

## Experimental physics\*

Over the past five years, refresher courses in experimental physics, lasting two weeks each, have been held under a programme of the Science Education Panel of the Indian Academy of Sciences (IAS), Bangalore at various places in the country (Goa University, IGCAR, Kalpakkam; Saurashtra University, Rajkot; Bhavnagar University, Indian Institute of Technology, Guwahati; and University of Mysore). For each workshop about 20 to 25 postgraduate teachers were selected from among a large number of applicants from all over the country. In these refresher courses, there were lectures and seminars on various aspects of experimental physics and on several electronic kits, developed over some period, jointly by IAS, IGCAR and Physics Department, Goa University. In these refresher courses, lectures were followed by teachers carrying out (i) a number of experiments mainly at the M Sc level, as were available at the host institution, (ii) assembling kits and (iii) using electronic kits with some experiments.

The kits are related to: a constant current supply, a temperature controller, a capacitance measurement circuit, a signal generator and audio amplifier, an on-line data collection kit, a furnace and a lock-in-amplifier. These kits, except the on-line data collection kit, do not cost more than Rs 2500 each and are sufficient in their technical specifications for student experiments. They are cost-effective and easily serviceable.

Using these kits, a variety of experiments at the M Sc level have been conducted.

(a) The constant current source used for (i) measuring temperature coefficient of resistance of copper, (ii) temperature coefficient of resistivity of a semiconductor and determination of energy band gap, (iii) Stefan-Boltzmann constant and emissivity of a surface, (iv) measurement of specific heat of copper, (v) measure-

ment of the electrical and thermal conductivity of copper to determine its Lorentz number, and (vi) thermal diffusivity of brass.

(b) Capacitance measurement circuit used for (i) comparison of capacitances, (ii) measurement of dielectric constant of a liquid, and (iii) measurement of the dipole moment of an organic molecule.

(c) The signal generator cum audio-amplifier used for (i) measurement of self-inductance, (ii) study of series and parallel resonant circuits, (iii) measurement of relaxation time constant of a serial light bulb, and (iv) demonstration of rotating magnetic field. Along with a bridge-balance detector, the signal generator can be used to study various types of AC bridges.

(d) The lock-in-amplifier could be used for (i) measurement of mutual inductance, and (ii) measurement of small resistance by AC technique.

(e) The IGCAR kit, namely the on-line data collection kit, has been used for acquiring on-line data on at least six experiments (including some of the above) and for the study of a ferroelectric phase transition. Many other experiments are being designed and developed based on these kits; additional kits are also under development.

Over the two-week period at each refresher course, each teacher was provided with four knocked-down kits for assembly, testing and operation. The teachers were guided in gaining hands-on experience by resource persons from Goa University and scientists of IGCAR. Starting from rudimentary steps like proper soldering, teachers were led through the exercises and the programme has worked well to the satisfaction of the participant teachers.

Enthused by the positive response from the nearly 100 participant teachers so far, the Indian Association for Physics Teachers was approached to nominate some 25 teachers from all over the country for a two-day demonstration workshop, wherein all the kits and experiments could be demonstrated before the nominated teachers with a view to bring these kits and new experiments to the attention of a wider audience. The two-day workshop on experimental physics held at Bangalore is the consequence of this joint endeavour.

Following the inauguration of the workshop by A. K. Sood, Secretary, IAS, R. Srinivasan (Raman Research Institute, Bangalore), the convener and coordinator of the programme, explained the objective of the workshop and the history behind it. On both the days, the morning sessions were devoted to lectures on the details of the kits by K. R. Priolkar, Efreem D'sa, Sadiq (Goa University), J. Jay Pandian (IGCAR) and R. Srinivasan. Jay Pandian's lecture touched on several aspects of modern experimental support systems that can be configured using currently available PCs and associated software. He dealt at length on embedded systems and virtual experiments also. The afternoon sessions, lasting about two and a half hours on both the days, were devoted to demonstration of the kits and related physics experiments to groups of teachers, each about 8 in number. By rotation, all the groups were shown all the kits and experiments. The teachers had been provided with a detailed manual on the kits and experiments much before the workshop. Hence they could come prepared for the workshop with knowledge about the working of the kits and experiments, and also have discussions at the time of demonstration.

At the concluding session, the teachers in their feedback opined that they were largely benefited by the workshop and wished that they were involved in hands-on refresher courses in future. Some expressed the view that although the kits and other aspects covered in the workshop were useful, there may be stumbling blocks in changing existing curricula and introducing such approaches at many colleges and universities due to various reasons. They suggested that the IAS might take up the matter at higher levels with the universities and UGC, New Delhi to make the programme more effective.

Sarmishta Sahu and staff of the Physics Department, Maharani Lakshmi Ammanni College, Bangalore helped in running the two-day workshop successfully.

Following the workshop, IAS had also supported a two-day workshop on new trends in teaching physics, sponsored by the Indian Association for Physics Teachers, and convened by B. N. Chandrika at VVS I Grade College for Women, Bangalore.

\*A report on the two-day workshop on experimental physics, sponsored by the Indian Academy of Sciences, Bangalore in association with the Department of Physics, Maharani Lakshmi Ammanni College, Bangalore and held on 4-5 November 2005 at Department of Physics, Maharani Lakshmi Ammanni College.