the National Physical and Oceanographic Laboratory and, thus, DRDO. The facilities at the Centre are also accessible to users outside the Cochin University/NPOL community, through CUST's Centre for Sponsored Research and Consultancy.

Another productive collaborative venture is the tie-up with Wilhelm-Pieck University of Rostock, German Democratic Republic, in the area of naval architecture. For over a decade now, CUST has been host to visiting faculty from Wilhelm-Pieck, and presently the Department of Ship Technology is headed by an eminent professor from the GDR. Several CUST researchers have successfully completed advanced research degrees at Wilhelm-Pieck.

The School of Marine Sciences has a research tie-up with the Plymouth Marine Laboratory of the National



Ship technology—students studying a scale model of the main engine room of a large ship.

Environmental Research Council, UK. Similar collaborative activities are in progress between the Department of Polymer Science and Rubber Technology and the Deutsches Kunststoff Institut, Darmstadt, Federal Republic of Germany. This joint research programme is supported by the Volkswagen Foundation of the FRG.

Concluding remarks

In this article, I have not been able to do justice to all the departments and all the research activity. I often ponder what impact CUST has made in its short life, and very often the answer to this question is quite positive. The university held an 'open house' in the computer science department and the enthusiasm was overwhelming. Thousands of students, common people and children came to see in what way computer science is developing and helping in the betterment of mankind. For many of them this was the first exposure to the latest developments in

this field. Equally popular was the 'Aquafest' festival organized by the Department of Industrial Fisheries. Queues of visitors came for three days to learn about marine life, marine resources, and how we can make environmentally acceptable use of them. I therefore believe that in terms of public awareness CUST is contributing significantly. The university will host the 77th session of the Indian Science Congress in February.

It is difficult to assess impact in science and technology by counting the number of publications, Ph D theses and projects. However, if numbers had a meaning, it may be noted that CUST has produced more than 300 Ph D's so far, the number of publications goes into several thousands, and we have attracted projects in frontier areas.

We do have our problems. While there is the desire to excel, there is also constant pressure to lower standards in response to popular demands. Still, when I look at the balance sheet, I feel very strongly that this is a university with much more on the credit side and a bright future.

Note: This article has been prepared on behalf of CUST. It has not been possible to include details of all the departments and all research activities owing to paucity of space. K. K. Jayan, Prof. C. P. Girijavallabhan, Prof. K. G. Nair and several others provided material used in this article. K. P. Sasidharan assisted in the preparation of the manuscript.

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