



HUMAN RESOURCE DEVELOPMENT AT PIEAS - A BRIEF HISTORICAL ACCOUNT

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In this article the historical-role of the Pakistan Institute of Engineering and Applied Sciences (PIEAS) as the key Human Resource Development (HRD) centre of the Pakistan Atomic Energy Commission (PAEC) is described. This brief account covers a period of about 37 years, from 1967 to 2004 and goes on to describe the several transformations that a small and modest facility 'Reactor School' went through by first growing into the famous 'Centre for Nuclear Studies (CNS)' and later-on the present day PIEAS - as one of the most respected and prestigious degree awarding institute of the country. PIEAS was established to cater for the HRD needs of PAEC but now its scope has been broadened to a much wider extent to address the national needs. Presently PIEAS is imparting education to the postgraduate level in 7 different areas with a diversity that ranges from Nuclear Engineering to Nuclear Medicine, while several other graduate and postgraduate degrees are in the pipeline. The pioneering role of its founders and the award-winning contributions of PIEAS graduates are also presented.

Keywords: Reactor school, CNS, PIEAS, Academic programmes, Research activities at PIEAS, Civil awards

1. Introduction

The Pakistan Institute of Engineering and Applied Sciences - more widely known as PIEAS today - is a multi-faceted, degree-awarding university-level educational institution, with academic and training programmes being conducted at the highest level in certain specialized disciplines. PIEAS is the premier educational wing of the Pakistan Atomic Energy Commission (PAEC), for which it has been the major human resource development centre, leading up to the highest technical level. The breadth of the courses offered and types of project work at PIEAS are a reflection of the complexity and diversity of the programmes of the PAEC. During recent years other technical and scientific organizations of Pakistan, such as National Engineering and Scientific Commission (NESCOM), Dr A.Q Khan Research Laboratory (KRL), Pakistan Nuclear Regulatory Authority (PNRA), relevant sections of Pakistan Army and even the International Atomic Energy Agency (IAEA) are benefiting from the services of PIEAS graduates. At this point in time, the academic and training programme at PIEAS consists of four major components: (i) seven different Masters' programmes (equivalent to M.Phil), viz. M.Sc.'s in Nuclear Engineering, Systems Engineering, Nuclear Medicine, Materials Engineering, Process

Engineering, Medical Physics, and Information Technology ; (ii) very extensive Ph.D. programmes in a number of disciplines; (iii) a bachelor programme in computer and information sciences (BSCIS); and (iv) short training courses in specialised fields. The academic programmes of PIEAS are complemented by an active R&D programme that extends to working on industry-related projects. The educational infra-structure that has been created for this purpose is now so extensive that the Institute can aspire to pass on to the youth of the nation the expertise in a wide range of other fields, such as biomedical engineering, mechanical engineering, laser sciences, and computational physics, etc., that has been acquired over many decades by the PAEC. Several of these programmes are in the pipeline, and their implementation is currently at different stages, ranging from academic proposal to final approval from the Board of Governors of PIEAS.

2. PIEAS: The Evolution of Reactor School to CNS and Beyond

The story of the development of PIEAS is one of organic growth. Over the years, it has undergone several metamorphoses, each of which has radically changed many of its outward physical characteristics, while maintaining a basic continuity in its academic traditions and fundamental

objectives. It is an old institution with a new name.

The seeds for this institution were sown many years back in 1967, when a small training facility called the 'Reactor School' was established at the Pakistan Institute of Nuclear Science & Technology (PINSTECH) to conduct some courses in nuclear technology for the newly inducted engineers and scientists of the PAEC. The need for such a facility within Pakistan was being increasingly felt, because the problems of exclusive dependence upon foreign countries for all higher-level training and education in this field had become all too evident. PINSTECH was selected as the venue for the training programme because the expertise and experimental facilities required for such a specialised field were not available at any other institution in the country. By 1969, this training programme had acquired sufficient depth and breadth for Quaid-i-Azam University (then called the University of Islamabad), to accept it for the award of a Master's degree in nuclear technology, with Reactor School being formally affiliated to the University through its Physics Department.

To broaden participation and encourage greater competitiveness in this programme, a Fellowship programme was instituted in 1972, under which engineering graduates and M.Sc. degree holders in the physical sciences were invited to compete directly for the award of attractive fellowships for the duration of the course. On successful completion, they were to be inducted into PEAC as regular employees. This pattern of selection for the fellowships purely on merit, through an intensely competitive process involving written and oral examinations conducted on a national basis, has been successfully followed every year over the past quarter century. The almost palpable degeneration in our social milieu, which is evident all around us, has not been allowed to affect the integrity of our fellowship award process. In this zealous guardianship we, and our parent organisation, the PAEC, have been motivated by our acute awareness that the technology that we are dealing with is the most demanding of disciplines, and one in which any lowering of standards can have a disastrous impact.

By 1976, we had greatly broadened the scope of our programme, and it was renamed M.Sc. (Nuclear Engineering). The Reactor School itself was upgraded administratively to the level of a Division of PINSTECH and was renamed the 'Centre for Nuclear Studies (CNS)'. With its expanding activities, additional space became of

paramount importance, and therefore a separate building, located close to PINSTECH, was constructed, and the CNS shifted to it in 1978.

Almost a decade later, in its continuing evolution, its affiliatory relationship with Quaid-i-Azam University underwent a major change in 1986, and CNS was granted much greater academic autonomy by giving it the status of an 'affiliated college'. At about the same time it was also accorded financial autonomy by the PAEC, and plans for a major expansion in its activities were formulated. These were guided primarily by the realisation that in the prevailing geo-political environment, the indigenisation of nuclear power must be accorded the highest priority. The expansion of training facilities at CNS was to be an important component of this general objective.

With this greater freedom from the Quaid-i-Azam University and its parent organization PAEC, the-then CNS was able to introduce several new degree programmes. These included M. Sc. (Systems Engineering in 1988; M. Sc. (Nuclear Medicine) in 1989; and Ph.D.(Nuclear Engineering) in 1990. Later on, Ph.D. programmes in Systems Engineering and in Nuclear Medicine were embarked upon. In 2000, BS (Computer and Information Sciences) was started. In 2001, M. Sc. (Medical Physics) was launched at PIEAS, and M. Sc. (Information Technology) was initiated at the Computer Training Centre (CTC). A variety of shorter courses also continued to be added to the curriculum. Since 2002, M. Sc. (Process Engineering) and M. Sc. (Materials Engineering) have also been started.

To accommodate the new laboratories, lecture-halls and other facilities which were necessitated by this expansion programme, several new blocks of buildings had to be constructed and laboratory equipment acquired. This process is still continuing. At the same time, hostel space is also being steadily expanded: at present more than 300 Fellows can be accommodated here. The enhancement in its infra-structure that created the capability for offering programmes in many different fields meant that the institution had outgrown its old name, and a new one was considered desirable. Therefore, the institution's name was changed to "Pakistan Institute of Engineering & Applied Sciences" (PIEAS), in 1997. In April 2000, PIEAS was granted a degree-awarding university status by the Government of Pakistan to promote education and research at its highest standards in Pakistan.

Table 1. PIEAS - IMPORTANT LANDMARKS, 1967-2004.

1967	'Reactor School' established at PINSTECH.
1969	M. Sc. (Nuclear Tech.) initiated.
1975	Programme base broadened and renamed M. Sc. (Nuclear Engineering).
1976	'Reactor School' renamed as 'Centre for Nuclear Studies (CNS)'.
1988	M. Sc. (Systems Eng.) initiated.
1989	M. Sc. (Nuclear Medicine) initiated.
1996	National Physics Talent Contest launched.
1997	'CNS' renamed 'Pakistan Institute of Engineering & Applied Sciences (PIEAS)'. First Ph.D. degree in Nuclear Engineering awarded at PIEAS.
1999	Federal Cabinet approved proposal for grant of degree-awarding status to PIEAS.
2000	PIEAS is granted a degree-awarding university status by the Government of Pakistan. BS in Computer and Information Sciences initiated.
2001	M. Sc. (Medical Physics) initiated. M. Sc. (Information Technology) initiated at CTC. Pakistani Team Participates in the International Physics Olympiad.
2002	M. Sc. (Process Engineering) initiated. M. Sc. (Materials Engineering) initiated . Pakistani team wins bronze medal and honourable mention certificates in 34 th International Physics Olympiad.
2003	The ever-rising figure of PIEAS student body reaches 500.
2004	The faculty reaches 100 with more than 40 Ph.D. staff. The scholars pursuing Ph.D. programmes reaches 74.

The story of PIEAS would remain incomplete without mentioning the vision and role of Dr. Inam-ur-Rehman, who is truly considered the institute-builder and father figure in its development. During the 38 year history of PIEAS only 4 people served as head of the institute for different lengths of time. Mr. Muhammad Ahmed was the first in-charge of the Reactor School from 1967 to 1968. Dr. Inam's association with Reactor School and CNS spanned the period from 1969 to 1997 as its head. Almost all the achievements of PIEAS are a direct or indirect result of Dr. Inam's efforts to continuously improve the scope and standard of education and research at PIEAS in order to fulfil his dream to make it one of the world's renowned places of learning (this legacy is still with us). So much so were his contributions that, upon his superannuation in 1997, a symposium was held with the title 'Dr. Inam-ur-Rehman (AiK, S.I.): A model teacher, an institution builder and a great human being: The proceedings of this symposium carry a much more detailed story of the development of PIEAS; for example, see articles that are provided in references [1-4]. He is still associated with PIEAS as a 'Scientist Emeritus'. The degree-awarding status to PIEAS was granted during Dr. Abdullah Sadiq's (S.I.) headship - 1997

to 2003 - who was selected to be its first Rector. Dr. Muhammad Aslam succeeded Dr. Sadiq on his superannuation in 2003, and he is the present Rector of PIEAS. A summary of important landmarks in the history of PIEAS is provided in Table 1.

3. The Academic Programmes at PIEAS

Today, the academic and training programmes at PIEAS consist of four major components: (i) seven different Master's programmes (equivalent to M.Phil.); (ii) the very extensive Ph.D. programme in many disciplines; (iii) the bachelor programme; and (iv) short training courses in specialised fields. A brief account of each programme is presented hereunder.

3.1 M.Sc. Nuclear Engineering

The M.Sc. (Nuclear Engineering) programme is by far the oldest at PIEAS. More than 873 engineers/scientists have graduated from this programme over the past three decades, and today constitute the backbone of PAEC's nuclear power projects. A rather unusual feature of this programme is the immense diversity of fields represented among its participants. They are taken from almost all the engineering disciplines from

Mechanical, Electrical, Chemical, Metallurgy, etc., as well as several of the physical sciences, especially Physics, Mathematics and Chemistry. This diversity is just one of the imperatives of the multi-disciplinary nature of nuclear engineering itself. It has always been a stimulating challenge for the faculty to begin with a group of people with diverse backgrounds and travel with them towards the unified goal of understanding the complex systems and processes involved in nuclear technology.

3.2 *M.Sc. Systems Engineering*

In all the projects and working plants of the PAEC, and indeed in all modern industrial undertaking, computers, instrumentation and control systems play a central role. With the breathtaking rate of development in these fields, their importance is increasing rapidly. To cater to PAEC's manpower requirements in this vital area, an M.Sc. (Systems Engineering) programme was initiated here in 1988. Ten batches have already graduated from this programme and another two are currently enrolled at PIEAS.

3.3 *M.Sc. Nuclear Medicine*

The commencement of the M.Sc. (Nuclear Medicine) programme in 1989 has been a major departure for the institution from its original base of engineering and physical sciences. We were constrained to do so because with the expanding network of nuclear medical centres in the country there was an acute need for higher education in this area, and there appeared to be no other institution which could undertake this onerous task. In the design and implementation of this programme we were generously helped by many of the nuclear medical centres. The PAEC also provided us with the resources to call upon the services of some of the leading international practitioners in this field to help conduct courses as well as participate in the evaluation of research theses. Since initiation, four batches have graduated from the M.Sc. (Nuclear Medicine) programme, and the fifth is currently underway. The course has now matured as a nationally and internationally recognized programme, having been approved by the Pakistan Medical and Dental Council (PMDC) as a post-graduate qualification equivalent to an 'Intermediate Diploma', that is equivalent to an M.Phil. Degree for the purpose of registration in the subsequent Ph.D. programme - which has also been initiated here. Because of the very close association of several of the leading international experts in the field with its design and implementation, it has had a high degree

of visibility and acceptance in the international academic domain. This has been further reinforced in recent years by the work of some of our graduates who are now engaged in Ph.D. studies in several institutions around the world. The International Atomic Energy Agency (IAEA), recognizing the high academic standards of this programme, has included it amongst those that it actively sponsors in the form of allocation of Fellowships for attending it.

3.4 *M.Sc. Medical Physics*

The M.Sc. Medical Physics was initiated in 2001 with the view that PAEC at its different medical centres, as well as organizations such as the Pakistan Nuclear Regulatory Authority (PNRA), were in need of trained scientists with a degree in Medical Physics. This is a two-year, full-time, teaching and research programme with one year of course work and one year of clinical training and thesis project. During the first year, three semesters are devoted to course work. Each semester has at least four courses of total 12 credit hours. Then, in the final year two semesters are devoted to on-the-job clinical training, a thesis research work, final defence and a final oral examination.

3.5 *M.Sc. Materials Engineering*

The most outstanding achievements of PAEC are, indeed, in the field of Materials. In extractive metallurgy these range from prospecting to mining, leading to extraction and eventually refining of several metals. In physical metallurgy the expertise is in the fields of alloy development and structure-property-processing optimization; ceramics processing; research in high- and low-temperature materials; emerging technologies such as nano-scale materials, and so on. In order to disseminate this rich experience, and with a view to further enhancing both the quality and the quantity of research, an M.Sc. course in Materials Engineering was initiated in 2002.

This is a five-semester (24 months) full-time programme covering various aspects of Materials Engineering. It is conducted by the Department of Chemical and Materials Engineering in PIEAS. The emphasis is on the practical applications of materials science and engineering in order to address the national engineering needs. Areas of study include materials characterization; alloy development and phase control; composites; polymeric and ceramic materials and their synthesis; material production processes, etc.

3.6 *M.Sc. Process Engineering*

This five-semester (24 months) full-time programme covers the analysis and design, operation and control considerations of process systems that are generally dealt with in the field of Chemical Engineering. It therefore has a technical content relevant to the needs of the modern Chemical Engineering profession, and closely reflects the skills and capabilities of our current faculty. The programme has been arranged into three related yet independent streams: (i) Process Modelling and Control; (ii) Chemical and Mineral Processing; and (iii) Environmental Engineering, by providing a list of electives that allow students to place emphasis on a particular aspect of the curriculum. The PIEAS's Department of Chemical and Materials Engineering hosts the programme. M.Sc. Process Engineering was started in 2002, and since its inception the demand for Process Engineering graduates is ever-increasing and other strategic organizations are sending their nominees at an ever-increasing rate.

3.7 *M.Sc. Information Technology*

M.Sc. Information Technology was started at an affiliate centre of PIEAS, namely Computer Training Centre, in 2001. The term "informatique" was coined by the French in the early 1960s, and referred to the application of computing to the communication processes used by scientists in exchanging information and data among themselves. The domain represented by this new term was ultimately viewed by the French and other Western European countries as an application of computer science and, subsequently, the term has represented computer science. The Russians, however, embraced the term "informatika", and took a broader perspective. They believed that this emerging field was, in fact, a social science, concerning itself with the use of technology in various communities (e.g. Scientific) and the interaction of technology and human/organizational structures. In the United States, it took on a broad perspective and included "the cognitive, information- processing and communication tasks of industrial practice, education and research, including information science, and the technology to support these tasks." Informatics incorporates at least three domains: (1) technology and its application, (2) information organization and structure, and (3) human behaviour (especially communication). The intersection of these three domains attracts special attention in this field.

In the formulation and implementation of our academic programme, we have been guided primarily by two basic objectives. One is the fulfilment of the manpower development requirements of the PAEC; and the other is the commitment to the maintenance of academic standards at levels comparable to the best in the world. This involves a multi-pronged approach, of which one of the most important aspects is curriculum development. To ensure this, we have an ongoing process through which syllabi are kept under constant review, so that changes occurring in the field are rapidly incorporated into our courses of studies. Strengthening of the faculty and fostering their continuing professional growth is another vital element in this process. The development and maintenance of laboratories in the wide variety of highly sophisticated disciplines has been a very difficult task, but a necessary one. Consequently, PIEAS now has nearly 30 laboratories in different areas for conducting students' experiments as well as for R&D work.

Relevant details concerning the PIEAS Graduates and registered students of the above academic programmes are provided in Table 2.

4. **Ph.D. Programme**

The Ph.D. programme has been instituted relatively recently here (see Table 3), but is now receiving much more attention as the avenues for education at the highest level in technical fields are being increasingly blocked by the industrialised countries. Four Ph.D. degrees in Nuclear Engineering have already been awarded, and currently there are 73 doctoral candidates registered in different departments of PIEAS. In the future, we expect to see a substantial increase in this number. During past few months, and till end of 2005, this number has exceeded well over 100 registered Ph. D. scholars. The active research areas for doctoral programme are provided in Table 4.

5. **The B.S. Programme (Equivalent to B.Sc. Eng.)**

5.1 *Bachelor of Science in Computer and Information Sciences*

The four-year degree programme, BS (Computer and Information Sciences), is designed to provide essential knowledge and skills in computer science and its applications. Students are encouraged to develop their expertise in at least one of the following areas of specialization:

Table 2: The Student Body of Different M.Sc. Programmes

M. Sc. Level Course (Equivalent to M. Phil.)	Registered in 2004	Total Graduated to 2004
Nuclear Engineering	93	957
Systems Engineering	86	212
Nuclear Medicine	22	92
Medical Physics	28	23
Information Technology	19	31
Process Engineering	67	19
Materials Engineering	31	10
TOTAL	346	1344

Table 3: Scholars of Different Ph. D. Programmes

Course	Registered in 2004	Total Graduated until 2004
Nuclear Engineering	12	4
Electrical Engineering	13	1
Medical Sciences	04	-
Computer & Information Sciences	08	-
Physics & Applied Mathematics	16	-
Chemical & Materials Engineering	19	-
Mechanical Engineering	01	-
TOTAL	73	5

Software Engineering, Computer Networks, Databases and Information Retrieval, Data Communication, Numerical and Scientific Computations, and Artificial Intelligence. The student body of BSCIS programme is shown in Table 5.

5.1.1 Eligibility for Admission

In order to be eligible for admission in any four-year undergraduate degree programme, first division is required in the preceding academic career. A person holding Higher Secondary School Certificate from a Pakistani Intermediate and Secondary Education Board or an equivalent such as A-Level from any other recognized university is eligible for admission to any four-year undergraduate programme of study provided s/he meets the prerequisite course requirements of the department where s/he is seeking admission.

5.1.2 Credit Hours and Duration

According to rules, a student needs to complete a minimum of 120 credit hours to qualify for a four-

year undergraduate degree. Furthermore, a student is required to take a minimum of 9 credit hour courses and a maximum of 22 credit hour courses in a semester, with the approval of the Head of Department. The minimum duration of such programmes is 8 semesters (48 months) and the maximum is 11 semesters (66 months). Normally, 15 credit hour courses and laboratory work are offered in each of the eight semesters.

The number of total student body of PIEAS has been increasing at a rapid pace since it was granted a degree-awarding status. Figure 1 shows this trend as a bar chart.

6. Short Training Courses in Specialised Fields

Besides the regular academic programmes, PIEAS has conducted a large number of courses on various specialised topics whenever a need for it is perceived within the PAEC. The length of these courses has varied from 2 to 18 months, and the areas covered have included reactor

Table 4. Doctoral Programmes (Active Research Areas)

<p><u>Nuclear Engineering</u></p> <p>Key element of a viable energy policy for Pakistan</p> <p>Design and development of portable radiation monitors</p> <p>Modelling of nonlinear material damage processes</p> <p>Simulation of rigid body penetration in plates</p> <p>Numerical techniques for neutron spectrum adjustment of MTRs</p> <p><u>Chemical and Materials Engineering</u></p> <p>Modelling and analysis of fuel gas treatment from fossil fuel based combustion</p> <p>Advanced polymeric composites</p> <p>Synthesis of metal and metal oxide nano-particles</p> <p>Computational modelling of natural convection heat transfer from an assembly of vertical cylinders</p> <p>Processing of advanced materials through electrometallurgy by using unconventional electrolytes</p> <p>Development of polyimide based nano-composite materials via sol-gel techniques</p> <p>Analysis of inhomogeneous deformation under compressive loading</p> <p><u>Electrical Engineering</u></p> <p>Interoperability of Pakistan Telecommunication Company Limited's equipment for central monitoring and diagnostics</p> <p>Design and development of a portable mobile robot</p> <p><u>Nuclear Medicine</u></p> <p>Role of nuclear medicine for detection of patient <i>foramen ovale</i></p> <p>Role of Tc-99m Ciprofloxacin in the detection of endocarditis</p> <p>Change of diastolic function parameters between stress and rest gated myocardial perfusion SPECT studies: correlation with perfusion parameters</p> <p>Evaluation of UBI- (29-41) for imaging of bacterial infection in human subjects</p> <p><u>Physics</u></p> <p>Lasers and quantum optics</p> <p>Development and applications of lasers</p> <p>Laser-tissue interaction and wave propagation in random media</p> <p>Modelling and simulation of corrosion product activity in primary circuits of Pressurized Water Reactors under flow rate perturbations</p> <p>Modelling of corrosion product activity in primary circuits of Pressurized Water Reactors under power perturbations</p> <p>Application of CR-39 detector in Uranium exploration</p> <p>Radon transport studies using solid state nuclear track detectors</p> <p>Measurement of radon activity concentration in dwellings in different parts of Pakistan</p> <p>Monte Carlo simulation of fission product release rates from fuel to primary coolants of Pressurized Water Reactors</p> <p>Ultra fast kinetic and spectroscopic studies of biomedical samples</p> <p>Study of physical mechanisms of Regenerative Sooting Discharges</p> <p><u>Computer Science</u></p> <p>Reconstruction of 3D images from 2D images by shape from shading techniques</p> <p>Automatic evaluation of endothelial function using vascular ultrasound images</p> <p>Development of algorithms and computerized grammar of Urdu for the machine translation between English and Urdu languages</p> <p>New neural network-based architectures for non-linear time series prediction</p> <p>Filtered and transformation based image processing techniques</p> <p>Development of parallel numerical algorithms</p>
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Table 5. The Student Body of BSCIS Programme

Course	Registered	Graduated to 2004
Bachelor of Science (Computer and Information Sciences)	140	33

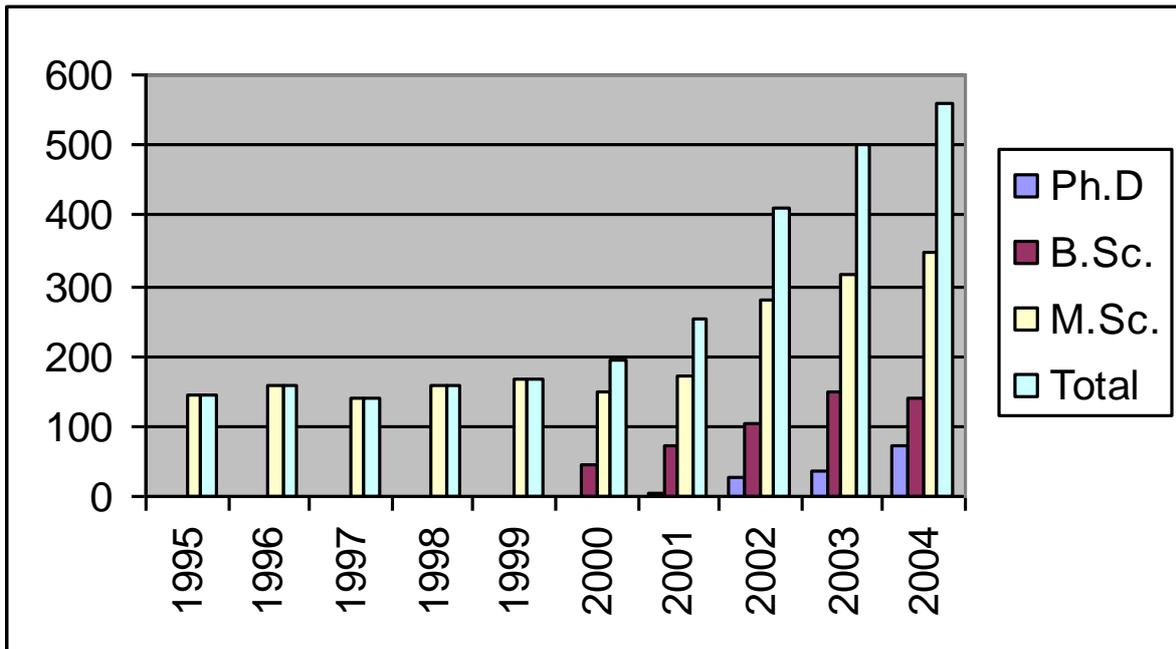


Figure 1. The year-wise rise of student body at PIEAS

supervision and operation, health physics, medical physics, laser technology, vacuum technology, computer applications and advanced reactor safety. Scientists and engineers who are directly inducted into the PAEC generally require an introduction to issues and techniques pertaining to nuclear power. During the past few years, PIEAS has conducted a number of short courses for these purposes that are called the 'Nuclear Orientation Programme'. For technicians and scientific assistants, the 'Basic Nuclear Orientation Course' has been conducted here on a regular basis for many years now, and it has played an important role in increasing the efficiency and versatility of personnel at that level. More recently, short courses have been given a modular format and are now being offered for a wider variety of participants, even outside the PAEC. For example, our expertise in Computer Aided Design/Computer Aided Manufacture is now being disseminated in modular courses being frequently offered to the

employees of the PAEC as well as and other organizations the general public.

7. PIEAS Infrastructure

PIEAS is among a congregation of R&D establishments of the PAEC located at Nilore, Islamabad. It has a large campus, spread over 150 acres of land with academic blocks, laboratories, workshops, a computer centre, a library, an auditorium, student hostels, a cafeteria, sports facilities and houses for faculty and staff. Table 6 provides the main features of the PIEAS campus.

It will be evident from all of the above that PIEAS is engaged in manpower development programmes at many levels and in many directions, but the major thrust of our efforts is directed towards postgraduate academic work. At this level, research and development activities become an integral part of the educational process. We therefore try to ensure that all of our Masters' graduates get some experience of

Table 6. Main features of PIEAS campus

<p><u>Location</u>: : Nilore, Islamabad (25 km on Lehtrar road due south-east of the Federal Capital)</p> <p><u>Campus Area</u>: : About 150 acres</p> <p><u>Academic Buildings</u>: 8 blocks with a total covered area of about 1,60,000 sq. ft. housing:</p> <ul style="list-style-type: none">• 400-seat auditorium• 11 lecture halls• 4 conference rooms• 27 laboratories• 4 workshops <p><u>Students Accommodation</u>:</p> <ul style="list-style-type: none">• Separate boys and girls accommodation blocks• 4 hostel blocks (200 rooms) for single students & 10 two-bedroom houses• A new hostel accommodation is for 100 students with double occupancy <p><u>Computer Centre</u></p> <ul style="list-style-type: none">• Computers (300+) & workstations (7) on the campus and in the hostels are connected through local area network using fiber optics cables.• Scanners, printers, plotters, etc.• Several multimedia and overhead projectors <p><u>Library</u></p> <ul style="list-style-type: none">• PIEAS Library with more than 10,000 books• Access to PINSTECH library which is the national resource centre for physical sciences with more than:<ul style="list-style-type: none">• 32,000 books & 120 current journals• 50,000 back issues of journals• 1,000,000 technical reports
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independent work on an R & D project relevant to their background and interests. Faculty members participate actively in the supervision of this work, besides contributing to other projects. To facilitate collaboration amongst faculty members on R & D work, a number of technical groups have been formed within PIEAS, which cover almost the whole spectrum of disciplines involved in nuclear energy applications. Faculty members are also encouraged to undertake collaborative work with other PAEC establishments, as well as with other universities and R & D organizations at home and abroad. A number of such efforts are underway, and fruitful results have been obtained from many of them. PIEAS faculty members have published more than 400 papers in international journals. A large part of the R&D work has also been reported in the hundreds of Masters' dissertations and technical reports that are regularly prepared.

At PIEAS, traditionally, the focus has been on education, training and academic R&D. But, recently, efforts have also been made to apply the expertise available here to industrial R&D. In this context, several products of industrial use, such as PC-controlled drilling machines, PC-controlled milling machines, and robotic manipulators have been developed. Specialized systems for educational purposes such as PC-controlled multi-variable tanks (containers holding different water level) have also been supplied to various institutions.

PIEAS has had interactions of several kinds internationally. A large number of students from Muslim countries have benefited from the academic offerings here, and many of them are now playing a significant role in this field in their own homelands. For some of our courses we have

Table 7. List of civil awards obtained by PIEAS graduates

Sr. No.	Name of Award	Number of Awardees
1.	Sitara-i- Imtiaz	3
2.	Tamgha-i-Imtiaz	5
3.	Pride of Performance	18

used the services of foreign experts, particularly in newly developed areas. Of course, most of our faculty members have had extensive exposure to the universities and research laboratories in industrialized countries. This international interaction has greatly helped in ensuring the maintenance of high standards at the institution.

Being part of an institution of higher learning, we at PIEAS, besides responding to the current needs of the PAEC, must also keep our antennas tuned to the future. Any vibrations that we receive from that realm must be quickly amplified, analysed, interpreted, and presented in a perceptible format. So, a part of our energies has to be devoted to the development of fields which may not appear to be in the mainstream of technology in Pakistan today, but which, in our estimation, may become indispensable for our technological development tomorrow. It is with this end in view that we also have an ongoing effort for the preparation of proposals for new academic programmes to fulfil the likely needs of the future.

From time to time PIEAS faculty members have been awarded national and international awards. Dr Shahid Qamar was awarded the coveted Professor Raziuddin Siddiqui Gold Medal and Cash Prize of the Pakistan Academy of Sciences for the year 2001 for his outstanding research contributions in Physics. Dr Nasir Ahmed was awarded, the best university teacher award by the UGC (now HEC) in 2002 for his contributions in teaching and research. A list of some other

national civil honours conferred on PIEAS graduates is given in Table 7.

8. Conclusion

Having undergone an intensive development programme over the last three decades, PIEAS now has a very sound academic infrastructure that can be compared with that in any Pakistani university. This consists of a highly qualified faculty; laboratory facilities in many different areas; a sophisticated computer centre, library and workshops; a large number of lecture halls; hostels and recreational facilities for students; and an administrative structure with extensive experience of dealing with all academic requirements. Thus, it possesses all the ingredients required for a University-level institution. In fact, the quality of infrastructure at PIEAS is in many ways unique amongst Pakistani educational institutions. This institution is now fully geared to provide educational services on a wide scale. It represents a large reservoir of experience and expertise that has the potential to make substantial contributions to national development. Its reorganisation, converting it into a degree-awarding institution, has enabled it to function at an optimal efficiency and to utilise more fully its full potential for contributing to the national needs in higher education.

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