Pakistan Institutional Excellence Project

(Cooperative Agreement No. Pakistan 391-0498-A-00-0802-00)

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Cooperating Institutions:

- University Grants Commission, Islamic Republic of Pakistan
- U. S. Agency for International Development
- Midwest Universities Consortium for International Activities, Inc. (MUCIA)

SIX YEAR DEVELOPMENT PLAN

ELECTRICAL ENGINEERING DEPARTMENT

UNIVERSITY OF ENGINEERING AND TECHNOLOGY

Lahore, Pakistan

May 1991

Lead University:
Purdue University
West Lafayette, IN

PROJECT PURPOSE

The purpose of the Institutional Excellence Project (IEP) is to improve Pakistan's capabilities to develop, adapt, and utilize advanced scientific and technology innovations in support of economic and social development. This purpose will be achieved by strengthening research, teaching and outreach in selected science and technology departments in cooperating universities. The primary mechanisms to be employed in this effort will be the establishment of formal and informal linkages among Pakistani and U.S. scientists and their institutions, education and training and a small grants research program.

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PD-ABF-075

INSTITUTIONAL EXCELLENCE PROJECT (IEP)

SIX-YEAR DEVELOPMENT PLAN
for the
ELECTRICAL ENGINEERING DEPARTMENT
UNIVERSITY OF ENGINEERING AND TECHNOLOGY
LAHORE, PAKISTAN

May 1991

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Prepared by:

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International Activities, Inc. (MUCIA)

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EXECUTIVE SUMMARY

The Institutional Excellence Program (IEP) of USAID is designed to develop the research programs of several academic units in Pakistan that have the potential to perform at international standards of quality. Such development is expected to promote technology transfer to local industry and thus to support economic development. IEP is a unique initiative in that its emphasis is not simply on manpower training or on commodity procurement. Rather, its objective is to establish within selected pockets of intellectual strength working linkages with the respective professional fields, both local and international, that will promote long-term interactions and continuing flow of information. It is anticipated that such linkages will sustain the institutions and stimulate their continued development after the AID program has ended.

One candidate for participation in IEP is the Electrical Engineering Department at the University of Engineering and Technology, Lahore (UET). This report presents an assessment of UET's current situation and particularly its capacity to participate in IEP. Subsequent to an affirmative conclusion, the report goes on to propose an appropriate program for UET under IEP that will strengthen the institution in areas that are most likely to be sustained and to have a significant impact on local economic development.

Although UET is beset by the problems that plague all of Pakistan's public higher education sector, the university is the strongest engineering school in the country. As a major educational institution in Punjab, it attracts the best students in the nation's most populous province and serves as the major source of engineering manpower for both the semi-private utilities such as WAPDA as well as private industry. Therefore, it offers a convenient entree for upgrading technology in Pakistan. The Electrical Engineering Department attracts the strongest students coming to UET, so that department is a key resource.

Although the physical facilities are poor, the personnel of the Electrical Engineering Department at UET are fairly well qualified. A number of the faculty hold Ph.D. degrees from abroad, and the department is already operating its own postgraduate degree program. The strongest group in the faculty is in the computer-engineering area, even though their computing facilities are quite modest. This strength has been sustained by international linkages that provide periodic leave

opportunities, and international-level research publications have resulted. This capability has not yet been exploited by local industry, however. Electronics and communications are related interest areas in the faculty that are not as well developed on the research level but which offer opportunities for local industrial applications.

The Assessment Team recommends that UET be included in IEP, with the focal areas being computers and their applications in industrial electronics and communications. IEP resources should be used to provide facilities, to train staff, and to provide technical assistance. Special emphasis should be placed on establishing lasting linkages with professional colleagues in the U.S. and on attracting research contracts from industry in Pakistan. Because another USAID project to support energy-related education will be providing a significant portion of the required commodities, IEP may focus on establishing linkages and on effecting required changes in institutionalized procedures. Contacts with industry will be developed through seminars, workshops, and graduate student thesis research projects, which should generate more financial support for the university, and faculty training will be provided concerning effective methods of research administration.

One interesting aspect of the proposed program is the use of a sandwich Ph.D., in which young teaching staff at UET would begin their Ph.D. work in Lahore, take some classes and conduct research at an American university under co-supervision of American and Pakistani professors, and then complete their degree requirements at UET. Two advantages of this program are that the thesis topic can be tailored to meet Pakistan's local needs and that the participant is more likely to return to UET than are those who receive a foreign Ph.D.

The estimated budget for this six-year project amounts to $4.22 million. It is proposed that expenditures for equipment procurement and research projects be subject to annual review of project progress. UET faculty will be expected to present specific proposals to the review team.

At the end of the six-year project, the expected outcomes include a general upgrading of the faculty in terms of training and of computer and other research facilities. More importantly, lasting professional linkages will be established that will sustain increased research productivity. The other important outcomes will be closer

ties with industry, involving frequent seminars, workshops, and funded graduate-student research projects on topics relevant to industrial development.

1. INTRODUCTION

1.1 BACKGROUND

1.1.1 Mission of the IEP

The USAID-Pakistan Institutional Excellence Program (IEP) is a long-term development program that aims to strengthen selected academic institutions in Pakistan for the purpose of supporting national economic development. In particular, the program is intended to enhance postgraduate education and research in critical disciplines through staff training, information exchange, technology transfer, cooperative research projects, upgrading of facilities, and formation of university-industry linkages. The IEP's emphasis on the latter aspect of the program makes it a novel effort in institutional development. The program is intended to foster active collaboration by Pakistani faculty both with American colleagues and with private-sector and government organizations in Pakistan. If it is successful, the linkages that are formed will ensure that such collaboration will continue after IEP itself has ended.

In order to implement the IEP, USAID has entered into a cooperative agreement with the Midwestern Universities Consortium for International Activities (MUCIA), which is a consortium of eight major public universities located in the midwestern United States. For the purposes of this project, five other American universities are also collaborating with MUCIA. MUCIA, with Purdue University serving as the lead institution, has responsibility to work directly with the participating Pakistani organizations to accomplish the goals of the program.

Although the IEP is planned to support up to eleven institutions over a ten-year time span, the implementation will be phased such that each participating organization will be involved directly for only six years. It is expected that only four or five institutions will initiate activity in 1991. Candidate institutions have been identified by Pakistan's University Grants Commission (UGC) on the basis of their relevance to

national economic development and their capacity to participate. The Electrical Engineering Department of the University of Engineering and Technology (UET) in Lahore, Punjab Province, is among these candidates.

1.1.2 Role of Assessment Teams

To help USAID and the UGC select the participating units, MUCIA is fielding assessment teams to visit six or seven candidate institutions in order to assess the degree to which each administration's capabilities and objectives accord with IEP objectives; to evaluate the productivity record of the faculty with respect to education and research; to survey the strengths and needs of the department with respect to physical facilities, research and instructional equipment, secretarial and technical support staff, faculty training, and current and potential professional links with the private sector and government research labs. Each assessment team works with the faculty to formulate a subdiscipline-selective departmental development proposal that outlines the envisioned scope of staff training and facility improvements, a six-year implementation schedule, and a provisional budget. The assessment report/development proposal for all institutions are compared by the IEP, UGC, and USAID administrative personnel as a major criterion for selecting institutions that are likely to flourish most with IEP assistance and to accelerate Pakistan's integration into the world's technological and economic culture.

The MUCIA assessment team for electrical engineering at UET Lahore was composed of Professor Richard Marleau and Professor Thomas Chapman of the University of Wisconsin-Madison and Professor Oner Yurtseven of Purdue University-Indianapolis. Dr. Chapman served as the team leader. The team was joined also by Professor Sadaruddin Shaikh of Mehran University and for part of the time by Professor George McCormick of Iowa University and Dr. Nick Poulton of Purdue University, both from the MUCIA Islamabad office, and by Dr. John Monagle of USAID, Islamabad. After meeting in Islamabad for several days of orientation, the team traveled to Lahore where it visited UET from October 29 until November 12, 1990. While in Lahore, the team met the university administration, most of the electrical engineering faculty, and some students. It also visited several industrial organizations.

During its deliberations, the assessment team kept in mind two guiding principles of the Institutional Excellence Program. First, the program is not intended to be a general institution-building exercise. Although all parts of Pakistan's higher education system are in need of help, the IEP is targeted to support pockets of strength, to make them stronger and hence models for the rest of the system. Specifically, the IEP will attempt to develop strong teams of faculty in selected subdisciplines with resources and networks that will allow them to sustain and indeed to propagate academic excellence in Pakistan. Second, it is the intent and stated policy of USAID that its support should nurture economic development through free markets and individual initiative. Thus, the team sought to emphasize technologies that are likely to be implemented for improvements of efficiency and quality in the private-business sector.

1.1.3 Conceptual Organization of This Report

The purpose of this report is to summarize the findings of the assessment team and to present its recommendations. The report first presents a quantitative description of the current status of the electrical engineering department in terms of staffing, programs, students, facilities, and resources. The significance of these findings is then considered in a synthesis of the issues that arise in comparing the current status of the department with its stated mission and goals. Based on that comparison and consideration of local needs, a strategy for change is presented. This strategy is developed by assigning appropriate priorities among desirable objectives and identifying the contributions that both the IEP and UET can make to accomplish the desired outcomes. Finally, the report proposes a program for enhancing the effectiveness of the electrical engineering department, complete with a summary of appropriate inputs and the corresponding time frame.

1.2 GOAL OF ELECTRICAL ENGINEERING DEPARTMENT, UET LAHORE

The University of Engineering and Technology Lahore is the oldest and largest of the four major engineering schools in Pakistan. The UET electrical engineering department is a key institution in Pakistan's technological development, producing nearly 300 B.S. graduates this year, and it is the only one in the country authorized to grant the Ph.D. degree. Its location in Lahore, the capital of the populous Punjab Province, makes UET a critical resource for the economic development of this major region.

While electrical engineering at UET has a major mission in educating a large number of undergraduate engineers, its goal most relevant to the IEP is its intent to establish a Center for Postgraduate Studies in Electrical Engineering to improve the efficiency of its M.S. and Ph.D. programs and to encourage more research activity by the faculty. Postgraduate programs have been in place for 25 years, but lack of facilities and resources, among other factors, has limited their effectiveness. Out of 228 students admitted to the graduate program, only 25 M.S. degrees and one Ph.D. have been granted. By upgrading faculty capabilities, by providing resources and facilities for research and instruction in key areas, and by stimulating linkages with the industrial sector, the IEP can support UET's effort to improve. Production of a significant number of advanced degrees and expanded research effort focused on problems relevant to local industrial activity will support faster economic development.

It is true that physical facilities for undergraduate education at UET are appallingly poor and that their amelioration is imperative for quality and efficiency to improve. It is therefore unfortunate that the IEP cannot address that problem directly. On the other hand, it is the premise of the IEP that developing poles of excellence within the teaching faculty will have a greater long-term effect on undergraduate education than construction of new teaching labs and provision of instructional equipment. The major problem with undergraduate education in Pakistan is a lack of discipline and commitment among students and faculty alike. **If pockets of outstanding faculty teams, dedicated to professional excellence, can be developed in the universities, their deportment will be a model for their colleagues and students. Furthermore, their effectiveness in research will inspire the confidence of both government and the private sector so that more resources will ultimately be directed to the department.** This has been the experience of high-quality departments in other countries.

With regard to the facilities for the undergraduate program, it should also be noted that a large equipment grant from USAID to support energy-related education is concurrently being planned for UET. Therefore, the planning of IEP can be coordinated with that program so that the two contributions are complementary.

There is growing demand for postgraduate education in Pakistan for several reasons. Because of burgeoning university enrollments and poor quality of instruction and questionable grading practices, a B.S. degree no longer ensures good employment prospects. Furthermore, the government and government-owned companies now pay employees a bonus for holding an advanced degree. At the same time, the employers who must pay this bonus are demanding qualitative improvements in the capabilities of the employees who obtain a graduate degree. Therefore, the department is under pressure to provide an efficient, high-quality M.S. program. There is also demand for a Ph.D. program, especially for upgrading teaching staff.

The department's opening proposal to establish a Postgraduate Center at UET calls for the establishment of five separate laboratories:

1. Power engineering
2. Electronics engineering
3. Computer engineering
4. Communications engineering
5. Integrated computation

At least the first four of these labs would be sub-divided into subsections to accommodate the specialized research interests of individual faculty. **Thus, the department initially proposed that ten or more research labs be equipped to accommodate the activities of a like number of graduate-program faculty.** (Only the teaching staff with post-graduate degrees themselves will supervise graduate-student research.) **Instead, the IEP assessment team suggests that the Postgraduate Center be organized in only two or three divisions initially, building on strength and teamwork and focussing on selected technologies that are likely to impact on local industrial development.** That is, the department should consider both consolidation and emphasis on priorities, rather than uniform distribution of resources.

Although no comprehensive data are readily available, it appears that many of the UET electrical engineering graduates in the past have gone to work for the Water and Power Development Authority (WAPDA, the state-owned power company) and other government agencies. Accordingly, the emphasis in the department has been in electrical power, its generation, transmission, and use. Many of the older faculty specialize in this area, including consideration of high-voltage phenomena, and it

appears at the top of the list of proposed laboratories. While power and energy considerations in general will continue to be important in the economy and infrastructure, it does not seem to be an area requiring greatly expanded research at Lahore.

The IEP's investment will bear greater returns if it is concentrated on newer areas of technology that are just starting to be established in Pakistan. The assessment team recommends that UET be included for participation in the first phase of IEP if the following three areas are emphasized:

1. **Computer engineering**
2. **Telecommunications**
3. **Electronics**

The first priority is clearly **computer engineering**, not only because of the ubiquity of computers in modern technology, but also because the strongest research capability in the department lies in this area. Faculty in this area already have international linkages, and UET can clearly be the major center in Pakistan for research on computer systems and computing. The other area with immediate capability for serious research is **communications engineering**. It is recommended that the IEP provide support so that UET can proceed to develop a pilot Ph.D. program covering these two areas. Included in support of the computer area would also be the establishment of general computation facility for the department.

The third area identified for support, **electronics**, is not one in which the faculty has extensive experience so there is little prospect for world-class research in the near future. On the other hand, applications of electronics are very important in the modernization of industry, through automation and control instrumentation. Furthermore, several members of the faculty have shown initiative in introducing basic electronics into undergraduate laboratories and projects. There are opportunities, with staff training and provision of facilities, to upgrade the department's capability in electronics such that a useful M.S. program can be established and constructive projects can be developed with industry. With cooperation and teamwork within the department, this increased capability can be combined with the strength in computers and the interests in communications, instrumentation, and even power to contribute significantly to technological development in Pakistan.

2. STATUS

This chapter presents a detailed description of the current status of the Electrical Engineering Department at the University of Engineering and Technology Lahore. During its two-week visit at UET, the Assessment Team obtained a considerable amount of information about various aspects of the institution and its current program. This information, which is summarized in Section 2.1 and analyzed in Section 2.2, has been used to assess the department's capacity to participate in the IEP and to plan an appropriate development program. It will also be useful as a baseline in future assessments of progress and the program's impact.

2.1 EXISTING PROGRAM

2.1.1 Faculty Expertise and Background

Faculty expertise of the Electrical Engineering Department of UET appears to have four focus areas, namely power, communications, electronics and computers. A summary of faculty characteristics is presented in the following table. Detailed information about the faculty members is given in Appendix 5.7.

Faculty Background and Research Interests

Name/Sex	Rank	Age	Highest Degree	Institution	Area	Research Interests
S. M. Haque (M)	Prof., Dean	57	Ph.D.	UMIST (UK)	Power	High-voltage Engr.
K. E. Durrani (M)	Prof., Chm.	47	Ph.D.	UMIST (UK)	Power	Power System Design
A. Hameed (M)	Prof.	48	M.S.	UET (PAK)	Power	Industrial Power Systems
T. A. Shami (M)	Prof.	46	Ph.D.	UMIST (UK)	Power	Power System Protection
N. M. Sheikh (M)	Prof.	41	Ph.D.	UET (PAK)	Communications	Signal Processing
A.R.S. Bukhari (M)[1]	Prof.	46	Ph.D.	Med. Dental Univ. (JAP)	Electronics	Biomedical Instrumentation

[1] On extended leave to Saudi Arabia.

A. H. Shah (M)	Prof.	46	M.S.	Loyola (US)	Electronics	Electronic Circuit Design
M. A. Chughtai (M)	Prof.	40	Ph.D.	UMIST (UK)	Computers	Design & Interfacing Techniques
S. H. Bokhari (M)	Prof.	39	Ph.D.	U. Mass. (US)	Computers	Parallel Proc./Networks
H. T. Hassan (M)	Assoc.Prof.	37	M.S.[2]	UEP (PAK)	Power	Power Transmission
M. Yasin (M)	Assoc.Prof.	49	M.S.	UET (PAK)	Power	Voltage Distr. Over String Insulators
A. Hussein (M)	Assoc.Prof.	41	M.S.	UET (PAK)	Power	Power
M. Saleem (M)	Assoc.Prof.	41	M.S.	UET (PAK)	Communications	UHF & Comput. Comm.
M. Saeed (M)	Assoc.Prof.	41	M.S.	UET (PAK)	Electronics	Microprocessors
J. Iqbal (M)	Assoc.Prof.	41	M.S.	UET (PAK)	Electronics	Electronics
M. Suleman	Assoc.Prof.	43	M.S.	UET (PAK)	Electronics	Electronics
A. A. Khan	Assoc.Prof.	48	M.S.	Keiko Univ. (JAP)	Electronics	Illumination
M. A. Iqbal	Assoc.Prof.	39	Ph.D.	UET (PAK)	Computers	Parallel Proc., Distrib. Computers
I.A. Goryia	Asst.Prof.	42	M.S.	UET (PAK)	Electronics	Electronics
A. Farooq	Asst.Prof.	43	M.S.	UET (PAK)	Electronics	Commun., Biomed Instrumentation
M. N. Ayyaz[3]	Asst.Prof.	30	M.S.	UET (PAK)	Computers	Computer Engineering
H. N. Ahmad	Asst.Prof.	43	B.S.	UET (PAK)	Power	Transmission
M. Ahmad[4]	Asst.Prof.	30	B.S.	UET (PAK)	Electronics	Control & Electronics
T. Azhar	Asst. Prof.	30	B.S.	UET (PAK)	Electronics	Solid State Devices
A. H. Khan	Asst.Prof.	34	M.S.	U. Penn. (US)	Electronics	Neural Networks
Z. A. Khan	Asst.Prof.	36	Ph.D.	UMIST (UK)	Power	Microprocessor Appl.
H. Ali	Asst. Prof.	46	B.S.	UET (PAK)	Power	Power Distribution

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[2] Going to UMIST for Ph.D., January 1991.

[3] Ph.D. in Progress at Syracuse University, N.Y.

[4] M.S. and Ph.D. in progress at University of Texas.

Z. M. Alvi[5]	Asst.Prof.	30	B.S.	UET (PAK)	Computers	Computers
W. M. Khan	Asst.Prof.	39	M.S.	UET (PAK)	Communications	Image Processing
S. A. Qureshi[6]	Asst. Prof.	30	B.S.	UET (PAK)	Power	Power
M. Yousaf	Asst Prof.	47	B.S.	UET (PAK)	Power	Power & Indust. Electronics
S. H. Shami[7]	Asst.Prof	27	B.S.	UET (PAK)	Electronics	Network Analysis
M. Zulfiqar	Asst.Prof.	49	B.S.	UET (PAK)	Electronics	Electronics
I. Ahmed	Lecturer	28	B.S.	UET (PAK)	Computers	Feedback Control
A. Abbas	Lecturer	28	B.S.	UET (PAK)	Communications	Telecommunications
K. M. Hassan	Lecturer	29	B.S.	UET (PAK)	Computers	Industrial Automation
N. A. Mufti	Lecturer	27	B.S.	UET (PAK)	Communications	Artificial Intelligence
M. Imran	Lecturer	28	B.S.	UET (PAK)	Electronics	Remote Sensing

- POWER

In the power area, there are four full professors, three associate professors and four assistant professors. Dean S. M. Haque has specialty areas in high-voltage engineering, power systems, power system protection, energy and electrical machines. He received his Ph.D. in 1969 from the University of Manchester Institute of Science and Technology (UMIST) and published five research articles that spanned from 1960 to 1974. He has supervised several master theses, and he currently directs two postgraduate students.

The chairman of the department, Dr. K. E. Durrani received his Ph.D. from the UMIST also in 1970. His specialty areas are analysis and design of power systems, electrical machine analysis, and system modeling. He published a textbook, *Electrical Machine Analysis*, in 1974 in addition to his six scholarly publications.

[5] M.S. in progress at Bradford University, UK.
[6] M.S. in progress at UMIST, UK.
[7] On indefinite leave for personal reasons.

Professor A. Hameed received his M.Sc. in Engineering from UET in 1974, and he published six works during the years 1970-1974. After a gap of 13 years, he has produced about 9 additional publications from 1987 to 1990, mostly in the UET Research Journal. His specialty areas are power system analysis, electrical machine analysis, design and analysis of industrial power systems. He has supervised several masters theses.

Dr. T. A. Shami received his Ph.D. in 1985 from the University of Manchester and produced six publications, all during the 1984-85 period. His specialty areas are power system protection, power system transients, high voltage engineering and dielectrics. Thus, out of four senior faculty members, only Professors Shami and Hameed would be expected to devote time for research since both Dr. Haque and Dr. Durrani are full-time administrators. Dr. Haque plans to retire in two years, and one of the full professors is expected to become dean in 1992. Dr. Durrani indicated interest in renewing his research effort if administrative release time is given in the future.

There are three associate professors in the power area. H. T. Hassan completed his M.Sc. in 1986 at UET and has a scholarship to complete his Ph.D. at the University of Manchester. His specialty areas are power transmission, distribution of electrical energy, power system analysis and electrical machine analysis. The other two associate professors, M. Yasin and A. Hussein are in the high voltage measurement and electrical machines areas. Their participation in the Ph.D. program appears remote at this time.

Among the assistant professors in the power area, only M. Z. A. Khan has a Ph.D. received from the University of Manchester in 1990. He specialized in microprocessor applications in power supplies and power system analysis. He is young and enthusiastic. He is expected to develop and run the Energy Management System Laboratory with the "energy group" funding the department will receive from USAID.

H. N. Ahmad is in the process of completing his masters in the power supply area. He is expecting to receive a scholarship from the Canadian government to work on his Ph.D. in the transmission and distribution of high voltage.

S. A. Qureshi is presently studying for his Ph.D. at the University of Manchester in power systems. He is expected to complete his work in two to three years.

H. Ali is about to finish his masters in power distribution, and he plans to continue his Ph.D. at UET. The last assistant professor in the area is M. Yousaf who is still working towards his masters. He is not expected to pursue a Ph.D. due to his advanced age. None of the six current lecturers is in the power area.

Consequently, the power group has two senior faculty, A. Hameed and T. A. Shami, and one junior faculty, M.Z.A. Khan, to develop and expand the research potential of the group. With the return of S.A. Qureshi and H.N. Ahmad with their Ph.D.'s, and the local Ph.D. of H. Ali, this group will form a strong team in power system analysis, electrical machines, microprocessor- controlled power systems, and high-voltage engineering.

- COMMUNICATIONS

The only senior faculty member in the communications area is Dr. N. M. Sheikh who obtained his Ph.D. at UET in 1979, the first and only Ph.D. granted by the department so far. His specialty areas are signal processing, telecommunications, satellite communication, data transmission and line-of-sight systems. He teaches most of the graduate-level courses in his area and supervises masters students. He has studied in Holland at the Phillips Research Laboratories and also participated in research activities in West Germany.

The only associate professor in communications is M. Saleem who completed his masters in 1979 at UET. He is currently in the Ph.D. program working with Dr. Sheikh and has a scholarship for two years of study at Denison University in the United States. He is interested, however, in participating in the IEP academic training program. His specialty areas are in computer communications, industrial electronics and UHF communications.

Assistant professor N. Ayyaz is in the process of completing his M.Sc. and Ph.D. at Syracuse University. The department is not clear what his specialty area is other than some aspect of communications.

Another assistant professor, T. Izhar, will complete his masters in the area of modular speech and digital data interfacing with M. Saleem. He intends to move to electronics, VLSI and solid state electronics for his Ph.D. work.

W. M. Khan is an assistant professor who has completed his masters degree in 1978 at UET. His areas of interest are speech and image processing as well as parallel processing and neural networks. He has applied for a government scholarship to study for a Ph.D. abroad specializing in neural networks.

Lecturer A. Abbas has a Pakistani government scholarship for masters and Ph.D. study in the U.S. He plans to work in the communications area.

Another lecturer, N. A. Mufti, who joined the department in March 1990, plans to work in the communications area also for his masters and Ph.D. degrees. He appears to be an extremely bright and motivated young man who left a well-paying microcomputer service job to become a lecturer at UET.

The communications area, therefore, will have three faculty with Ph.D.'s in two to three years. By the end of six years there will be four more Ph.D.'s joining the department making it a good, viable core for offering Ph.D. degrees in communications.

- ELECTRONICS

The only senior faculty member in this area is Professor A. H. Shah, since the other full professor, A. R. S. Bukhari, will leave UET for at least three years to work in Saudi Arabia. Professor A. H. Shah has his B.Sc. and M.Sc. degrees from Loyola University, U.S.A. His specialty areas are electronic circuit design and control systems for industrial and military applications. He produced four research publications during 1984-85. He is also the Director of Undergraduate Studies.

The two associate professors, M. Saeed and J. Iqbal have completed their masters degrees in 1981 and 1978, respectively. They are both heavily involved in consulting with the private and public sectors as well as running their own business in electronics and manufacturing. M. Saeed has just completed writing a sophomore-level textbook on electronic circuits and devices. He has been admitted to the Ph.D. program to study

the application of industrial automation using adaptive robots. The department, however, does not have senior faculty with this expertise to supervise his Ph.D. work.

Associate Professor M. Suleman received his M.Sc. in 1983 from UET. He teaches electronics courses and laboratories. It is unlikely that he will be involved in future Ph.D. work in this area.

A. A. Khan is another associate professor in the electronics area whose mission has been mainly in teaching. He received his M.Sc. degree in 1967 from Keiko University in Japan. His specialty area is illumination, in which the possibility of any future research is very limited. Among the assistant professors, I. A. Goryia and F. Aslam have mainly teaching activities in the electronics area. They completed masters degrees at UET in 1988 and 1990, respectively. Neither are likely candidates for a Ph.D. program in electronics.

Assistant professor A. H. Khan has bachelors and masters degrees from the U.S.A., the first from Wilkes College in 1985 and the latter from the University of Pennsylvania in 1987. He has published three papers during 1986 to 1988. He has industrial experience in the design and production of accelerometers and pressure sensor systems. He has also worked with the installation of instrumentation in industrial water treatment plants and the design of microcomputer based annunciators, data loggers and controllers. His future interest is more in control topics than electronics. However, he is applications oriented, and he wants to pursue a Ph.D. program in the general field of industrial automation.

Another assistant professor M. Ahmad went to the U.S.A. after receiving his B.Sc. from UET in 1981. He is working towards his masters and Ph.D. at the University of Texas at Austin. According to the senior faculty in the department, he is expected to specialize in electronics and controls and return in two to three years.

The only lecturer in this area is M. Zulfiqar who received his B.Sc. from UET in 1984. He teaches applied electricity and electronics to civil engineering and mechanical engineering students. Due to his advanced age, he is unlikely to continue with masters or Ph.D. work.

In summary, there is no faculty member in the electronics area with a Ph.D. degree at this time. In about three years time, A. H. Khan and M. Ahmad are expected to finish their Ph.D.'s and contribute to the electronics research activity.

- COMPUTERS

The two senior faculty members in this area are A. Chughtai and S. H. Bokhari.

Dr. Chughtai is currently the Director of Graduate Studies. He received his B.Sc. and M.Sc. from UET and completed his Ph.D. at UMIST in 1986. His specialty areas are computer design and interfacing techniques, testable and fault-tolerant digital system design, computer-aided design, simulation techniques, and VLSI design. He has produced seven quality publications during the period 1986-90 and written a laboratory textbook, *Digital Logic Design Experiments* in 1988. He has supervised several masters theses.

Dr. S. H. Bokhari received his B.Sc. from UET and completed M.Sc. and Ph.D. degrees at the University of Massachusetts in 1976 and 1978, respectively. His specialty areas are computer engineering, parallel processing, distributed computing and computer networks. Between 1975 and 1987 he published 21 research papers, seven of them in the prestigious IEEE Transaction on Computers. He has done collaborative work with researchers at the NASA Langley Research Center. He is currently at Langley and is expected to return to UET in January 1991.

Associate professor M. A. Iqbal has B.Sc. and M.Sc. degrees from UET and is about to complete his Ph.D. also at UET. This will be the second Ph.D. to be awarded in the twenty-five years that graduate studies have existed at UET. He worked closely with Dr. S. H. Bokhari and has spent eighteen months at NASA-Langley doing research. He published two research papers and three NASA research reports during the period 1986-90.

One of the two assistant professors in the computer area is currently abroad. Z. M. Alvi, who completed his B.Sc. in 1975 at UET, is expected to return in two to three years with his M.Sc. and Ph.D. from Bradford University in England.

The other assistant professor, S. H. Shami received his B.Sc. in 1986 from UET. He is currently in the M.Sc. program in the computer engineering area. Due to some personal and family problems, his progress has been slow. He is, however, interested in pursuing both the masters and Ph.D. work in the computer or communication areas.

Lecturer K. M. Hassan received his B.Sc. in 1986 from UET, and he has completed four of the six required graduate courses for his master's degree. He plans to complete the degree by mid-1991 and continue with Ph.D. study in the U.S.A. He currently teaches microprocessor laboratory and digital electronics courses. He wishes to specialize in computer control of industrial processes.

The other lecturer in the same area is I. Ahmad who completed his B.Sc. in 1987 at UET. He is in the master's degree program at UET working with Dr. Chughtai. He is interested in doing Ph.D. work in the U.S. in computer engineering or semiconductor electronics. He teaches laboratories in instrumentation and feedback control.

The computer group, therefore, has two strong, research-oriented senior faculty members, one associate professor with an excellent research record and four promising young junior faculty members, making this group the most active in the department in terms of research.

2.1.2 Postgraduate Students

- ENROLLMENT BY LEVEL AND SPECIALIZATION

There are presently 115 students in the postgraduate program, 4 (less than 4%) of these being females. There is admission of 40 to 45 new M.Sc.-program students each year stemming from the 160 to 170 applications per year. The present student body is distributed in terms of specialization as follows:

35 in power engineering,
35 in electronics engineering,
30 in computer engineering and
15 in communications engineering.

The new admissions are distributed equally across the three specialties of power, electronics and computers. These are essentially all part-time students in the M.Sc.

program. The Ph.D. program has attracted only very limited interest with one student in progress and only one graduated since its inception. **The above postgraduate student body is in addition to the 1200 (50 females) undergraduate students in the pipeline.** It is to be noted that the postgraduate program starts at 3:00 PM each class day, with the undergraduate program filling university facilities during the early part of the day.

- ADMISSION REQUIREMENTS

Admission to the postgraduate program is based on a prorating of an applicant's total undergraduate performance weighted against 100 points with the addition of the grade of the entrance examination, a copy of which is included as Appendix 5.10. Admission requires a combined grade of at least 110, while the highest combined sum on record is 140 points.

Almost all of the postgraduate students are seeking the M.Sc. degree, which requires preparation and defense of a thesis project in addition to the course work. A few are proceeding to a "Diploma" that results from this same postgraduate program, but does not include a thesis. The latter is of little value in the professional world. It does not result in advanced pay status for those holding the diploma.

- PROGRESS REQUIREMENTS

Each student must pass a minimum of six courses (maximum of nine, the extras resulting from the demands of the advisor in fulfilling deficiencies) in addition to carrying out a comprehensive project, reported in a thesis.

A given postgraduate course meets four hours per week, 14 weeks per term. A full-time student may take up to four courses per term, while the part-time student can take at most two per term, commonly only one. Most (90%) of the postgraduate students are operating on a part-time basis, being full-time employees of some engineering firm. In order to pass a given course, the student must attain at least 50% grade on "both parts" of the course grade. The course grade consists of two parts, one termed "sessional" associated with day-to-day performance including quizzes, homework, class contribution, etc., while the other part is based purely on a final exam. If the performance on the exam falls between 41% and 50%, the student is allowed to repeat the exam without repeating the course. If the exam grade is less than

40% the student repeats the entire course. In each course 80% to 90% of the students pass each term. UET is reluctant to indicate that any student fails to make nominal progress through the curriculum. There may be attrition due to many causes rather than simply poor performance when one is studying on a part-time basis.

- AGE DISTRIBUTION

The present male postgraduate students are of age 30 to 40, with the females running from 24 to 26, with the overall average in the high twenties.

- PROVINCIAL DISTRIBUTION

The provincial homes of the graduate students are:

Punjab 80% (70% undergrad),
Sind 10% (15% undergrad),

Baluchistan 3% (5% undergrad), and
N.W.F.P. 7% (10% undergrad).

- ETHNIC DISTRIBUTION

It is claimed by UET professional staff that there is essentially no ethnic distribution of student body to be considered, except to note that there are a few Iranians, Iraqis, Egyptians and a Nigerian, all undergrads.

- EMPLOYMENT DATA

Noting that almost all participants in the postgraduate program are employed full time (8:00 a.m. to 3:00 p.m., i.e., 34 hours per week) in industry, there is little to comment on in regard to how they spend their time, other than to indicate that they are very busy. Of the postgraduate students, 60% to 70% are presently employed by WAPDA, with approximately 20% employed by TNT (the telephone service), while less than 10% are employed by private firms. The pay scale for a practicing engineer, the condition of most postgraduate students, is Rs. 3,000 per month (approximately $150).

- PROMOTION RATE AND ADVANCEMENT IN INDUSTRY

Up to 1984 the promotion rate from Diploma stage to M.Sc. was only 15% per year. Since that date it is of the order of 25%. When the candidate has obtained the

M.Sc. his government pay rate is advanced two increments of 5% each. There are few jobless engineers with M.Sc.'s. Their job hunting is usually fruitful within a year or two. Because many of the M.Sc. projects are closely aligned with the candidates' professional experience in industry, the M.Sc. effort usually results in solid advancement in job satisfaction if not in actual income. In certain cases, results of work at UET have been of immediate direct effect at WAPDA. (A case of a team effort directed to transformer protection was cited.)

Graduates of the M.Sc. program commonly enter WAPDA, TNT, the defense program, with only 10% moving into private industry. The pay grade of 17 (Rs. 3,000 to Rs. 3,200 per month) moves up by Rs. 200 to Rs. 400 per month upon award of the M.Sci...

2.1.3 Curriculum and Educational Materials

- COURSE LIST AND COURSE CONTENT

Taking note of the *Outline of Tests in the Specializations* (prepared by the Computer Engineering Group) this list of courses is seen to have been approved by the Syndicate in January 1990. This list further presents course descriptions for all postgraduate courses and additionally includes text books used in most of those courses. Although this program only recently received approval, essentially all of these courses have been offered during their development stages over the last several (2 to 5) years.

- TEXT AVAILABILITY

The content of each of the graduate courses is based on a sound choice of texts (though often quite dated), which usually are of extremely limited availability to students. **When it is realized that a modern text costs the major portion of a month's salary for a professor at UET, it is easy to realize that students simply do not have access to such texts. Teaching staff often take great care to provide comprehensive notes that students are invited to photo-copy. Faculty often distribute selected pages of the text.**

The few textbooks available result from gifts, grants, and affiliations with interested parties in other countries. If such a text is available, extensive photocopy use serves the students. There is a "book-bank" included in the library. In its limited ability to serve the students with textbook loans, it serves only the undergraduates.

There was also mention of Indian versions of modern texts and book smugglers that trade in such products. This must not be considered as a proper source for the future.

- SUPPORT MATERIAL AND LIBRARY RESOURCES

It was emphasized that there are essentially no periodical journals available to the post-graduate students, although the assessment team was told that the Netherlands has been sending IEEE and IEE publications to UET for the last five years and will continue to do so. **The UET main Library contains on the order of 150,000 books and volumes of bound journals. This is all extremely dated and of little value, except historical, in support of modern research.** The few sets of bound IEEE transactions and IEE journals that do exist run over a very limited span up to only 1985. Another visit to the library to take specific note of the IEEE transactions that should be present as a result of the above mentioned grant by the Netherlands showed that there were very few current journals available. It was said that the next box of such journals covering the last year or so was in shipment. As a result of further inquiry, the assessment team was provided a "REQUEST TO ORDER" listing several IEEE Transactions and a variety of other journals, mainly from the UK. The status of most of these requests seemed to be unknown. Considering that the most recent Transactions may be a year or so old, this provides a very poor environment for modern research. **The library has a well qualified staff, prepared to make the library a very functional and useful resource, but present lack of funding makes this impossible.**

The faculty feels great need for, and value in, text preparation. It is clearly recognized that such efforts require extensive time, which is extremely scarce during the program development now taking place. The book "Digital Logic Design: Experiments" by M. Ashraf Chughtai is an excellent example of the dedication of some of the professional staff to placing reasonably priced media in the hands of the students. This is a laboratory guide and manual directed to the undergraduate program. Postgraduate faculty are alert to such need and opportunity.

Although the graduate courses are presented at a level of sophistication comparable with U.S. schools, the lack of the actual text for continued review and reference must be devastating, greatly detracting from the potentially valuable presentation. Support equipment for presentation and demonstration is essentially nonexistent. The

department has only one overhead projector, and transparencies for it must be hand-prepared.

- OVERLY THEORETICAL ASPECT OF COURSE PRESENTATION

Course presentations center on pure theory. Both the faculty and students realize that this is the case, while both feel great need for presentation of application of this theory and examples of such. This is essential to the work they will do in, or in conjunction with, industry. Even though they find the presentation overly theoretical, they often find exposure to this theory to be quite beneficial in their employment.

- THE PRODUCT OF THE UET PROGRAM

In discussion with representatives of top engineering firms in Lahore, it was noted that **UET undergrads are hired with the realization that they have essentially no practical experience with modern equipment. They are immediately placed in either formal introductory company courses or are placed with colleagues who provide extensive on-the-job training. These students simply are not ready to "hit the ground running".** The industrial representatives further indicated that they felt both the postgraduate students and most of the professional staff had similar deficiencies. They did indicate, however, that they felt there were many keen graduates of UET ready to really dig in and begin filling in where deficiencies exist. It was indicated that many UET graduates have become very productive contributors.

- FREQUENCY OF COURSE OFFERINGS

Noting that the postgraduate program is so new, it must be realized that it is impossible to present detailed notes of frequency of offering. The popular courses have been offered approximately once per year, while others have been offered only once since inception, and others on the list have not yet been offered. It is intended that no course be offered less frequently than once every two to two and one-half years, assuming the faculty expertise is available. Considerable effort will be extended in assuring such qualified faculty is available. It is also noted that course lists for certain specialty areas are quite short as a result of a limited staff to develop and teach such courses. The control systems courses fall into this category.

2.1.4 Ph.D. Program

There are presently six students registered in the Ph.D. program at UET. They are all faculty members of UET. One of these candidates has finished all his work and is waiting to present his final defense. One other staff member, the only Ph.D. graduate of UET, received his degree several years ago.

The Ph.D. program begins by a student visiting with several professors, exchanging ideas regarding a thesis topic. After agreement of both parties, a supervisor is chosen. A preliminary proposal is presented in written and oral form to a UET review committee. After approval the supervisor establishes contact with an external advisor, typically from the United States or the United Kingdom. As the research proceeds, it may be decided that the Ph.D. candidate should spend some time in the institute of the external advisor. Funding for this venture may come from the UGC, UET and/or the foreign agency. This involves a coordinated effort. The thesis is prepared, submitted to the supervisor for approval and editing as appropriate, then it goes to the external advisor. Once his corrections and additions are properly installed, and three papers of IEEE or IEE quality have been prepared, with at least two accepted for publication, the candidate submits himself for his final defense. It is expected that two more papers stemming from the thesis should be in the pipeline. The student must spend a minimum time of three to four years in this endeavor and is allowed at most seven years, which can be extended one year in special circumstances.

2.1.5 Research Activities

Faculty expertise and research areas were summarized in Section 2.1.1. This section provides additional information on research projects and their funding.

The university has a total budget of Rs. 18 million, and only Rs. 1 million is spent on research. Out of that fund, approximately Rs. 200,000 ($\approx$\$10,000) is normally allocated to the Electrical Engineering Department. The faculty members submit proposals through the department chairman, and the dean forwards the proposals from UET and Taxila to the Director of Research, Extension and Advisory Services in the Office of the Vice-Chancellor. There is a university-wide review process for these proposals, and recommendations are made to the Vice-Chancellor who then makes the final decisions on the distribution of funds.

During the academic year 1989-90, a total of Rs. 80,000 ($4,000) was allocated to the Department of Electrical Engineering for research activity by the Office of the Vice-Chancellor. The funding was distributed as follows:

a) Research group composed of Dr. A. R. S. Bukhari, Dr. M. A. Chughtai and K. M. Hassan received Rs. 35,000 to develop "Data Acquisition and Control System Using Microprocessor."

b) Associate Professor M. A. Iqbal received Rs. 10,000 for his Ph.D. research "Algorithms for Assignment Problems" under the supervision of Dr. S. H. Bokhari.

c) Lecturer T. Izhar received Rs. 12,500 to develop "Speech and Digital Data Interface" towards his masters degree thesis under the direction of Associate Professor M. M. Saleem.

d) Professor A. H. Shah received Rs. 15,000 for the "Design and Development of Electronic PABX" project.

e) Associate Professor M. Saeed was given Rs. 7,500 to initiate his Ph.D. research work on "Optimization of Industrial Production Using Adaptive Robots" under the supervision of Dr. N. M. Sheikh.

The department has not received any external research funding during the last five years. Some funding from industry has come in the form of laboratory testing of transformers, switches and other products in the electrical machinery and high voltage areas. According to the regulations set up by the university, a third of such outside income goes to the faculty-staff team that conducts the test, another third is used to improve or enhance the testing equipment in that laboratory, and the remaining third stays at the Vice-Chancellor's office. However, the latter is earmarked to be used by the department that generates the funds.

Travel funds related to research are very limited. The Vice-Chancellor has the authority to allocate funds to the faculty who travel abroad to present technical papers. Associate Professor M. A. Iqbal received Rs. 20,000 in August 1990 to attend and

present a technical paper at the prestigious 1990 IEEE International Conference on Parallel Processing. However, the faculty member himself spent an additional Rs. 20,000 of his personal funds since the department did not have any travel money.

The faculty has collectively supervised a number of masters-level theses during the last 25 years of postgraduate programs in the department. Every year, approximately 6 to 10 theses are submitted. The quality of most of these theses appears to be below the standards required by U.S. engineering schools. Therefore, most of this work does not lead to publications in international journals. This, however, is to be expected, since even in the U.S., research work at the masters level in engineering does not yield highly theoretical research papers in refereed journals. Nevertheless, the overall quality needs to be improved, and the students should be encouraged to present the results in conferences or publish them in engineering journals at the national level.

Since UET has produced only two doctorates during the last 25 years, it is not possible to assess quality at this point. The recent Ph.D. work by M. A. Iqbal, however, has already led to three publications in the U.S., attesting to its comparable quality with U.S. Ph.D.'s.

Detailed research information and a list of publications for each faculty member are given in Appendix 5.7.

2.1.6 Facilities and Equipment

- CLASSROOMS

It is again impossible to detail the postgraduate classroom status alone, in that this program is so intimately involved with the undergraduate program in terms of staff and facilities. The postgraduate program classes begin at 3:00 PM, following the undergraduate use of the same facilities. Noting the much greater size of the undergraduate program compared to the graduate program, there is plenty of lecture-room space for the postgraduate program. **The postgraduate program presently has no equipped laboratories at its disposal.** The assessment team was assured that future plans provide extensive space for postgraduate laboratories, both instructional laboratories and secure research laboratories. As a result of closer inspection we feel that statement has to be qualified (see the second section following). In any case, there will remain a severe need for laboratory equipment. The only equipment presently

available to the postgraduate-program laboratories is that of the undergraduate laboratories, which is already in great demand by the undergraduate program. **The USAID energy program will bring extensive power and computer equipment into Electrical Engineering. It is intended for the undergraduate program, but this plan must be given careful evaluation and possible redirection so that the equipment will be used well and the graduate program will benefit as well.**

- STUDENTS PER CLASS

The new postgraduate program supporting primarily part-time students has only 12 to 15 students per course. This is expected to grow to 20 to 25 students per course as the program develops.

- LABORATORY SPACE FOR THE NEW POSTGRADUATE PROGRAM

Present plans for the postgraduate center involve vacating the second floor of the existing Electrical Engineering building. This will involve placing the old analog computers in or near the labs dedicated to control systems on floor one. The floor two communications laboratory will move down to the first floor also, sharing space with other electronics laboratories. These floor-one laboratories are very large (>3000 sq. ft.), easily accommodating such moves. The floor-two television laboratory is now vacant, with no evidence of any television facilities present. On the floor-two plans there is shown a fourth laboratory on floor two. This does not now exist. It is simply roof space. It was claimed that this would become a 3600 sq. ft. laboratory, subdivided to provide secure research carrels. The EMS (Energy Management Systems) lab to be provided by USAID will also be placed on floor one, appropriately adjacent to the Power Systems (protective relaying) Laboratory. This clearly places many undergraduate laboratories on floor one.

The existing space on floor one is used very inefficiently. All the rooms visited or used by the assessment team could be used much more efficiently, especially if they were given some acoustic treatment, i.e., killing the echoes which are so prevalent.

The Vice Chancellor announced that Rs. 4,000,000 had been granted to UET for the construction of a new structure for Electrical Engineering. This may be an addition to the present building in readily available space adjacent to the present structure, or it may be constructed some distance away on campus so as to separate it

from the portion of campus where student disturbances have taken place. In any case, there is more than adequate planned building space to support the laboratory program. The environmental quality of such space is in question, however. **The construction of the new building appears to be a certainty. IEP funding must be contingent on either proper remodelling and construction on the existing second floor or proper construction of the new building. Special efforts must be extended in providing the proper environment for computers and other electronic equipment. This includes supplying the laboratories with properly chilled, humidity controlled air at positive pressure so that all dirt blows out of the lab.** Such rooms should also be acoustically treated to absorb the fan noise of the computers and to allow efficient communication between the users. Based on visits to the existing second floor, it is very evident that it would be most desirable to place any USAID-funded program in the new building.

It was further pointed out that the National Institute for Power is soon to construct a building on the UET campus to house their program. This will consist mainly of "well equipped" labs. According to conversation with faculty, this has been promised for the last "10 years". It is felt that USAID should not make decisions contingent on this development.

- CAMPUS UNREST AND TURMOIL

The Assessment Team was repeatedly assured that the campus turmoil that has brought the campus to a stop several times in recent years has minimally affected the postgraduate program. Following are the concepts presented to various members of the assessment team at varied times. "The postgraduate students do not get involved in such things. If they should find disturbances so disruptive that they do not feel comfortable on campus, there is time to reschedule classes so that nothing is missed. The postgraduate and undergraduate programs are separate and distinct with little interaction between the two." During industrial visits it was learned that the quality of those graduating from the UET undergraduate program was falling drastically. Recently only 20% of the students have been passing the entrance exam commonly presented by these local companies. The industrialists feel that this is the result of the recent turmoil, but they further indicated that they feel the campus was heading toward stability.

- LABORATORY EQUIPMENT

There is at present no equipment for the postgraduate program. **The only laboratory equipment available to the postgraduate students is what might be provided by a given undergraduate lab director based on a formal request. This is not allowed to impact the undergraduate laboratory environment.**

UET presently lists 15 undergraduate laboratories, but only ten of these are currently functional. The rotating-machinery labs include motors, generators and switch gear of 1920's vintage. This is clearly not typical of modern machinery. The high-voltage laboratory includes more modern equipment, about 25 years old, but this is of very modest performance and limited voltage range (500kV max). The two labs just mentioned are housed in the mechanical engineering building across the road from the electrical engineering building. The existing power systems laboratory, in the electrical engineering building, provides an introduction to a wide variety of protective relaying equipment and line analysis equipment. This is all based on vintage electromagnetic equipment rather than modern electronic equipment or microprocessor-based gear.

It is very encouraging to see that the UET teaching staff has designed and fabricated quite comprehensive teaching stations to present transistor electronics. These along with power supplies, signal generators, and oscilloscopes at least ten years old support the introductory electronics program. For "chip" electronics, the students build up circuits on 2-inch by 5-inch "bread boards". This provides minimal operating space. **In the computer laboratories there are five to six personal computers that include special interface boards, thus allowing students to interface to the lab environment through A/D and D/A convertors, parallel interfaces or serial interfaces under control of a computer clock.** This is intended to allow construction of very comprehensive projects that have direct industrial and commercial applications. However, there was little comment or evidence that such development has been taken to the commercial or industrial environment. There are simply too few such stations even to support the undergraduate program. **This equipment is quite fully occupied by the undergraduate program, and is hardly adequate for postgraduate development and research work.**

There is great need for a variety of modest-performance instruments, quality electric components, tools and a variety of personal computers and computer work stations. **Purchase of the above mentioned equipment by the IEP should be integrated and dove-tailed with that to be delivered as a result of the USAID energy program. It is felt that some of the high-performance computer stations planned for that grant might be traded for many more lower performance personal computers, possibly in a network configuration serving undergraduate programming instruction.**

- EQUIPMENT MAINTENANCE

The current equipment maintenance program is minimal, if existent at all. Electrical Engineering is provided Rs. 15,000 ($750) annually for all maintenance, including the building itself. Each laboratory is provided a Rs. 2,000 - 4,000 contingency fund. This is used for purchase of components and at times is used in instrument repair.

If a major repair is needed it may be necessary to call on research funds. The entire UET is allotted Rs. 1,000,000 per year for research. Rs. 200,000 (≈ $10,000) of this usually goes to Electrical Engineering. Professors submit proposals request equipment purchases from this base. If their proposal is favorably reviewed, they receive a 3-month initiation grant. If their three-month report is viewed with favor they receive the remainder of their request. When debilitating failure occurs, professors are often required to use their research money for repair. In fact, most electronic equipment we now see in the labs has been purchased with the research funds.

2.1.7 Current Linkages

- ACADEMIC INSTITUTIONS

The linkage of Electrical Engineering with other universities, domestic and international, is limited. The only two sustained linkages are with the University of Manchester Institute of Science and Technology (UMIST) in the power area, in the form of graduate-degree programs by UET staff, and the computer-group research collaboration with NASA Langley.

Several faculty members in the power engineering area are graduates of UMIST and there are two future faculty members completing their degrees at UMIST. During the visit of the assessment team, Professor Shami went to UMIST for a three-week visit. Two faculty members, S. H. Bokhari and M. A. Iqbal established frequent contacts with NASA-Langley Research Center where each visited the facilities for a period of six months or more.

- PUBLIC SECTOR

The government agencies are the biggest employer of Electrical Engineering graduates, e.g., Water and Power Development Authority (WAPDA), Telephone and Telegraph (T&T), Army, Railway, etc. Virtually no contract research activity has been developed, however. The High Voltage Laboratory conducts testing on transformers, and the department receives some funding which is used to acquire new equipment or maintain the testing equipment. WAPDA officials contacted by the assessment team confirmed that there were no currently established linkages with UET, but they indicated interest and welcome cooperative arrangements when and if UET would initiate the dialogue.

- PRIVATE SECTOR

No industry at present funds Electrical Engineering research projects, but hopefully, with better facilities in the Center of Postgraduate Studies and Research, the private sector will find benefits in collaboration. Few of the private sector representatives who were contacted could articulate how the linkage could be established with UET, because most of the private sector in electrical engineering, communication and computer engineering areas is foreign branch offices of major U.S., European or Japanese companies in which most of the activity is sales rather than product design, development or research. However, the software development for gradual automation in some key industries was suggested as a potential link with UET.

- CONFERENCES AND WORKSHOPS

The faculty members participate/present papers in national conferences and workshops. Only one workshop has been offered at UET, however. A successful conference titled "Microcomputer Interfacing for Data Acquisition and Control Using the IBM-PC" was held during 23 December - 4 January, 1990.

- ADVISORY COMMITTEE

The department does involve several engineers from the public and private sectors on an advisory committee.

2.1.8 Professional Environment

The departmental academic administrator is the Chairman of Electrical Engineering, who with his subordinate staff along with general administrative staff of UET provides reasonable services to students. The director of postgraduate studies and the director of research activities/extension UET administer postgraduate student affairs. There is also a director for undergraduate studies.

- SUPPORT FOR PROFESSIONAL ACTIVITIES

Moral support is given to faculty for professional activities outside the classroom and research laboratory. However, the university does not have an official policy of promotion and encouragement for professional activities based on incentives. Seniority systems appear to prevail when travel opportunities arise for short courses, seminars and professional training.

- HIRING AND PROMOTION POLICIES

The proposals and policies put forward by the faculty members are encouraged. The Vice-Chancellor indicated that there would be additional faculty positions available for the Electrical Engineering Department. However, there is no long range planning in terms of the specialty areas of new faculty recruits. Specific attempts are needed to strengthen the subject areas targeted for developmental assistance-- namely computer engineering, communications and electronics.

- INCENTIVES FOR EXCELLENCE

There is no particular reward system in UET to provide faculty incentives. Seniority dominates pay and promotion policies, but merit has been considered in specific decisions.

- AVAILABILITY OF SUPPORT STAFF

The lab assistants and technicians work as supporting staff. They tend to lack proper training and experience. With the planned acquisition of several new items of

high tech equipment, there is an acute need to train the laboratory assistants, technicians and the maintenance support staff.

- ACCESS TO FACULTY DEVELOPMENT ACTIVITIES

  The faculty members have easy access to the faculty development programs, viz., post-graduate training abroad, funded by government fellowships and by the University. Several young faculty members are presently studying abroad under such programs.

- MANAGEMENT CAPACITY

There is little training of faculty members for management and administration. Therefore, lack of management training given to the faculty is noticed. On the other hand, the Chairman and Vice-Chancellor are prepared to take measures needed to modify the existing system. Some of the Vice-Chancellor's views are summarized in Appendix 5.9. Generally, the professional environment leaves much room for improvement. Few of the faculty have shown much initiative in improving themselves or the institution. Lack of resources is a convenient excuse, but few people seem to work after 1:00 or 2:00 P.M., except when teaching a post-graduate course. Otherwise, the campus is shut down.

2.1.9 Costs and Financing

- TEACHER SALARIES BY QUALIFICATIONS

  The teachers are appointed in four grades, viz.,

Title	Degree Requirements	Pay Grade	Total Salary Per Month Starting at Grade
Lecturer	B.Sc.	17	Rs. 3,200
Assistant Professor	B.Sc. + 4 yrs. exp.	18	Rs. 4,000
Associate Professor	M.Sc.	19	Rs. 5,000
Professor	M.Sc. + 15 yrs. exp.	20	Rs. 9,000
	Ph.D. + 12 yrs. exp.	20	Rs. 10,500

An annual increment is added each year in scale. A minimum of 5 international publications are required for grade 19, while 8 are needed for grade 20. In addition to the base salary, faculty receive other benefits such as allowances for housing, transportation, and health care.

- AGGREGATE BUDGET DATA

UET gets Rs. 8 million annually, of which Rs. 1 million annually is spent on research activity. Most of the budget (70%) goes for paying salaries to staff and faculty.

- COST PER STUDENT BY LEVEL

An average cost of UET tuition and fees per postgraduate student is Rs. 50,000 per year, while it is only Rs. 10,000 ($\approx$ \$500) per year for undergraduates.

- COST ANALYSIS OF MAJOR PROGRAMS AND ALTERNATIVE TECHNIQUES

A major M.Sc level thesis program/project requires roughly Rs. 20,000 to Rs. 30,000 ($\approx$ \$1000 - \$1500) and could be subsidized by using common facilities and sharing research instruments.

2.2 SYNTHESIS OF ISSUES

There are a number of issues concerning the current status of UET that should be considered in planning an effective development program within the context of the IEP. These include the efficiency, effectiveness, and relevance of the existing programs, the management and leadership of the institution, and the resources and financial support available to the department.

Although it is difficult to discuss separately the undergraduate and graduate programs in electrical engineering, because they share the same faculty and facilities and they are both impacted by the local political situation, the IEP is focussed on research and hence on the graduate-level program. The efficiency and effectiveness of the postgraduate program have been only marginal to date. Although there are over 100 students enrolled in the M.Sc. program, only half a dozen complete their degree each year. And in twenty-five years, only one Ph.D. has been granted.

There are many reasons for this low internal efficiency of the program, not all of them under the control of the institution. Over the years there may not have been a large incentive for students to complete their graduate degrees. Now, however, employers in the public sector are paying a salary premium for the degree so that students should be better motivated to complete their programs. On the other hand, one should be aware that students may not be in the program with the best motivation. There were indications that many students seek an easy project for their thesis rather than taking up a rewarding intellectual challenge. The faculty must pay attention to establishing uniformly high standards as well as convincing the students that there are benefits in pursuing challenging problems.

The recent development and approval of a large core of graduate-level courses should improve the yield of the program. In most areas there are qualified faculty to teach the courses and to supervise research. Additional faculty are currently in Ph.D. programs abroad. Some new equipment, particularly computers, will be provided by the USAID energy project, but availability of modern equipment and literature will continue to be a problem for students trying to do research projects.

Although the impact of student unrest, political activity, and lack of discipline is claimed to have little direct effect on the postgraduate program, there must be significant indirect effects. First, if the faculty is being intimidated by the threat of physical violence, they cannot be putting all their energy into their professional activities. Also, the disruptions of the undergraduate programs in recent years must have taken their toll on the quality of the undergraduate training. Some remedial work may be required in the graduate program. With the successful passing of the recent elections, everyone seems to be optimistic that the political disruptions on campus will become less prevalent. This seemed to be the case when the team was in Lahore.

The relevance of the faculty research and the student projects has not been sufficient to attract support from industry. Industry knows that the students at IEP are bright, being selected from the cream of Pakistan's educational system, so they seek to hire them. On the other hand, those students must be trained on the job to perform useful functions. The faculty must make a greater effort to identify relevant problems in industry and to sell their ability to solve those problems. This

effort should be facilitated by the fact that most of the graduate students are working in industry; the contacts through the employed current students should give the faculty access to the companies. Also, many UET alumni are in high positions of influence in industry and government. The help of those alumni should be enlisted. The key limitation in these efforts seems to be self-confidence of the faculty. Most of the staff lacks the needed confidence, because of limited experience, poor facilities, and lack of input from professional linkages.

The resources for doing research and graduate training are quite limited in that the university budget provides only a pittance for research, capital equipment, and maintenance. Clearly, a broadened base of funding is needed. **Although assistance projects such as the IEP can help move the department temporarily, long-term success depends on developing sustained support. The government policy of keeping student tuition very low is counterproductive in this regard and fosters lack of academic seriousness and resolve among the student body. If the government will not change that policy, and provide greater support in general, it is clear that the faculty must seek financial support in the form of research contracts, grants, and gifts from the private sector.**

One source of hope in addressing these issues lies in the area of leadership and administration. Within the faculty, there is a critical mass of intelligent, well educated, and motivated individuals who see what needs to be done and is prepared to do it. The Vice-Chancellor is also committed to changing and improving the academic situation on the campus. The leadership of these key people can change the professional environment in the department to develop motivation through proper incentives and reduced bureaucratic impediments.

One challenging issue for the administration and for the department as a whole is their problem in selecting priorities for development and support. Apparently there has been political pressure within the faculty to give all members a share of the support coming from USAID, rather than targeting the input according to a strategic plan. Some of this attitude may have resulted from the false impression that UET was earmarked to receive a much larger share of the IEP's budget than is actually available. The Assessment Team understands that the department now agrees with the priorities and approach outlined in this report.

Some comment should be made about the social aspects of the program at UET. As indicated by statistics given above, very few women participate in either the undergraduate or graduate program, and there are no female faculty members in electrical engineering. Also, the vast majority of the student body comes from Punjab. The reasons for such representation are easy to find in the general social and political situation in Pakistan. Although it is regrettable that a large portion of Pakistan's human resource is not being developed and that the impact of UET on Pakistan's industry and economy is limited provincially, much of the problem is woven into the nation's social fabric, and government policy, so few of the desirable changes can be effected by a single institution of higher education. Major changes in the entire social structure of Pakistan would be required to change these realities.

3. STRATEGIES FOR CHANGE

The two previous chapters have presented the objectives of the electrical engineering department at UET and summarized the current status of the department. This chapter discusses the specific needs of the department in pursuing its objectives and proposes a six-year program for meeting these needs.

3.1 PROBLEM ANALYSIS

The electrical engineering department at UET has major responsibilities for educating a significant number of Pakistani engineers and for supporting technological development in Pakistan. It is limited in its ability to meet these responsibilities because of very poor facilities, inadequate faculty preparation, and difficult educational conditions. At the same time, local industry requires implementation of modern technology, particularly computer-based information, communications, and automation-and-control systems, if it is to be economically efficient and competitive in the domestic and international markets.

Although there must be countless opportunities for operational improvements in both purchased and indigenous technology, industry does not approach the department to any great extent for help on its technical problems. The reasons given are that the

department has no resources to offer and the faculty is lacking experience and confidence in its abilities.

Although the students who reach the university are mostly very bright, especially those in electrical engineering, the quality of undergraduate education is poor. Aside from a lack of resources, the faculty is overburdened with enrollments that are too large and a curriculum that may not be well conceived. Most importantly, the current social and political situation permit intimidation of teaching staff and prevent systematic implementation of objective student assessments and the imposition of high academic standards. Although the faculty is already relatively well educated, there are few incentives for individuals to work hard and to set proper examples for the students.

While publication is a criterion for promotion of teaching staff, the poor quality and paucity of publications by most of the staff makes that requirement something of a farce. Although lack of physical resources is a convenient explanation, a more critical issue is the lack of stimulation and input from colleagues that normally comes from effective networking. The faculty at Lahore is mostly isolated by the great difficulty in communicating with the international scientific community.

There is a demand for postgraduate training at UET, especially at the M.S. level. There are almost 200 applicants per year for the program at UET. Unfortunately most of these candidates are part-time students who are not sufficiently committed or who are unable to complete the thesis part of the program. The lack of experimental and computation facilities is a particular disincentive.

These are enormous systemic problems that have no simple solutions. Indiscriminate infusion of financial resources to these problems is unlikely to have any significant impact. The limited support of IEP must be carefully targeted to have a meaningful impact on the quality of engineering education and on the effective mobilization of university capabilities for promotion of industrial development.

In spite of the many obstacles faced by UET in providing a high quality education to its electrical engineering students and in supporting local industry, the Assessment Team found reasons to believe that some properly targeted support from the IEP will turn the department around and help it meet those objectives.

First, we found some talented and motivated individuals who can participate actively and successfully in a research-oriented program. Indeed, the more senior people among this group are the ones who have already taken the initiative to propose a Center for Postgraduate Studies. **Second, the university administration, namely the Vice-Chancellor, has a good understanding of the objectives and requirements of the IEP and is prepared to support it. Third, there are needs and opportunities in local industry for the fruitful application of new capabilities at UET, and the industrial managers we met expressed their willingness to cooperate.** Other positive factors are the planned implementation of a USAID project on energy-related education that will provide a significant input of new equipment in the department, the planned establishment of an instrumentation center for maintenance and repair of equipment on the campus, and the planned construction of a new building for the electrical engineering post-graduate program. All of these new resources will complement and support the efforts of the IEP.

3.2 PROPOSED IEP FOR UET

The Assessment Team recommends that the UET Electrical Engineering Department be selected to participate in the first phase of the Institutional Excellence Program. Furthermore, we recommend that the focus of the program at UET be computer engineering.

- COMPUTER ENGINEERING PROGRAM

There are three compelling reasons to emphasize computers in the UET development program. First, it is clear that any reputable electrical engineering program in the world must provide a strong background in computers and computing to its students in order to prepare them for working with modern technology; computers are basic, indispensable, and pervasive in engineering practice. Second, the most obvious opportunities for UET to work with local industry are in the area of computers. Industry would welcome the assistance of faculty and their graduate students in creating or modifying software for their computer applications and in installing computers for improved plant operations. Finally, the most important reason is that UET already has a critical mass of three talented faculty members who are qualified to develop and sustain a viable research program in this area.

In our discussions with the department, there was seldom any doubt that computer engineering must be their top-priority field for participation in the IEP. On the other hand, there was a reluctance to exclude any other faculty specialties from IEP support. While the Assessment Team resists the efforts of the departmental faculty to distribute IEP resources to all parts of their department, because we believe in building on strength and rewarding merit, we are aware that all parts of electrical engineering are more or less interrelated. Furthermore, for most purposes computers are only a tool, and other aspects of electrical engineering must be involved in their productive application. For that reason, we recommend that two such areas of application also be included in the IEP program, electronics and communications.

The concept of the IEP at UET, then, is that it will develop within the context of the postgraduate program of the electrical engineering department with a focus on computer systems and computer applications. Between the IEP and the USAID energy-education project, the department will be provided with significant computing capability, including personal computers, networks, design workstations, and a mainframe system. To develop this system, the IEP will send some of the concerned faculty abroad for short-term training, and linkages will be established with American engineers who can help with system design and installation. Some of the latter will be brought to Lahore for technical assistance when needed.

- PH.D. PROGRAM

Because the faculty in computers, Bokhari, Chughtai, and Iqbal, are already well educated and have some linkages in the U.S. and the U.K., they are able to offer their own Ph.D. program at UET. This program will be encouraged and enhanced in two ways. First, stipends will be provided for full-time M.S. as well as Ph.D. students to serve as research assistants for these faculty. Second, through the professional linkages a sandwich Ph.D. program will be implemented. Young staff members who are seeking the Ph.D. in this area will be sent to do a portion of their course work and research in the U.S. under the co-supervision of his UET professor and a linked American professor. The latter will visit Lahore early in the program to define the thesis project jointly and will return again to participate in the final examination of the student.

The sandwich Ph.D. program offers several advantages. While the computing resources are being developed in Lahore, new teaching staff will become familiar with similar resources abroad. This will promote technology transfer as well as cement professional linkages. Furthermore, defining the thesis topic in Lahore will increase the relevance of the research to the Pakistani environment. Also, granting the degree at UET will improve the chances that the young faculty member will stay in the institution rather than emigrating as many do when they receive their advanced degrees abroad.

- WORKSHOPS AND CONFERENCES

Early in the program, and especially after new equipment is available, the faculty will offer seminars and workshops on computer methods and applications for engineers in industry government agencies. One such workshop, on interfacing and data acquisition, was run quite successfully last year, and there was demand from additional participants. A major objective of these programs will be to solicit research projects from the attendees. When possible, visiting American faculty will participate in these programs.

- COMPUTER ENGINEERING APPLICATIONS: ELECTRONIC AND COMMUNICATIONS

Identification and implementation of various computer applications will necessarily involve faculty who are primarily interested in electronics or communication. Unfortunately, UET's research strength in these areas is not as great as in computers. On the other hand, some of the faculty in electronics have good contacts with industry that should be cultivated and utilized. Some research assistantship stipends will be provided for full-time M.S. students to work on industrial problems related to computer applications. Basic equipment and supplies of components for construction of devices will also be provided for these projects. The intent is to build successful linkages with industry and to establish within UET a system for developing applied research projects and channeling the necessary funding from interested sponsors to the projects.

In each of the three target areas, computers, communications, and electronics, the department has designated a responsible faculty member. These are Ashraf Chughtai, Noor Sheikh, and Azhar Shah, respectively. Through the help of its engineering facilitator, Thomas Chapman, MUCIA will establish at least one faculty linkage in the

U.S. for each of these areas. Through those linkages, the labs in Lahore can receive needed information and can obtain technical assistance when needed.

In order to develop a true research capability at UET in the areas of electronics and communications, as well as control automation, it is important that some of the younger staff receive Ph.D. training abroad. While sandwich programs have advantages, as indicated above, the capability may not exist at UET to support internal Ph.D.'s in these areas. Therefore, the IEP will provide funds for extended Ph.D. study in the U.S. for several young faculty members. Whether these programs turn out to be sandwich or regular American Ph.D.'s, linked faculty should be involved in supervising the projects to ensure that the topics are relevant for Pakistan and that the Ph.D. recipient chooses to return to UET.

One of the chief obstacles in the successful implementation of the IEP is the great difficulty of communicating between the U.S. and Pakistan Mail is slow, and journals may not even arrive. Telephone service is not good either. Effective communication is needed to maintain the desired linkages and to promote useful collaboration. At a minimum the project must provide facsimile transmission between UET and the engineering facilitator. Preferably, electronic mail facilities should be established in Pakistan so that scholars can network with the international professional community.

If it is possible for the IEP to arrange the installation of BITNET or some connected electronic network in Pakistan, this would be an opportunity for the computers and communications groups at UET to undertake a valuable and challenging project.

3.3 PROGRAM NEEDS

3.3.1 External Support

In order to implement the proposed program, the IEP must provide the following types of assistance to UET:

- books, journals, and bibliographic access
- computer equipment and software
- technical assistance in establishing the computer labs

- short-term overseas training of computer-lab staff
- travel to establish linkages
- support for computer-related research projects
- overseas fellowships for Ph.D. candidates
- visiting faculty to discuss research areas and graduate courses
- support for seminars and workshops at UET
- basic equipment and components to support applied research on electronics and communication
- stipends for full-time research students at UET
- conferences, internships, and research leaves for key faculty
- support for international communication and professional networking
- technical assistance and training in research management

All of these components are needed to establish a viable research program at UET. The breadth of the support, that is, the number of research areas and key faculty to participate, will depend upon the resources available. The top priority is clearly the computer area, with extension to applications in electronics and communications being desirable but necessarily subordinate.

3.3.2 Recommended Administrative Action

In addition to the external support listed above, the success of the program, and the ultimate success of electrical engineering at UET in upgrading itself, depend upon certain types of support from the university administration and the faculty as a group. From the university and the government the post-graduate program in electrical engineering requires an additional building, which has already been committed. More important than any physical resources are human resources, as well as concessions and reforms of operational rules by the university with respect to departmental staffing, workloads, and financial arrangements.

- DISTRIBUTION OF TEACHING AND RESEARCH WORKLOADS

The present system in the university is quite rigid with respect to the duties and responsibilities of the teaching staff. Rather than basing all expectations on seniority, the department must assign teaching loads and allocate other resources according to the abilities, interests, contributions, and other attributes of the individual faculty members. For example, professors should not necessarily be given lighter teaching loads than

assistant professors simply by virtue of their status. The load should reflect the actual activities of the individuals.

The key faculty who are involved in the IEP will have significant responsibilities for development of laboratories, research activities, graduate student programs, and industry contacts that will require a major commitment of their time. Their teaching loads will have to be adjusted accordingly. Teaching loads, at least in student numbers, are already heavy because of high enrollments. The university must arrange for release of the key faculty from their normal teaching responsibilities to allow them to develop the research programs. To take their places, new teaching staff must be hired, which means that additional faculty positions must be created in electrical engineering. Additional support staff is needed also to support the new facilities and to implement the research program.

- NEW STAFF

Other requirements from the institution include the authorization for creating positions of research assistants for some full-time graduate students, who may later join the teaching staff, and for additional teaching staff. More lecturer and assistant professor positions are needed to help with the undergraduate teaching program while other faculty members are involved in developing the research program, and to create opportunities for graduates from the M.S. program to join the teaching staff. At the same time several positions should be added at the associate professor and professor levels to accommodate those young staff members who complete Ph.D. degrees and those who distinguish themselves by their research activity. Those latter positions added for the purpose of this project should require as a minimum qualification the Ph.D. degree.

One key position that must be created is that of a computer system analyst. The computer resources to be established at UET will require the full-time attention of a very capable individual, and no faculty member is likely to have time to attend to these needs because of other demands on his time. The minimum qualification for such a person is a B.S. engineering degree, and some additional training or experience is necessary.

- INCENTIVES

Similarly, the compensation of the faculty should not be based solely on seniority. A system of incentives should be instituted to reward those faculty who contribute to the development of the department and who are successful in establishing outside contacts. For example, faculty who receive research contracts from industry or who develop successful short courses or workshops should either be relieved of some undergraduate teaching assignments or they should receive additional pay or other benefits. Establishment of such rewards has the potential of dividing the faculty and causing resentment. The entire faculty should be involved in adopting a flexible and fair system of incentives. They should all be made to understand that such incentives will upgrade the status of the department, which will ultimately benefit all of the faculty.

- OFFICE FOR FINANCIAL MANAGEMENT OF CONTRACTS AND GRANTS

Related to a system of incentives is the general problem of financial management in the department. One desirable outcome of the IEP, which should be in place at the end of six years, is a system of research administration that will assist individuals or groups of faculty to contract research projects with industry and government groups, to obtain the resources needed to implement the project, and to pay out easily whatever funds are needed to cover the project expenses. The IEP will provide some training to UET faculty in the way that American universities handle these issues, but it is up to UET to modify its rules to facilitate such activities.

3.4 INSTITUTIONAL CONTRIBUTIONS TO OVERCOMING OBSTACLES

In Section 3.3.1, we have listed the inputs that the IEP should provide to change the UET electrical engineering department into a viable research institution and a major force to support economic development in Pakistan. We also mentioned some of the requirements that must be provided by the institution. In this section we reiterate and amplify the points that must be addressed by the department, the university, and the UGC.

- **The first prerequisite for the success of the IEP at UET, and indeed for UET's participation, is that the department must be willing to establish**

priorities among research fields and to accept that some members of the faculty and research areas will not participate directly in the IEP. The basic premise of the IEP is that emphasis will be placed on areas of excellence that have the potential to become world-class research programs. The Assessment Team believes that the department has finally accepted this concept and is willing to emphasize the areas suggested in this report, but their acquiescence should be confirmed.

- Another important principle that must be accepted by the institution is that merit should be recognized and rewarded. **Rules that dictate that promotions, teaching loads, opportunities for overseas training, and other benefits be allocated according to seniority must be modified.** Incentives for the faculty to work hard, to establish high standards of performance, and to develop active research programs and collaboration with industry must be developed.

- **A system should be developed in UET to administer research contracts and other activities with industry.** Perhaps a separate foundation should be established to handle private funding of research projects, workshops, and other kinds of institutionalized consulting so that income can be channeled directly to the appropriate recipients.

- Appropriate incentives include not only direct rewards but also the absence of disincentives. Administrative procedures should be streamlined to make it easier for faculty to do research. A management system should be established that will make it easier for the faculty members to buy supplies, to communicate with colleagues elsewhere, to have access to computers and equipment, and to receive pay for extra activities. As part of the IEP project such a management system should be developed so that small expenditures are pre-approved in a research budget and so that every small step would not require approvals from the top administrators.

- Additional faculty must be hired in order to reduce the teaching loads of active researchers, to release staff for study abroad, and to develop young talent on the staff. Criteria for teaching loads and for promotion should be modified to

give greater incentives for research productivity. Although most hiring should be directed at younger people and include a probationary period, the department should consider hiring senior staff who have been trained abroad if qualified individuals can be found who would strengthen the department's research capability. In such cases, it will be necessary to create additional professorships.

- A system should be developed to establish and administer full-time research assistantships, and perhaps teaching assistantships, for graduate students. Availability of such assistantships, provided initially by the IEP but ultimately out of research contracts, should attract top-rate students, some of whom may eventually join the faculty. Full-time graduate students supported by such assistantships should increase the research productivity of the department as well as the efficiency of producing M.S. degrees. Care must be taken to insure that the assistantships go to the best candidates and that the expectations of professional performance are of the highest level.

- The department should establish an Industrial Liaison Committee, with representatives from utilities, government laboratories, and especially private industry, to advise on research activities and relations with industry. The department already has an advisory committee, but this new committee should focus on opportunities for industrial development and introduction of new technologies. It should be a catalyst for more extensive interactions with the private sector.

- Local administration of an IEP project at UET will put heavy demands on some of the departmental faculty. A local project implementation office will be needed with facilities and a staff that can coordinate all the various components of the project. This means that UET must provide both physical space and adequate staff to maintain communication within the faculty and with UGC, MUCIA, and local industry. We understand that Professor Chugtai will be in charge of this office. Because he will have responsibility for development of research activities and graduate courses as well as project management, he must be given significant support in staffing. IEP funds should be used to provide equipment such as computers and a photocopier for this administrative office,

but UET must also provide the staff, a telephone, and adequate office furniture and a budget for supplies and expenses.

- There are several changes required in the physical environment on the campus in order to nurture a strong research program. **First, arrangements must be made to keep the department open to faculty and graduate students for the entire day and into the evening. Productive research and efficient use of resources require much more than three five- or six-hour days.** Also, efforts should be made to upgrade the physical environment and the general maintenance of the facilities. It is difficult to develop a mentality of excellence without a commitment to quality in the small details of everyday life. There are many improvements that would not cost much but would affect the general atmosphere of the department, such as painting the dirty walls in the halls, providing more bookcases in faculty offices, giving faculty keys to rooms where they need access, providing at least an intercom for faculty offices, modifying acoustics of meeting rooms, etc.

- It is likely that the department will receive a large amount of equipment from the USAID energy-management education project. This equipment will be quite useful for research and graduate training as well as for undergraduate instruction. The faculty must be willing to use the equipment for all these purposes and ensure that it is utilized as extensively as possible. Arrangements must also be made to ensure proper maintenance of that equipment as well as any provided by the IEP. Maintenance staff and a budget for maintenance must be provided.

- Proper laboratory space, with appropriate security measures as well as faculty access, must be provided for the new laboratory and computer equipment. Space is being provided on the second floor of the existing building, and a new building is planned. Measures must be taken to ensure that the space is prepared properly with respect to room size, air conditioning, and dust control. Some funds from the IEP should be used for this purpose, but the university will have to contribute to the general allocation and construction.

- Among the greatest obstacles to success of the IEP program is the difficulty of communication between Lahore and the international scientific community. UET and the UGC will have to address this serious problem along with USAID and MUCIA. It will be a problem for all participants in the IEP. We understand that the UGC is developing improved systems for bibliographic access, which will be available to UET. This problem requires careful consideration because of the high cost and logistical difficulties in providing hard-copy journals in Lahore. UET and UGC must provide reliable facsimile access to the department, and the possibility of establishing computer/satellite electronic mail connections must be explored. MUCIA will attempt to assist in this latter effort by providing information about systems established in other parts of the world.

4. IMPLEMENTATION STRATEGY

The previous chapter outlined the inputs that are required to develop a significant research capability at UET. These inputs include faculty training, technical assistance, management training, new laboratories, new equipment, modified institutional procedures, improved access to information, and linkages with industry and with sister institutions abroad. This chapter presents an implementation strategy for providing these inputs, a timetable for implementation, and a budget estimate. Benchmarks for evaluating the progress of project implementation and success are also presented. The timetable is summarized in Section 4.9, and the budget summary is given in Section 4.10.

4.1 ADMINISTRATIVE AND MANAGERIAL TRAINING

Both for project implementation and for long-term success of UET's efforts to establish a research program, it is essential that an effective administrative structure be established. This section outlines the proposed training in the administrative area.

During year one, the following short-term administrative trips are recommended:

a) The Vice-Chancellor of UET should join other vice-chancellors of the universities selected for the IEP for a two-week tour of the MUCIA member universities in the U.S. They would meet their counterparts in the U.S. and study the administrative infrastructure in U.S. universities needed to carry out a long-term, post-graduate-oriented project like the IEP.

b) The Chairman of the Department of Electrical Engineering at UET, Dr. K. E. Durrani, and the Director of Graduate Studies, Dr. M. A. Chughtai, should go for a two-to-three-week visit of a few U.S. universities (mostly MUCIA members) to initiate networking activities and also to study the administrative policies and procedures at the departmental level in U.S. universities. This trip should include a review of curricula in these departments as well as establishing the initial contacts with possible specialty area counterparts in the U.S. The trip needs to be scheduled at the earliest possible time if UET is selected as one of the participating institutions in IEP.

c) The department has indicated that Dr. Chughtai, Director of Graduate Studies, will have the day-to-day responsibility for running the project. The financial aspects, however, will be handled by Professor A. Hameed, again according to department officials. It is therefore proposed that during year one, Professor A. Hameed should visit one or two U.S. institutions for a two-week internship in project administration.

d) It is expected that UET will create a position and hire a new person to operate, maintain and service the computer equipment for the Department of Electrical Engineering. This person has to have at least a baccalaureate degree in computer science, mathematics or engineering and have some experience with computers. As soon as the position is filled, this person needs to have two to three months of training in computer system installation, maintenance and service, either in the U.S. or possibly in Pakistan if such a facility is locally available.

4.2 FACULTY DEVELOPMENT GUIDELINES

The basic objective of the six-year plan is to provide opportunities for the young and promising faculty members to complete their masters and Ph.D. degree programs as quickly as possible and utilize them as future faculty members to enhance the quality and the amount of research activity and industry-university linkages. Thus, the first priority is given to these initiatives within the department.

Faculty members who have completed their Ph.D. work during the past few years have the next priority for post-doctoral study in order to continue their current research activity and move into new research areas.

The third priority is given to mid-career faculty members who wish to renew and broaden their knowledge base through exposure to new technology and current research activity in U.S. universities. The development and training opportunities include short courses, workshops and study tours for those faculty who have the potential and commitment to apply the fruits of their training to teaching, project development and research activities. Faculty who are engaged solely with teaching responsibilities and are not involved in postgraduate study should not be eligible to participate in this development project.

The Department of Electrical Engineering at UET strongly believes that future faculty members should register for masters and Ph.D. programs within the department and complete their degrees at UET. The resources of IEP would support sandwich-type temporary training in the U.S. for a duration of 1 to 2 years as part of such programs in cases where UET can provide primary thesis supervision.

In some cases and for some faculty candidates it would be more useful in the long run if they complete the masters or Ph.D. in the U.S and then return to UET. The option may be left flexible enough so that decisions can be made on an individual basis. Several of the junior faculty indicated a preference for staying in the U.S. during the entire Ph.D. study and receiving the degree from a U.S. institution. Their reasons include the uncertain political situation in Pakistan and the prestige attached to the graduates from U.S. universities.

The department and university administrators, however, prefer a sandwich-type masters or Ph.D. program so that the faculty members are obligated to return and serve at UET. This goal is logical and reasonable in the long run after several more Ph.D. faculty have returned and the Ph.D. program is firmly in place at UET.

Another important consideration is the distinct difference between the Ph.D. program at UET which is only thesis-oriented and the U.S. Ph.D. program where both course work and a thesis are required. It is imperative that even if the sandwich Ph.D. program is implemented and if UET is selected to participate in the IEP, the Ph.D. candidates must spend the early part of their Ph.D. work in the U.S. to enroll in Ph.D. level courses in their specialty areas.

4.3 PLAN FOR FACULTY DEVELOPMENT

According to arguments given in Chapter 3, the first priority for support is the area of computer engineering. The second and third priorities are communications engineering and electronics, both of which rely heavily on the capabilities in computing and provide applications. The proposed faculty-development plan for these three areas is presented in the following sections.

4.3.1. Faculty Development in Computer Engineering

Currently, the department has two professors (Chughtai and Bokhari) and one associate professor (Iqbal) with the Ph.D.-level preparation in computer engineering. Two assistant professors (Alvi and Ayyaz) are expected to finish their Ph.D. degrees abroad and to join the group in two to three years. Two junior faculty (K. M. Hassan and I. Ahmed) are proposed to take part in the IEP for their Ph.D. study, bringing the total number of faculty having the Ph.D. to seven by the completion of the project. This will be a strong core of faculty to develop a strong Ph.D. program within the department.

Year-by-year faculty development in computer engineering is given below:

YEAR ONE

1. Associate Professor M. A. Iqbal has worked closely with Professor S. H. Bokhari and spent close to eighteen months at the NASA Langley Research

Center. With Professor S. H. Bokhari returning to UET in January 1991, M. A. Iqbal should have six months to a year of postdoctoral work in the U.S., preferably at a university rather than at NASA, to broaden his academic experience. His expertise can be utilized by the host university through teaching a graduate course and establishing linkages in his specialty area.

YEAR TWO

1. Instructor K. M. Hassan should start his Ph.D. course work in the general area of computer control and process control. This might be a sandwich program if proper arrangements can be made.

YEAR THREE

1. K. M. Hassan continues with his Ph.D. program.
2. Lecturer I. Ahmad should start his Ph.D. studies in computers. This also may be a sandwich program.

YEAR FOUR

1. An M.Sc. or Ph.D. student, to be identified, should take research leave in the U.S. as part of a sandwich program.
2. K. M. Hassan completes his Ph.D. degree at UET.
3. I. Ahmad continues his Ph.D. program.
4. Professor M. A. Chugtai should take a research leave for six months to one year preferably in the same institution where one of the two Ph.D. candidates is studying.

YEAR FIVE

1. I. Ahmad completes his Ph.D. degree at UET.
2. Professor S. H. Bokhari should take a research leave for six months to one year at a university to establish additional linkages.

YEAR SIX

1. Another M.Sc. or Ph.D. student, to be identified, should take research leave in the U.S. in a sandwich program.
2. Z. A. Alvi or M. N. Ayyaz should take a research leave for six months to a year, preferably at a university where a student from UET is studying.

4.3.2 Faculty Development in Communications

Currently, the only senior faculty member in this area is Professor N. M. Sheikh, who holds the only Ph.D. in communications. Associate Professor M. Saleem is already in the Ph.D. program at UET and has a scholarship for two years to study at Denison University.

The two lecturers M. Imran and N. A. Mufti are interested in pursuing the communications area. M. Imran has almost completed his M.Sc. work and is ready for Ph.D. study. N. A. Mufti is just beginning his M.Sc. study. Another instructor, A. Abbas has a five-year scholarship to study abroad in the communications area. It appears, therefore, that in 3 years there will be two faculty with a Ph.D. in this subject area, and the number will increase to five by the end of the sixth year. At that point the communications area will be ready to undertake its own Ph.D. program.

Year-by-year faculty development in communications is given below:

YEAR ONE

1. M. Saleem should take a research leave to start his Ph.D. program in the U.S. He should consider graduate schools other than Denison.
2. M. Imran should start his Ph.D. in digital communications in the U.S.
3. Dr. N.M. Sheikh should visit two or three U.S. universities (preferably where Saleem and Imran are sent) for three to four weeks to initiate linkages in his area.

YEAR TWO

1. M. Saleem continues Ph.D. work.
2. M. Imran continues Ph.D. work.
3. N.A. Mufti should go to the U.S. to do research work related to his M.Sc. study and to take some Ph.D. courses.

YEAR THREE

1. M. Saleem completes his Ph.D. at UET.
2. M. Imran completes his Ph.D. at UET.

YEAR FOUR

1. N.A. Mufti should return to the U.S. for Ph.D. work.

2. Dr. N.M. Sheikh should take a research leave for six months to one year, preferably at the university where one or more of the Ph.D. students are studying.
3. An M.Sc. student, to be identified, should go to the U.S. for thesis work in a sandwich program.

YEAR FIVE

1. N.A. Mufti completes his Ph.D.
2. A Ph.D. student, to be identified should be given a research leave in a sandwich program.

YEAR SIX

1. The Ph.D. student, to be identified, continues his/her work.
2. M. Saleem should take a research leave for a semester.

4.3.3 Faculty Development in Electronics

Currently, there is no faculty member with a Ph.D. in electronics. Professor A. H. Shah is the only senior faculty member in the field. None of the associate professors expressed a strong interest to pursue a Ph.D. at UET or abroad. Assistant Professor M. Ahmad is expected to complete his Ph.D. in three years at the University of Texas in electronics and control, and then join the department. Two assistant professors, W. M. Khan and A. H. Khan, have completed their M.Sc. degrees and are ready for Ph.D. work. Another assistant professor, T. Izhar, will complete his masters degree within four months as well.

It appears, therefore, that within four years, the electronics area may have four faculty members with Ph.D. degrees. At that time, sufficient faculty resources may be available to start a local Ph.D. program in this area. In the meantime, practical projects and M.Sc. work with industry can be developed.

A year-by-year schedule of faculty development is given below:

YEAR ONE

1. A. H. Khan should be sent to the U.S. for a Ph.D. program in industrial electronics and control.

2. W. M. Khan should start his Ph.D. in electronics and speech processing at a U.S. university.
3. Professor A. H. Shah should visit two to three U.S. universities for two weeks (preferably the ones where the Ph.D. students are studying) to seek linkages.

YEAR TWO

1. A. H. Khan continues with Ph.D. work.
2. W. M. Khan continues with Ph.D. work.
3. T. Izhar should start his Ph.D. in solid state electronics and VLSI at an American university.

YEAR THREE

1. A. H. Khan completes his Ph.D. work at UET.
2. W. M. Khan completes his Ph.D. work at UET.
3. T. Izhar continues his Ph.D. work.
4. S. H. Shami should start his Ph.D. program in the U.S.
5. M. Saeed should take a research leave in the U.S. for a semester.

YEAR FOUR

1. T. Izhar completes his Ph.D. at UET.
2. S. H. Shami continues his Ph.D.
3. J. Iqbal should take a research leave in the U.S. for a semester.
4. M. Z. A. Khan should take a research leave for six months to a year to study as a postdoctoral fellow in power electronics.

YEAR FIVE

1. S. H. Shami completes his Ph.D at UET.
2. Professor A. H. Shah should take a research leave for six months to a year in order to establish additional links with U.S. institutions.

YEAR SIX

1. A. H. Khan should take a research leave for postdoctoral work.
2. Although the power area is not viewed as one of the three priorities in IEP, it would provide a positive impetus for the future of the department if Professor

A. Hameed or T. A. Shami visits a few U.S. universities and establishes linkages in the power area as well.

4.4 RECOMMENDED SCOPE AND SCHEDULE OF TECHNICAL ASSISTANCE

It is suggested that the IEP provide technical assistance to the electrical engineering faculty at UET in the form of visiting professors and consultants. Although it is desirable to have some professors from the U.S. spend at least a semester at UET, so that they could teach graduate-level courses and seminars and provide sustained input in research projects, few active researchers are able to take more than a few weeks away from their home institutions. USAID restrictions on support of dependents may also make extended stays unattractive except in exceptional cases. Therefore, most of the faculty visits are designed to be for two to three weeks.

Short visits by American faculty at UET can be quite productive, especially if particular individuals can make repeated visits. Short-term visitors can participate in workshops and short courses that will be useful to the faculty and graduate students and also appeal to the industrial community. They can consult intensively with the faculty on research planning, and they can work with graduate students in planning thesis projects, especially those that will involve some work back at the visitor's home department as part of a sandwich program.

Short and repeated visits between UET and selected departments in the U.S. are the key to establishing viable professional linkages. The visiting American faculty will get to know the UET staff and the situation in Pakistan so that they can give useful advice on appropriate research topics. They can direct the research activities of visiting UET fellows at their home department in the proper context. Also, they can help supply needed technical information that may not be available in Pakistan.

Some Pakistani consultants can also contribute to the UET program. Individuals who have especially good contacts with industry should be brought in to give advice on research problems that are relevant to the local situation and on methods to develop more effective collaboration with industry.

The following is a year-by-year schedule of U.S. faculty to be recruited for possible graduate course teaching and research initiation at UET as well as a schedule of local consultants hired in Pakistan to assist UET. It is expected that some of the U.S. faculty will also function as the networking counterparts in the priority areas of computer engineering, communications and electronics and serve as co-supervisors of theses done in sandwich programs. As with staff development, priorities can be assigned according to the research area.

YEAR ONE

1. Three U.S. faculty members should visit UET for a duration of two to four weeks to complete the second phase of networking. During the first phase, Professors Chughtai, Sheikh and Shah should visit several electrical engineering departments in the U.S. and identify, with the help and guidance of the program facilitator, appropriate counterparts in the U.S. Those counterpart faculty should then visit UET and lay the foundation for linkages during the next six years.

2. One U.S. faculty member in computer engineering should visit UET for a six-month period (either August 1 to January 31 or February 1 to July 31 according to the current semester schedule at UET for postgraduate studies). This faculty member would teach one graduate-level course, help initiate some research projects, and assist the department in strengthening the laboratory facilities.

3. One local consultant in Pakistan should be hired for one month to assist with the computer system set-up.

4. Two U.S. faculty members in the communication area and two in the electronics area should visit UET for a duration of four weeks, each conducting seminars and consulting on M.Sc. and Ph.D. research projects.

YEAR TWO

1. One U.S. professor in electronics (preferably one with a significant amount of industrial experience and an inclination for practical projects) should visit UET for six months.

2. Two U.S. professors in computer engineering and two in communications area should visit UET for a duration of four weeks each.

3. One local consultant in Pakistan should be hired for one month to help establish linkages with industry in electronics.

YEAR THREE

1. One U.S. professor in communications should visit UET for six months.

2. Two U.S. professors in the electronics area and two in computer engineering should visit UET for a duration of four weeks each.

3. One local consultant in Pakistan should be hired for one month of assistance in communications.

YEAR FOUR

1. One U.S. professor in the computer engineering area should visit UET for six months.

2. Two U.S. professors in the communication area and two in electronics should visit UET for four weeks each.

3. A local consultant should be hired for one month to assist with the electronics area.

YEAR FIVE

1. One U.S. academic in electronics should visit for the first six months.

2. Two U.S. professors in computer engineering and two in the communication area should visit UET for four weeks.

3. A local consultant should be hired for one month in computer engineering.

YEAR SIX

1. One U.S. academic in communications area should visit for the first six months.

2. Two U.S. academics in electronics and two in computer engineering should visit UET for four weeks each.

3. A local consultant should be hired for one month in communications.

During the six-year period, therefore, ten U.S. faculty members in each of the areas of computer engineering, communications and electronics would visit UET. It is expected that the ten U.S. academics in each area will cover a reasonable breadth and depth in that particular area, although all of them may be from one or two U.S. institutions, and some repeat visits may be desirable.

Visits by the program facilitator to monitor the progress of the project during the six-year period are not included as part of technical assistance. The role of the facilitator is, however, essential and needs to be coordinated with the technical assistance, networking and academic training components of the project.

4.5 GUIDELINES FOR SELECTION AND ALLOCATION OF EQUIPMENT

A primary goal of the UET Electrical Engineering Department is to improve the quality and efficiency of its graduate program, and that goal is entirely consistent with the related goals of producing significant research results and serving local industry. Presently the department is hampered in pursuing all of these goals by the severe lack of electronic equipment and computers. Although there is need for all sorts of electrical engineering equipment, it is not the purpose of the IEP to provide general support for the instructional program.

Consistent with the concept of the IEP, this report has identified priority research areas to be supported: Computer engineering, communications engineering, and electronics. The equipment to be provided by the IEP should be directly related to the expected activities in these priority areas. Within the context of UET's organization,

specifying these three areas seems equivalent to saying that only the power engineering group is to be excluded from the project. That is not really the case.

In modern electrical engineering, the classical subdisciplines of communications, electronics, and power engineering are not so easily distinguished. For example, both communications systems and power systems make extensive use of electronic components, and electronics designers use modern communications theory. Proper control of machinery or of large-scale power systems requires electronic communications to obtain feedback. And all of these fields make heavy use of computers and microprocessors. Therefore, the priorities that have been identified for appropriate research activities and staff specialization do not translate directly into prioritized categories of equipment. To support any modern research activity, the Electrical Engineering Department needs a basic array of experimental and computing facilities. A lesser amount of specialized equipment will be required for specific projects.

Fortunately, the department is expected to participate in a major USAID energy-education project that will provide a large infusion of basic electrical engineering and computing equipment. The specifications of that equipment have been prepared by MATHTECH, Inc., consultants to USAID and the Government of Pakistan. Although the equipment specified by MATHTECH is supposed to be used for undergraduate education, much of it is quite sophisticated and will be suitable for research activities. Indeed, it would be a terrible waste of the investment if it were not used for post-graduate projects and faculty research. The proposal for equipment presented here for IEP assumes that the MATHTECH equipment will be available for research projects so that the IEP input can be integrated with it.

Because most of the equipment needed for this program will be of general utility, especially the computer systems, the questions of priority are not related directly to research areas. Rather, the questions of what equipment should be provided, and when, relate to the department's capacity to operate, maintain, and utilize it. Instead of indicating priorities for equipment, we can identify several categories. Procurement of these categories, and even equipment within the categories, should be phased to ensure that the investments will be cost effective.

- The first category of equipment needed at UET involves high-performance workstation computers capable of handling complex problems in systems analysis and simulation, and doing advanced computer-aided design (CAD). Such equipment is needed for research in the computer-engineering area, but it will also be used as a tool in all other areas of research.
- The second category, which is also related to the computing facilities, is the computer accessories and peripherals needed to support real-time on-line data acquisition and processing and system control. Again, such equipment will be used for research by the computer group, but it will also be needed by other researchers. Included in this category also are instruments for programming and testing electronic components, instruments and tools for diagnosis and repair of electronic equipment, and a supply of chips and tools to be used in constructing electronic circuits for various applications.

- The third category of equipment that should be provided is a variety of sophisticated signal recording and analysis devices, which are of primary interest to communications researchers but are also useful to most of the experimental researchers in the department.

- The fourth category of equipment to be considered is an array of additional personal computers or workstations that will eventually be needed to supplement the computing facilities established with the MATHTECH equipment and that in the first category of IEP equipment. This additional equipment will be placed in individual offices and labs, when needed, but it should be networked with the central servers.

Although one can identify the general types of equipment that will be needed to support developing research programs in electrical engineering at UET, it is not yet clear what specific types and options should be selected or when the faculty will be ready to use greatly expanded capabilities. Also, it is not yet clear what specialized equipment will be needed to support particular research projects that will develop after several years. Technology in computers and in electronic instrumentation is changing so rapidly, and the price/performance ratio dropping so fast, that it would be wasteful to purchase equipment and capabilities long before they will be used. For these reasons

the Assessment Team proposes that the procurement of new equipment be phased over the lifetime of the project.

Basic equipment in each of the first three categories can be purchased immediately. The specifications should be developed to make that equipment compatible with the MATHTECH equipment. More advanced equipment in each category, which will provide advanced capabilities, specialized equipment for particular research initiatives, and the equipment in the fourth category should be ordered at the time that it can be used effectively.

There is a question of how the equipment specifications should be prepared and how the decisions will be made regarding these purchases. For the first phase of procurement, the IEP should provide technical assistance in the form of visiting computer experts who can work with the faculty and ensure that the most appropriate computer system is obtained. Care should be taken to integrate the IEP computing equipment with the MATHTECH computing equipment. The combination of the two should constitute a functional computer center that serves the entire department.

The Assessment Team recommends that a system be developed in which faculty members prepare documented proposals for procurement of specialized or advanced equipment in the later phases of the six-year IEP. Such proposals should indicate the intended applications of the new equipment, relevance to the overall project objectives, provisions for operation, maintenance, and repair, and the range of users in the department. Visiting scientists, consultants, and external linkages should be used in preparing proposals. A committee involving the UET administration, UGC, MUCIA, and perhaps industrial advisors should evaluate these proposals. Processing of such proposals could well be part of the periodic review of project progress. Provision of later phases of equipment should be contingent on productive use of the existing facilities. Developing a tradition in the faculty of planning projects and generating proposals is crucial for establishing a sustained research capability at UET.

While much of the equipment to be provided is of general use, and for economic reasons should be used extensively throughout the department, the target research areas should have first priority in equipment access. The local project administration must

develop rules for allocating access as well as procedures that provide for proper care and routine maintenance of the equipment.

As part of the equipment budget, funds should be provided for environmental control, such as air conditioning, and for stabilization of the electrical power supply.

4.6 COMPUTER AND LABORATORY EQUIPMENT TO SUPPORT ACTIVITIES

Realizing that this Institutional Excellence Program is directed to improving the research skills of key faculty, aiding them to establish ties with industry in both the public and private sectors, the list of equipment to follow is directed toward this program. It is not intended to set up a base for the entire graduate program nor for an individual laboratory in UET Electrical Engineering. The main emphasis of this IEP project is accordingly directed toward improving staff skills by providing them some educational but mainly research support. Some of these people who will pursue advanced degrees, as well as some who have already attained their terminal degree, will require appropriate laboratory equipment support for their research programs. It is to this end that equipment listed below is directed.

It is also realized that UET-EE will be receiving considerable equipment to support the power area, part of this equipment being very specialized, while much of it is of very general use that would well-support other areas. In fact much of the computer equipment, especially that involved in real-time data acquisition and processing, would serve the computer, communications and electronics areas very well. It is to be further realized that much of the equipment in the MATHTECH proposal is such sophisticated equipment that few person on the UET staff in the power systems area will know how to use it. Much of it is so sophisticated that only people who have worked with such equipment in the recent past and stayed up to date, studying its configuration and applications, are able to use it effectively. In order to make effective use of this equipment, the power people will necessarily have to call on experts in computers, electronics and communications to help them with their problems. The assessment team feels that the resultant teamwork and synergism that results will be a great asset to the UET graduate program, truly becoming excellent.

The computers of both the MATHTECH program and this IEP project must be placed in common areas where graduate students and researchers will have access. High-performance work stations must not be placed in faculty offices or in professor's homes. They must be readily available to the students. In fact, they should be available to all EE graduate students for the order of 15 hours per day, while the researcher using a given computer should have 24- hour access to the computer he/she is using. The professor who will require access to high- performance computing and chooses not to work side-by-side with the student researchers should consider placing a much-lower-performance personal computer in his office, tied to the file server or work stations placed in the common computer area.

Future delivery of computers should depend on how effectively existing computers are being used. Location of computers and the manner in which they are used will be monitored by USAID-MUCIA personnel as part of a regular review, yearly, quarterly or monthly as determined to be appropriate. Future order and delivery of computer equipment will depend on how efficiently equipment in hand is being used.

The assessment team heard comments several times that the equipment provided as a result of the MATHTECH program was not going to be available to any program outside the power area. This is simply not acceptable. Certainly we would not expect people outside the power area to need access to equipment such as the rotating machines, the high-voltage equipment, transformers and other equipment that is specifically power oriented. On the other hand, the general-purpose computers must be made available to EE researchers. This IEP supplies higher-performance work stations than the MATHTECH program and duplication of many of the systems supporting real-time data acquisition and processing. It is especially important to match the computer resources to the needs of the user. It is a terrible waste of computer power to use a powerful work station to do word processing, etc. Realizing how fast computer technology is advancing, it must be further recognized that those devices you place in storage cabinets for possible future use often become obsolete while sitting on the shelf. Technology is advancing so rapidly that equipment often becomes obsolete in the time span between order and delivery. This is especially so when this time span exceeds one year, as it will in the case of both the MATHTECH project and this IEP.

Sharing of resources and expertise is essential to enhancing the research posture of UET-EE. In addition to the concepts mentioned above, it is strongly suggested that the new laboratory space to be added to floor two of the present electrical engineering building be carefully designed as a computer center. It would be preferred to place the computer center and computer laboratory in the planned new Electrical Engineering Building, rather than in the planned addition to floor two of the existing building, but realizing that this would delay progress, it is expected that the computer center and computer laboratory will be placed in the existing building addition.

Much of the very specialized equipment should be based in a well-staffed computer center with high-quality environmental control. The computer hardware serving the graduate program and that of the power systems program should be networked together so that hardware and personnel resources can be shared, thus spreading the resources most fully and providing minimal operating costs, which will necessarily be high. Listing some of the outstanding computer items in the MATHTECH proposal, on which the computer center should build, we have:

****
The following list of equipment is not suggested for this IEP
but is simply lifted from the MATHTECH proposal for examination
in the interest of coordinating acquisitions by the two programs.
****

MATHTECH Item No.	Quant	Price US$	Description
10		12,000 ea	XY-Plotter AO size with serial and parallel interfaces.
11	10	6,000 ea	Work-stations, 33 MHz, 387's with 8 MB RAM, 80 MB hard disk, 5.25" and 3.5" floppies. Note: these might be considered high- performance desk tops.
24		15,000	Software
25	2	200 ea	8085 based single board computers, 4.77 MHz., 8085 CPU, 512K RAM, 220V, 50Hz.
26	10	350 ea	8086 based single board computers, 4.77/8 MHZ, 512K RAM, 8087 Math Co-processor, 220 V, 50 50Hz.

27	2	500 ea	80286 based single board computers, 16 MHz. 1MB RAM, 80287 Math Co-processor, 220V, 50 50Hz.
28	2	2,000 ea	80386 based single board computers, 33 MHz. 80386 CPU, 64K Cache, 8 Mhz Bus speed, 4 MB RAM, 80387 Math Co-processor, 220V, 50Hz
29	1	4,000 ea	80486 based single board computer, 80486 CPU with internal cache and math co-processor, 8K Byte internal cache, 220V, 50Hz.
32	10	300 ea	Data acquisition cards for PC's, 16 bit parallel TTL level input.
33	4	470 ea	Dot-matrix printers
34	1	600 ea	FAX card
35	4	300 ea	IEEE-488 interface cards
36	4	200 ea	Logic analyzer cards
37	4	200 ea	Logic probes
38	4	200 ea	Logic pulser
39	1	3,000 ea	Logic analyzer
40	1	58,000 ea	30486 based file server
41	1	300 ea	Modem card
45	10	300 ea	A/D convertor card, 16 inputs per card, +/- 10 volt range,
46	10	300 ea	D/A convertor card
48	2	2,000 ea	Prom programmer
49	2	500 ea	IC testers

The above is an elegant set of equipment that would serve the computer program at UET extremely well. It must be realized that based on extensive conversations with teaching personnel in the power systems area, it is felt that there is only one person in

this area ready to take advantage of much of the above equipment dedicated to data acquisition and processing. It will be necessary to call on the strengths and interests of those in computers and electronics to make even the least use of this equipment.

Similarly many items included in the MATHTECH list of equipment will serve the communications group very well. It is further strongly felt that the staff interested in power will necessarily have to call on their communications colleagues to effectively use much of the communications equipment. It is further felt that even for some of the microprocessor-based power-line monitoring equipment, those interested in power will need to call on the computer personnel. If handled most effectively, this elegant equipment should serve as a nucleus or kernel about which a great integrated team effort involving most of the UET staff could build their careers and enhance the Department's research qualities and strengths.

Equipment suggested for the IEP budget is grouped into four categories:

- Category-one equipment suggested for purchase for the computer area is high-performance computer work stations to handle the heavy analysis of systems analysis, systems simulation and CAD work.
- Second category for the computer area focuses on computer and peripheral equipment to support real-time on-line data acquisition, processing and control.
- Third category is to supply a variety of sophisticated signal recording and analysis devices, certainly of interest to communications personnel, but of great universal use to most all EE experimentalist researchers.
- Fourth category is to supply personal computers to provide an expanded learning environment or to be placed in a private lab or office. If these personal computers are placed in labs or offices, they must be tied to central servers, providing the extended services available.

First, in preparing this list we avoid unnecessary duplication of any items listed on the preceding page in the MATHTECH proposal equipment list. **Second**, where we suggest the IEP supply equipment like that in the MATHTECH proposal, and realizing that the equipment specified in the MATHTECH proposal is at the forefront of

technology, we simply duplicate their entries in our suggested equipment list. **Third**, it is felt that the MATHTECH proposed computer equipment and that suggested in this plan should be placed in a common area so as to make most effective use of personnel and environmental control. By doing so it makes it more feasible to maintain an open research laboratory for extended hours.

Fourth, we do not plan to serve the entire proposed graduate program nor the undergraduate program in EE at UET with the following equipment. It is intended to serve those in the graduate program especially interested in heavy numerical work and those interested in computer interfacing to the process world. It is further felt that it is quite inefficient to supply $6,000 work stations on which to learn basic programming. The following list accordingly includes some lower performance personal computer-type stations to serve the learner, as well as the higher performance stations to serve the researcher. In this manner there will be a broad spectrum of computer services available. It will be very important to properly target the user community to make most effective use of these resources.

CATEGORY ONE

Suggested Equipment:

(Prices indicated in this report tend to be U.S. list prices, without shipping.)

Item No.	Quant	Price Each	Total Cost	Description
1	8	13,000	104,000	Work-stations (DEC 3100 series, Sun SPARC Station, HP-Apolo) with 8 Meg Ram, 300 MEG hard disk, ethernet interface, high- resolution-graphics color monitor. 220V, 50 50Hz
2	1	20,000	20,000	File server for the workstations of item 1, with 1-Gbyte disk. 220V, 50Hz
3	1	6,000	6,000	Tape drive for system back up. 220V, 50Hz
4	1	2,000	2,000	600 MByte CD-ROM Drive for software distribution
5	1	15,000	15,000	Software, mostly CAD-oriented to be chosen based on use and availability in the Lahore area
6	2	4,300	8,600	Laser printers, like HP LaserJet IID , with interface and cables to tie to central server

7	1	8,000	8,000	300 LPM dot matrix printer, with graphics performance, with interface and cables to tie to central server
8	1	2,000	-----2,000	4 to 6 color plotter, 11 in. by 17 in, with interface and cables to tie to central serve
		Total	$165,600	

It is realized that UET staff has had experience with Sun work stations, i.e., the Sun-3's and Sun -4's, and indicated a strong interest in such equipment. It is to be pointed out that these are no longer available from Sun, but they suggest their SPARC stations. Marleau of the assessment team has had extensive experience with an alternative system offered by DEC (Digital Equipment Corporation) Computers and would like to inform MUCIA, USAID and UET-EE that DEC offers a well integrated system, consisting of individual work stations, a central server, and special hardware and software allowing PC's to communicate with this network, allowing the PC to serve as terminals while computing on an appropriate work station, sharing it with the user at the work station. Careful consideration must be given to writing appropriate specifications for the computer system to ensure that the greatest utility is obtained.

The following equipment, intended to serve the real-time on-line use of microprocessors, is in part simply a duplication of a variety of the devices presented in the MATHTECH list. We take the liberty of duplicating their descriptions and prices in this document.

CATEGORY TWO

Suggested for purchase:

Item No.	Quant	Price each	Total Cost	Description
9	10	$2,500	$25,000	286-based PC's with 3.25 in. floppies, ethernet and VGA card and color monitor. System software providing communication with the file server of item No. 8 below and item No. 1 above (also suggest use of DEC PCSA LAN service, see appendix)
10	1	10,000	10,000	386-based file servers with 600 Meg hard disk

11	4	300	1,200	IEEE-488 interface cards; like MATHTECH item no. 35
12	4	250	1,000	Logic probe, Like HP 545A; Like MATHTECH item no. 37
13	4	350	1,400	Logic pulser, Like HP 546A; like MATHTECH item no. 38
14	10	300	3,000	A/D convertor card, Like MATHTECH item no. 45, 16 inputs per card, 12 bit, +/- 10 volt range, to place in PC's of Item No. 7
15	10	300	3,000	D/A convertor card, Like MATHTECH item no. 46 2 outputs per card, 12 bit, +/- 10 volts, 10 ma max., to place in PC's of Item No. 7
16	10	300	3,000	Data acquisition cards, Like MATHTECH item no. 32, 16 bit I/O port, TTL level
17	10	350	3,500	8086-based single board computers, 4.77/8 MHZ, 512K RAM, 8087 Math Co-processor, 220 V, 50 50Hz. Like MATHTECH item no. 26
18			5,000	Peripheral devices chips, A/D convertors, D/A convertors, Timers, Digital input chips, Digital output, opto isolators, UARTs, serial data communication chips, etc. (Speed, precision, voltage level, etc., to be specified for a specific project.)
19	2	2,000	4,000	Universal Prom programmer 20 and 24 pin PALA, EPLD, 26V12,18V10,22V10, GALA, 2716-27020 Eproms, 87 xxx Micros Cat No. Link Graphics Universal programmer or equivalent like MATHTECH item no. 48
20	1	2,300	2,300	IC testers. Consisting of Probe, Tracer, Pulser, Clip and Comparator. Multifamily logic clip HP 548A or equivalent Logic Comparator, HP10529A or equivalent Current tracer HP 517A or equivalent IC Trouble shooter kit HP 5022A or equivalent Logic Probe HP 545A or equivalent Logic Pulser HP 546A or equivalent.

21	10	450	4,500	Digital multimeters Fluke 8050A 4-1/2 digit or equiv
22	5	1,500	7,500	Signal generators, WaveTek 190, 1 MHz. Sine, triangle square wave, or equivalent
23	10	400	4,000	D. C. Power supply Leader LPS-152, dual 0-25V, @1A, 0-6V @5A
24			2,000	Leads, connectors and wire-wrap tools, to be specified working in conjunction with UET staff
25	10	100	1,000	Soldering stations
26	2	375	750	Desoldering station, Solder Wick Mod. 500 or equivalent
27			3,000	Hand tools (Pliers, cutters, strippers, screw-drivers, nut- drivers), power tools (drills, grinders, vacuum cleaners, etc.) and small bench-top tools (drill press, saw, etc.)
28			3,000	Expendable supplies, Paper, printer ribbons, toner cartridges, plotter pens, etc.
		Total	$88,150	

Rather than simply providing a broad base of equipment to support an instructional digital communications laboratory as was suggested by UET communications personnel, the following equipment is intended to aid the personnel with special strength in communications to interface with projects based on computerization of Industry. Again we note certain items in the MATHTECH proposal that will effectively serve the communications people, and are of such a nature that the power people should call on the expertise of the communications people in making most efficient use of this equipment.

****

The following list of equipment is not suggested for this IEP, but is simply lifted from the MATHTECH proposal for examination.

****

MATHTECH Item No.	Quant	Price US$	Description
4	1	1,500	Radio Noise Meter
13	2	975	Function Generators (Aidop)
22	2	1,000	RF Signal Generator with FM, AM, etc.

Recognizing that the communications group did not indicate a well defined project aimed at establishing ties with public- or private- sector industry, the following list of items is set out with thought that the communications specialists might use certain of this equipment for narrowly defined projects of specific interest to them as individuals. More important, it is provided to aid in systems analysis and design, especially involving computer control of systems. This quite sophisticated equipment will similarly serve the electronics area. These devices are intend to serve as research tools, not simply for casual laboratory graduate classroom equipment.

The following equipment is presented at priority level three. Order of this equipment might be held up until after items at priority one and two have been put to use, and users have demonstrated facility with the above computer equipment, especially if the communications personnel have no specific use of the equipment in establishing ties with industry. It must be realized that if such equipment is not effectively used shortly after delivery, it will soon be out of date with new and better models available. If these were to be ordered two-to-three years after the work-station computers and real-time systems were delivered, it is quite probable that greater performance could be obtained for the same cost. Before this equipment is ordered, the communications personnel should provide clear evidence of how they are going to use same. The very sophisticated signal analyzer in Item 29 below performs from essentially DC up through audio range, but not into the radio frequency range. If the communications personnel could provide a sufficiently strong argument, and computer personnel see no specific need for the specified instrument, we would consider

purchase of an analyzer to serve the radio frequency range if desired. The assessment team was not alerted to need for such equipment in support of any specific project.

CATEGORY THREE

Suggested for purchase:

Item No.	Quant	Price each	Total Cost	Description
29	2	$2,000	$4,000	20 MHz Sweep/Modulation generator for AM/FM measurements. Wavetek MOD. 193 or equivalent.
30	3	4,200	12,600	100MHz Digital Plus Analog Oscilloscopes, with GPIB interface and trolley cart, Tektronix 2221 (with option 10 and option 1K) or equivalent.
31	1	14,000	14,000	Dynamic Signal analyzer, .0005 50Hz to 100 KHz HP 35660A (with option 001, added memory; option 910 extra manuals; option w30; HP35680A Instrument Basic; HP35681A Analysis Pack) or equivalent.
		Total	$30,600	

Much of the above equipment suggested for purchase to support the research program at UET-EE is quite sophisticated and will require skilled programmers to make effective use of same. In order to better prepare the mass of students to use such equipment, it is strongly felt that it would be effective to have a number of low-performance personal computers available to the casual user. On the other hand, if the users are found to be sufficiently skilled with the above equipment, it may be more effective to purchase more of the high-performance work stations of Item 1 above. It is felt that this decision regarding the purchase of two additional high-end work stations as compared to 10 or 12 PC's is a critical choice to be made in consultation with UET. At category four we have an either/or situation. This equipment would be ordered only after all the above equipment, along with that of the MATHTECH, had been seen to be effectively used by the researchers in UET-EE. **It is to be stressed again that although the above equipment is to be dedicated to research use, not for casual instructional use, it must be readily available to qualified research users, not secured in faculty offices, nor in their businesses or residences.**

CATEGORY FOUR

Item No.	Quant	Price each	Total Cost	Description
32	2	$13,000	$26,000	Work-stations (DEC 3100 series, Sun Sparc Station, HP- Apolo, etc.) with 8 Meg Ram, 300 MEG hard disk, ethernet interface, high resolution graphics color monitor.
OR ---------- OR				
32	12	$2,000	$24,000	Personal computers, IBM OS/2 Mod 30 or equivalent.

ENVIRONMENTAL CONTROL OF COMPUTER WORK SPACE

The computers are to be placed in anew structure, either in the addition to the second floor of the existing EE building or in a new EE building. These rooms must be supplied with high quality air, filtered, and temperature and humidity controlled. It is understood that USAID is not taking part in building construction. They might support some remodelling of existing space to provide a proper computer-operating environment. It is not known how USAID might interact with new construction, providing the proper air handling equipment and acoustic treatment of such facilities. Therefore, no further detail is presented in this report in this regard. It is essential, however, that proper environment be provided.

4.7 LINKAGES AND NETWORKING

4.7.1 New Institutional and Professional Linkages

One of the major objectives of IEP is to nurture linkages that will support the department's development and its research efforts. The primary mechanisms for establishing the needed linkages are the reciprocal visits of UET and American faculty and their joint participation in supervising sandwich Ph.D. programs.

In addition to funding for travel and study, the development of lasting linkages requires coordination and assistance of the program facilitator to ensure that the proper contacts are made initially. Also, serious effort is needed to improve communications between the U.S. and Pakistan. The IEP and USAID should work with the UGC and

other agencies in Pakistan to establish a reliable computer-mail network that will permit Pakistani researchers to communicate readily with colleagues in other countries. Until such a network is available, facsimile machines must be provided, and the international telephone charges must be paid.

Within Pakistan professional linkages will be encouraged by more frequent conferences, seminars, and workshops. Professional publications within the Pakistani electrical engineering community should also be encouraged in order to link faculty at various universities and engineers in industry and government. Some funding might be made available to simulate these activities and to disseminate locally relevant research results.

4.7.2 New Industrial Linkages

In response to the assessment team's urging to establish a unified focus for future linkages with industry, we were presented with separate lists for each of the areas of specialization. These are summarized in the following.

Three or four two- to three-day seminars will be conducted each year, with possibly more during the July-to-September break, structured to fit the needs of industry. These may well be directed to existing problems of such agencies, or may be structured to introduce new technology and methods. With the development of a high-performance computer system at UET, and with the inherent improvements of the electronics, communications and power areas, UET should be able to attract considerable industrial interest and support.

The proposed seminars, for example, would center on industrial automation; introduction of CAD (Computer Aided Design) systems for many disciplines; trends of future development in communications systems, especially digital communication systems; electrical energy systems management and dispatch, and design automation workshops. Such seminars would certainly be of interest and value to the public sector enterprises such as WAPDA, the telecommunications system, the railway system and the military. Once UET is recognized as a solid source of advancement of technology, large private industries will probably take part in such seminars as both listeners and contributors. This should lead to ties with firms such as DESCON, PEL, and CUMAX, who all have strong interests in power electronics as well as many other

engineering disciplines. UET staff are indicating they will value the two-way interchange with industry, although this is essentially a new experience.

UET is also suggesting that it plans to develop a variety of one to two-week workshops providing more detail and interaction regarding a broad range of topics centered on their new computer strengths. These might involve parallel processing in Pakistan, trends of simulation (of a broad range of digital and continuous control systems, communications systems, etc), data acquisition, and microprocessor support of modern manufacturing, to mention a few. As these ideas become well established, UET would move into advanced topics such as energy management systems in a very broad sense, not simply of WAPDA's interest; microprocessor instrumentation for the process industry to optimize productivity and to establish and maintain high quality; and advanced digital communications.

It should be noted that the area of communications could be a field where new advances could have tremendous impact. The telecommunications systems in the U.S. continue to be based on analog transmission of signals from the end-user up to at least the local exchange. The U.S. telephone industry would benefit greatly if all transmitted signals could be transmitted digitally. The base in the U.S. is so large that this can be done only over a span of many years at great cost. With the Pakistani telecommunications being of rather limited scope and being quite unreliable, it would be of great value to start again, where possible, building an all-digital system. In this endeavor, UET would be a great asset to Pakistan.

As UET became ever more sophisticated, they would be prepared to interact more fully with the textiles industry in automating their processes, not necessarily replacing the laborers, but in assuring a greater production of a quality product, thus providing goods for export on the international market. Similarly, they could support the paper manufacturing industry, railroad traffic control (enhancing safety), power systems protection and efficient operation, management information systems to help business management have stronger ties with the production floor and the consumer market.

Although it took quite some effort and urging to get the UET staff to consider development of the list of items mentioned above, we and they know development of any one of these programs will require inordinate effort on their part. As the many

different areas are considered it must be realized that development of these seminars and workshops will require the coordinated and integrated effort of the entire existing Electrical Engineering staff, as well as that of new faculty and faculty in other departments at UET.

4.8 SUPPORT FOR RESEARCH PROJECTS

In order for the electrical engineering faculty to undertake specific research projects, they will require financial support to cover various research costs besides the purchase of major equipment. These costs include purchase of supplies and minor components, fabrication and other services, communication, travel, and perhaps some salary support.

A major innovation in Lahore would be the establishment of Research Assistantships for post-graduate students. That is, funds should be provided to pay full-time graduate students so that they pursue their research without the distractions of another job. Funding for graduate students could be channelled through specific research projects so that a particular professor could recruit student assistants to work with him. Some fellowships could also be provided through student competitions to encourage the best students to undertake full-time graduate study.

A mechanism for allocating the equipment money has already been suggested. Proposals for specific purchases would be reviewed and evaluated annually by a committee consisting of representatives of UET, UGC, and USAID. The same group could allocate research funds for proposed projects. Peer review within Pakistan might be used to obtain input on research quality and relevance. Some weight might be put on cost-sharing to encourage cooperation with industry. Proposed projects with industrial endorsement and partial support would be viewed favorably. Also, collaboration among UET faculty on joint projects would should be encouraged by the funding decisions.

Annual renewals of project funding should depend on documentation of satisfactory progress. Researchers should be encouraged to make use of linkages provided by IEP technical assistance.

4.9 TIME SCHEDULE

The time schedules for staff development and for technical assistance have been presented in earlier sections. Those schedules are summarized in the following table.

Anticipated Schedule for Staff Development, Technical Assistance, and International Networking Activities

Year One

Activity

1. Linkage (Vice Chancellor - two weeks)
2. Linkage (K.E. Durrani and M. A. Chugtai - two weeks each)
3. Linkage (A. Hameed - two weeks)
4. Staff Training (Computers - two months)
5. Linkage (M. A. Chugtai, N. M. Sheikh and A. H. Shah - two weeks each)
6. Sabbatical (M. A. Iqbal - six months)
7. Ph.D. (M. Saleem and M. Imran - first year)
8. Ph.D. (A.H. Khan and W. M. Khan - first year)
9. Networking (three US faculty for four weeks each)
10. Technical Assistance (one US faculty in computer engineering - six months)
11. Technical Assistance (four US faculty - four weeks each)
12. Technical Assistance (local consultant - one month)

Year Two

Activity

1. Ph.D. (K. M. Hassan - first year)
2. Ph.D. (M. Saleem and M. Imran - second year)
3. M.S. (N. A. Mufti - first year)
4. Ph.D. (A. H. Khan and W. M. Khan - second year)
5. Ph.D. (T. Izhar - first year)
6. Technical Assistance (one US faculty in communications - six months)
7. Technical Assistance (four US faculty - four weeks each)
8. Technical Assistance (local consultant - one month)

Year Three

Activity

1. Ph.D. (K. M. Hassan - second year)
2. Ph.D. (I. Ahmed - first year)
3. Ph.D. (M. Saleem and M. Imran - third year - at UET)
4. Ph.D. (A. H. Khan and W. M. Khan - third year - at UET)
5. Ph.D. (T. Izhar - second year)
6. Ph.D. (S. H. Shami - first year)
7. Sabbatical (M. Saeed - six months)
8. Technical Assistance (one US faculty in electronics - six months)
9. Technical Assistance (four US faculty - four weeks each)
10. Technical Assistance (local consultant - one month)

Year Four

Activity

1. M.S. (Computer engineering - first year)
2. Ph.D. (K.M. Hassan - third year - at UET)
3. Ph.D. (I. Ahmed - second year)
4. Sabbatical (M.A. Chugtai - six months)
5. Ph.D. (N. A. Mufti - first year)
6. Sabbatical (N. M. Sheikh - six months)
7. M.S. (communications - second year)
8. Ph.D. (T. Izhar - third year - at UET)
9. Ph.D. (S. H. Shami - second year)
10. Sabbatical (J. Iqbal - six months)
11. Sabbatical (M.Z.A. Khan - six months)
12. Technical Assistance (one U.S. faculty in computer engineering - six months)
13. Technical Assistance (four U.S. faculty - four weeks each)
14. Technical Assistance (Local consultant - one month)

Year Five

Activity

1. Ph.D. (I. Ahmad - third year - at UET)
2. Sabbatical (S.H. Bokhari - six months)
3. M.S. (Computer engineering - second year - at UET)

4. Ph.D. (N. A. Mufti - second year)
5. Ph.D. (Communications - first year)
6. Ph.D. (S. H. Shami - third year - at UET)
7. Sabbatical (A. H. Shah - six months)
8. Technical Assistance (one U.S. faculty in communications - six months)
9. Technical Assistance (four U.S. faculty - four weeks each)
10. Technical Assistance (local consultant - one month)

Year Six

Activity

1. Ph.D. (Computer engineering - first year)
2. Sabbatical (Z. A. Alvi or M. N. Ayyaz - six months)
3. Ph.D. (Communications - second year)
4. Sabbatical (M. Saleem - six months)
5. Sabbatical (A. H. Khan - six months)
6. Linkage (T. A. Shami - two weeks)
7. Technical Assistance (one U.S. faculty in electronics - six months)
8. Technical Assistance (four U.S. faculty - four weeks each)
9. Technical Assistance (local consultant - one month)

Other activities will proceed as rapidly as the faculty is prepared to implement them. The faculty and the UET project management office will be asked to prepare annual work plans along with specific proposals for equipment purchases and research projects. These work plans should include proposed short courses and conferences and other local networking activities. Procurement schedules for library materials should also be presented for approval of the annual review team.

4.10 ESTIMATED BUDGET

The following assumptions were made for the estimates given in the table:

a) Unit cost for networking and linkages is taken to be $2,724 for UET staff and faculty plus a travel component of $4,525.

b) Unit cost for technical assistance is $10,000 per month for US faculty plus a travel component of $4,525.

c) Unit cost for Ph.D. study in U.S.A. is $23,184 per year plus a travel component of $4,525 for the first year. The corresponding unit cost is Rs. 4,000 ($200) per month at UET.

d) Unit cost for M.S. study in USA is $22,540 per year plus a travel component of $4,525. The corresponding unit cost at UET is Rs. 3,000 ($150) per month.

e) Sandwich-type Ph.D. programs have a two-year component in USA and one year at UET. The MS program has one year in USA and another at UET.

Based on the proposed schedules, recommended inputs, and the types of equipment that are needed, an estimated budget has been prepared. This budget is presented on a year-by-year basis in the following table.

Estimated Budget for IEP Implementation at UET

Category Year	1	2	3	4	5	6	Total
Training	150,000	180,000	135,000	220,000	100,000	115,000	900,000
Visitors	150,000	125,000	125,000	125,000	125,000	125,000	775,000
Equipment	150,000	125,000	125,000	125,000	125,000	125,000	775,000
Research	10,000	20,000	30,000	30,000	30,000	30,000	150,000
Fellowships	3,000	5,000	5,000	5,000	5,000	5,000	28,000
Networking	45,000	5,000	5,000	5,000	5,000	11,000	76,000
Management	10,000	5,000	5,000	5,000	5,000	5,000	35,000
Books, Journals	50,000	50,000	50,000	50,000	50,000	50,000	300,000
Conferences	30,000	30,000	30,000	30,000	30,000	30,000	180,000
Communications	5,000	5,000	5,000	5,000	5,000	5,000	30,000
Total	603,000	550,000	515,000	600,000	480,000	501,000	3,249,000
Total	603,000	583,000	578,654	714,609	605,988	670,451	3,755,702
Contingency							500,000
Total							4,255,702

The budget for equipment exceeds the items listed explicitly in Section 4.6. It is expected that additional equipment will be needed by the department as research activities proceed. Visiting scientists and staff will identify needs for specific activities. Purchase of various items will require proposals for the annual review and must be justified in terms of a program plan.

Some basic equipment is needed to support the department shop for construction and testing of apparatus. This category of equipment is included in the general equipment budget. Some small equipment will be selected for purchase as a result of individual research proposals as well.

The equipment cost in the budget table includes the costs of delivery and installation.

Other categories in the budget include funding for research projects, student fellowships, networking in Pakistan, including local conferences and short courses, travel to international conferences, procurement of books, journals, and other bibliographic materials, communications with colleagues abroad, and local management. The first three of these have been discussed elsewhere in this report. Additional comment is needed with respect to the other items.

Funds are provided for faculty to travel to international conferences. This is an important method of establishing networks and linkages because of the opportunity to meet people as well as the access to recent research activities on the international scene. The local management office should have some flexibility in spending these funds because it is often necessary to submit registration materials by a deadline that will not allow time for extensive review. The facilitator and other linked faculty abroad can suggest interesting opportunities.

Significant funding is proposed for books and journals. The project and the UGC should look into new methods of gaining access to technical information. Funds provided here might be used for access to new electronic media in addition to traditional hard-copy journals.

The problem of effective international communication has already been mentioned. A reliable system of communication must be established in order for linkages to be effective. Funding provided here may be used initially for FAX and telephone costs. An effort should be made to connect with the international electronic-mail network.

Related to the communication problem is the need for an effective project management system at UET. UET should be expected to provide adequate staff and facilities to ensure that the project moves ahead efficiently. Funds are provided here for any required foreign-exchange currency to buy office equipment, including word processing computers, FAX, and copying machines. Good international communication is especially critical with this office.

Individual entries in the budget table are estimates given in current U.S. dollars. The bottom line of the table shows the annual estimates adjusted for a 6% inflation rate. A contingency of $500,000 is also included. It may be that costs for equipment delivered and installed in Pakistan will be much higher than expected. Also, average unit costs for training overseas and for visiting faculty may be higher than assumed.

It should be noted that the estimated budget does not include costs of MUCIA management and support in Islamabad or in the U.S. It does not include costs for visits to Lahore of the facilitator nor the facilitator's home office expenses.

4.11 BENCHMARKS AND MONITORING

The proposed program and the implementation procedures suggested for the Electrical Engineering Department at UET have built-in criteria and mechanisms for evaluation. Quantitatively, there are schedules laid out for faculty development, for technical assistance by visiting faculty, and networking activities. Therefore, the project can be evaluated with respect to implementation of those schedules. Important benchmarks will be a growing number of full-time graduate students, establishment of research projects, especially those related to local industry, and appearance of research publications from UET, both in Pakistan and internationally.

Qualitatively, an annual review has been proposed in which all aspects of the project will be considered. Continued support and specific expenditures will depend on faculty documentation of their progress. Purchase of additional equipment and funding

of specific research projects will depend on progress reports and proposals prepared by the faculty. Annual reports from MUCIA, with input from the facilitator and visiting scientists, should also be considered in evaluating progress and allocating additional resources.

After the initial years of project start-up, and especially at the end of the project, the criteria for evaluation will be the level of research activity, an established graduate program with full-time graduate students and a flow of research publications. Most importantly, the department should establish close relations with industry, and a number of applied research projects should be developed. A successful project will lead to enhanced funding for research from industry and government agencies such that the post-graduate program and the faculty research can be sustained by outside funding after the IEP support ends.

5. APPENDICES

APPENDIX 5.1 -- SOURCES CONSULTED

"Scope of Work" for USAID Pakistan-89-0498-030, Institutional Excellence Project

"Institutional Excellence Project (IEP) - Preliminary Institutional Analyses 4-13 June, 1990", prepared by MUCIA staff

"Higher Education and Scientific Research Sector in Pakistan - an Overview", Government of Pakistan(?), circa 1988

"Restructuring of Engineering Education and Research in Pakistan", Report of the Study Group, University Grants Commission, Islamabad, 1983

Undergraduate Prospectus, 1991 Entry, University of Engineering and Technology Lahore

Budget Estimates for the Year 1990-91, University of Engineering and Technology Lahore, August 1990

"Revised Outline of Courses of Reading for the Annual System", Department of Electrical Engineering, University of Engineering and Technology Lahore, 1990

Various proposals for the establishment of a Center for Postgraduate Studies prepared by Department of Electrical Engineering, University of Engineering and Technology Lahore, 1988-1990

"Consultants' Report on Upgrading Energy-Related Undergraduate Engineering Education in Pakistan", prepared for USAID, Islamabad, by Dr. M.S. Chen, Dr. Zaheer Fikri, et al.

"Commodity Procurement Document" for USAID project, "Upgrading Energy-Related Undergraduate Engineering Education in Pakistan", prepared by M.S. Chen, Zahir Fikri, J.D. Westfield, and Azam Soofi, November 1990

Draft copies of Chemistry and Geology IEP Assessment Team reports, 1990

APPENDIX 5.2 -- COMPOSITION OF ASSESSMENT TEAM

Prof. Thomas W. Chapman, University of Wisconsin-Madison (team leader)
Prof. Richard M. Marleau, University of Wisconsin-Madison
Prof. Sadaruddin Shaikh, Mehran University, Nawabshaw, Pakistan
Prof. Oner Yurtseven, Purdue University at Indianapolis

The team was also joined for part of its time in Lahore by **George McCormick** and **Nick Poulton** of the MUCIA Islamabad office and by **John Monagle** and **Charles Aanenson** of USAID, Islamabad.

APPENDIX 5.3 -- INDIVIDUALS INTERVIEWED

Faculty members of the Electrical Engineering Department, University of Engineering and Technology (UET), Lahore:

Vice-chancellor Ikram-ul-Haque Dar, UET

Dr. George McCormick, MUCIA, Islamabad

Dr. Nick Poulton, MUCIA, Islamabad

Dr. John Monagle, USAID, Islamabad

Mr. James Norris, USAID, Islamabad

Ms. Nancy Tumavick, USAID, Islamabad

Mr. David Sprague, USAID, Islamabad

Mr. Charles Aanenson, USAID, Islamabad

Mr. Farrukh Mahmood, Office of Energy, USAID, Islamabad

Dr. M. H. Qazi, University Grants Commission, Islamabad

Mr. Anjum Ahmad, Office of Energy, USAID, Islamabad

Mr. S. Imtiaz Rasul, Branch Manager, Siemens Pakistan Engineering Co., Ltd., Power Engineering Division, Lahore

Mr. Javaid Akhter, Member (Power), Water and Power Development Authority (WAPDA), Lahore

Mr. Mian Saleem Hasan, General Manager, Telecommunications, Water and Power Development Authority (WAPDA), Lahore

Dr. Kazi Ain Uddin Ahmad, Senior Executive Director, Escorts Group of Companies, Lahore, and National Institute of Power

Dr. Zahir Fikri, Managing Director, Face Limited, Consulting Engineers, Lahore

Dr. James D. Westfield, General Manager, Mathtech, Inc., Consultants to Energy Wing, Ministry of Planning & Development, Islamabad

Mr. Azam Soofi, Mathtech, Inc., Consultant to USAID on energy-education project, Islamabad

Dr. M. Qayyum, Managing Director, Pakistan Electric Co., Ltd. (PECO), Lahore

Mr. Razaque Dawood, Managing Director, Descon, Ltd., Lahore

Mr. Mazhar-ud-Din Ansari, Director of Engineering, Descon, Ltd., Lahore

Mr. Zubair Munir Khan, Senior Manager (Business Development), Descon, Ltd., Lahore

Prof. Imran, Chairman-designate of the new Computer Sciences Department, UET.

APPENDIX – 5.4 RECOMMENDATIONS TO DEPARTMENT

The following recommendations were given to the department by the assessment team during their visit.

1. Academic Programs

- B.Sc. Program

  Merge power, electronics, computer and control options so that they have common courses during the first two years;

  Delete excess electrical machinery courses and high-voltage courses as recommended by energy group;

  Delete surveying course at the freshman level and introduce computer or graphic courses;

  Add more humanities and social sciences courses as requirements;

  Change the freshman level FORTRAN course to PASCAL and teach it as an EE course within the department.

- M.Sc. Program

  Make an advanced calculus or numerical analysis course a required graduate math course for all options;

  Increase the quality of the M.Sc. thesis work;

  Generate industry-oriented projects to be used as M.Sc. thesis work;

  Increase the number of full-time M.Sc. students by offering stipends in selected areas such as electronics, communication and computer engineering;

  Facilitate more assistant professors (new arrivals) to teach graduate-level courses.

- Ph.D. Program

  Select computer engineering/communications area as pilot Ph.D. program during the next several years;

  Develop a few core Ph.D. courses in this area;

  Provide stipends for local Ph.D. candidates;

  Send young faculty with the M.Sc. degree completed to USA for Ph.D. work in other areas such as electronics and control for a full duration.

2. **Support Services**

- Library

  Provide the continuation of journal support from the government of Holland;

  Purchase collection of current graduate level textbooks in electronics, communications, control and power systems;

  Cover the IEEE membership and subscription fees of selected faculty (one or two in each area) for the next five years to special journals in their area of interest and make the journals available to the department library

- Computers

  Improve computing access for undergraduate and postgraduate students and faculty;

  Provide a cluster of (2-5) work stations and necessary peripheral devices (disk drives, printers, card slots, etc.) for research purposes only.

3. **Equipment**

- General

  This would be complementary to the equipment to be provided by the energy group. It may include oscilloscopes, signal generators, data acquisition systems, microcomputer chips and a generous amount of individual electronic components.

- Specialized

  This equipment can be moderately sophisticated engineering work stations with parallel processing capability, desk-top publishing and printing and graphics functions.

4. Personnel

- Faculty

  Two faculty positions in computer engineering, two in control/communications and one in power systems or electronics are needed, preferably filled by new young Ph.D.'s from abroad.

- Systems Engineer

  System analyst with at least B.Sc. degree (preferably M.Sc.) in engineering or computer science to manage the computer services of the Department.

- Computer Technician

  He will assist the systems engineer and provide maintenance to computer equipment of the Department.

5. Facilities

- Computer Space

  Laboratory space for microcomputers, work stations and development area must be environmentally controlled (temperature, humidity, with positive pressure air with no dust)

6. Other

- Separately administered modest "foundation budget" to cover various items such as components, special equipment, research publication expense, supplementary travel and research seed money for young, newly starting faculty.

APPENDIX 5.5 -- MEETINGS WITH INDUSTRY

5.5.1 DESCON

On 7 November, 1990 Marleau and Sheikh visited DESCON Engineering (PVT). They had the honor of meeting with:

Razak Dawood, Managing Director,
Mazharuddin Ansara, Director of Engineering, and
Zubair Munir Khan, Senior Manager in Marketing.

This was an extremely enlightening and potentially very beneficial meeting. Dr. Dawood very casually mentioned his affiliation with and interests in advanced education. It was only after Marleau's query that Dawood indicated that he was Rector of Lahore University of Management Sciences (LUMS) in Lahore. This is the most prestigious business school in Pakistan, patterned after Harvard in the U.S. and extremely well funded.

Dawood indicated great interest in being involved more closely with UET. As his discussion opened, he indicated that the performance of UET had fallen drastically in recent years. He stated that the exam his company offers to potential employees was being completed satisfactorily by less than 20 percent of the current graduates, having fallen from a much higher rate in years past. He returned very positively, however, indicating that those students that he has hired from UET have done exceptional work once they have worked their way through the company's introductory courses (not formally structured) and on-the-job training. He was very enthusiastic.

Dr. Dawood continuously stressed the need for "systems" engineers, i.e., electrical engineers that could pull a lot of systems together under computer control and interfacing. He further stressed the need of teaching **design**, i.e., the design method. He feels that engineers can no longer simply assemble devices, but they have to carefully evaluate many fine details and aspects of the design, regarding material properties, strengths, tolerances, etc. He then brought up one more word that is challenging the world's manufacturing community, **quality** and quality control.

When asked about the possibility of starting an engineering school at LUMS, Dr. Dawood indicated that various groups are always attempting new ties, for example with

the textile industry, setting up a textile institute. He felt that such mention of plans should be of no concern to UET or USAID.

All three DESCON executives indicated that they felt it best to employ Pakistani engineering school graduates rather than look to the international market. They would be willing to serve on an advisory board for UET if they were requested. They are ready to share problems with UET staff and students. This is the type of opportunity that could open the door for extensive interchange between academia and modern industry.

Marleau feels that strengthening this tie should not simply be left up to UET and DESCON, but that USAID personnel might be of great value in establishing a strong interaction. Dr. Dawood has very positive feelings with regard to the U.S. and USAID. He was extremely interested in the role that MUCIA is playing in this project. He further indicated that his son had applied for entry into Mechanical Engineering at the University of Wisconsin.

5.5.2 PECO

Pakistan Engineering Co. Ltd. Dr. M. Abdul Qayyum, Manager. Held 60% by GOP, 40% by private investors.

Annual sales Rs. 810,000,000, including 35,000 tons of power transmission tower last year. Very heavy equipment manufacture, lathes, milling machines, motors 1 HP to 150 HP, 150,000 bicycles last year.

PECO has had ties with USAID in a variety of energy projects. PECO likes to hire experienced engineers with **practical** knowledge of the process and materials. They can easily go outside Pakistan to find quality and performance in new-hire personnel.

Dr. Qayyum likes the Yugoslavian program of having engineering students spend one month per year in industry. He feels it would be a good idea to set up a cooperative-type program. PECO would welcome working with UET. It is clear, however, that UET must take the lead in this regard. Rather than him going to the school to hire students or professors, they must extend themselves to establish ties with him. Qayyum strictly believes in the market economy.

APPENDIX 5.6 -- BIODATA FOR ELECTRICAL ENGINEERING FACULTY

NAME:	**Durrani, K.E.**
AGE:	47
RANK:	Professor, Chair
AREA:	Power
B.S.:	1966, UET
M.S.:	1967, UMIST
Ph.D.:	1970, UMIST
GRAD. COURSES:	554, 555

PUBLICATIONS:

An introduction to *Electrical Machine Analysis*. Volume 1 Basic Mathematical Models National Book Service (Pakistan 1979. P. 269)

"Representation of Solid Rotors in Dynamic Response Analysis of Turbo- Generators." IEE (UK) publication on "Application of Computers in Field Problems" Mat 1967.

"A Generalized Curve Fitting Method," Electrical Engineering Review Vol. 2, No. 2, 1971

"Dynamic Response Analysis of Inter-Connected Synchronous /Asynchronous Machine Groups"

"Multi-Node Power Systems Dynamic Analysis," Proc IEE 1972 119(B), P. 1167-1175

"A Reduced Induction Motor Review," Vol. 2, No. 1, 1972.

"A Plan of Courses Dealing with the Numerical Application and Engineering Aspects of Computer Science Education," Computer Science Conference at University of Islamabad, March-1974.

MEMBERSHIPS: MIEE (Pak)

COMMENTS:

Specialties: Analysis and design of power systems, electrical machine analysis and system modeling.

Textbook, *Electrical Machine Analysis* (1979), included in count of publications. No other publications reported since 1974.

NAME:	**Haque, S. M.**
AGE:	57
RANK:	Professor, Dean
AREA:	Power
B.S.:	1956, Ahsmullah College, Dacca
M.S.:	1960, Kings College, London
Ph.D.:	1969, UMIST
GRAD. COURSES:	556
PUBLICATIONS:	5
MEMBERSHIPS:	FIE (Pak)
COMMENTS:	Specialties: High-voltage engineering, power systems, power system protection, energy and electrical machines. Publications occurred between 1960 and 1974. Continued to supervise M.S. theses until 1985. Will retire next year.

NAME:	**Bukhari, A.R.S.**
AGE:	46
RANK:	Professor
AREA:	Electronics
B.S.:	1965, UET
M.S.:	1972, Aachen
Ph.D.:	1982, Medical and Dental University, Tokyo
GRAD. COURSES:	573, 577, 581, 564
PUBLICATIONS:	"Computer Simulation and Experimental Analysis of Unpolarepicardical Potentials in Relation to the Direction of Propagation of the Excitation," Bull. Tokyo Med. and Dent. Univ. 28.3.77-86(1981) "A Three Channel Telemetry System for Monitoring EGG, Cardiac Output, Rate of Respiration and Basal Tranthoracie Admittance " Med. and Biol. Engr. and Computers., 19,426-432(1981). "A Telemetry System for Monitoring Cardiac Output by Electrical Admittanceplethsmography " Rept. Int. Med. and Dent. Engr.., 13 (1979). "Clinical Syaluation of an Electrical Admittance Blood Flow Monitor", J. Clinic Eng. 4, 341-346 (1979). "Use of Electrical Admittance Plethysmography for Transmission of Cardiopulmonary Parameters," Presented at the 5th International Conference Electrical Bio-Impedance in

August 1981 in Tokyo, Japan and published in the Proceeding of the Conference, pp. 60-61 (1961).

"A Single Channel Telemetry System for Monitoring Cardiac Output, Heart Rate and Rate or Respiration," Presented at the 5th International Symposium on Biotelemetry held in June 1980 at Kyoto, Japan and published in the Proceeding Bio-telemetry V. 235-237 (1980).

"Estimation of Cardiac Output by Admittance Plethsmography at Rest and Auring Exercise," presented at the 19th conference of the Japan Society of Medical and Biological Engineering.

"Cardiac Arrival Time Analyzer" accepted for publication in the IEEE Transactions on Biomedical Engineering as a communication article.

MEMBERSHIPS:

COMMENTS: Going to Saudi Arabia. Probably will not return to UET. Specialties: Biomedical instrumentation and digital computer interfacing.

All publications between 1977 and 1981.

NAME: **Sheikh, Noor Mohammad**
AGE: 41
RANK: Professor
AREA: Communication
B.S.: 1970, UET
M.S.: 1973, PII, Eindhoven, Holland
Ph.D.: 1979, UET
GRAD. COURSES: 565, 567, 569, 571

PUBLICATIONS: Noor M. Sheikh K. Rawer and E. Neske, "Latitudinal and Longitudinal Variations of the F2-Layer Peak Electron Density Obtained from Measurements and Comparison with the Predictions from the CCIR Model". Presented at XIX General Assembly of URSI (International Union of Radio Science). HELSINKI, 31. July-8 August 1978.

D. Bilitza, Noor M. Sheikh and R. Eyyrig, "A global Model for the Height of the F2-Maximum Using M3000 from CCIR," presented at XIX General Assembly of URSI, Holsinki 31-July-8 August 1978.

Noor M. Sheikh K. Rawaer and E. Neske, "Measured Electron Densities Compared with CCIR Predictions," presented at

ASHAY Conference, Alpbach, May 1978. (Abstracts COSPAR XXIII Plenary Meeting, Innsbruck 1978, p. 21).

Noor M. Sheikh E. Neske, K. Rawaer and C. Rebstock, "Comparison of Peak Electron Densities of the F2-Layer Derived From *insitu* Measurements with CCIR Predicitions", Telecommunication Journal, 45 (5), May 1978, Pp. 225-227.

Noor M. Sheikh K. Rawer and E. Neske, "Electron Density in the South Atlantic Anomaly Region", presented at Ashay Conference, Alpbach, Austria, May 1978. (Abstracts COSPAR XXIII Plenary Meeting Innsbruck, 1978, p. 16).

K. Rawer, D. Bilitza, S Ramakrishnan and N.M. Sheikh "Intentions and Build-up of the International Reference Ionospher", AGARDCPP-238, Ottawa, April 1978, pp. 6.1 - 6.10.

K. Rawer, C. Rebstock Noor M. Sheikh D. BIlitza and E. Neske, "World- wide Description of Ilnospheric Topside Electron Density," Space Research, Vol. XVIII, 1978 pp. 229-231.

Faheem Akhtar, Noor M. Sheikh A. Javed and M.D. Grossi, "Impulse Response of a Meteor Burst Communication Channel Determined by Raytracing Techniques," IEEE Transc. on Communications, April 1977, pp. 367-470.

Noor M. Sheikh "Optimum Detection of Peaks in Gaussian Noise with Linear Background," Electrical Engineering Review, EED, UET, (Submitted).

Noor M. Sheikh, "Digital Speech Link Using Delta Modulation," presented at the Seminar on Electronics, IEE (Pak). May 1975.

Noor M. Sheikh. "Detection of Peaks and Estimation of Peak Parameters in Spectral Data", Phillips Res. Report, NATLAB, Rep. No. 4798, 1973.

Noor M. Sheikh "Design of a Monolithic Amplifier for Digital Regenerative Repeater", PII Report. 1972.

MEMBERSHIPS:

COMMENTS: Specialties: signal processing, telecommunications, satellite communications, data transmission, and line-of-sight systems.

All publications between 1972 and 1978, prior to completion of Ph.D. His Ph.D. research work was done at IPW, Freiburg, FRG, with support from DAAD.

NAME: **Shah, Azhar H.**
AGE: 46
RANK: Professor
AREA: Electronics
B.S.: 1966, Punjab; 1970 Loyola, US
M.S.: 1973, Loyola(L.A.), US
Ph.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: electronic circuit design, control systems for industrial and military applications.

All publications in 1985-86. Director of undergraduate studies.

NAME: **Chughtai, Muhammad Ashraf**
AGE: 40
RANK: Professor
AREA: Computers
B.S.: 1973, UET
M.S.: 1978, UET
Ph.D.: 1986, UMIST
GRAD. COURSES: 573, 574, 576, 577, 578, 588

PUBLICATIONS: "Complete Binary Spanning Trees of Eight Nearest Neighbour Arrays," IEEE Transc. on Computers, Vol. C-34, No. 6, June 1985, pp. 547-549.

"Use of Multiplexers in Direct Synthesis of ASM-Based Designs," IEE Proc. Digital Techniques, Pt. E, Vol. 133, No. 4, July 1986, pp. 194-200.

"Six Channel DM-TDM Line Link," Journal of IEEP, Vol. V, No. 3, 1978.

"On the Synchronization Problems in DM-TDM Line Link," Fourth National Conf. on Electronics, Islamabad, Inst. of Electronics, April 1984.

"Pseudo Exhaustively Testable ASM-Based Design of Digital Systems," IEE Proc. Digital Techniques, Pt. E, Vol. 134, No. 5, Sept. 1987, pp. 237- 242.

"Hierarchy of Automatic Synthesis of Digital System," IEEP Pro; 17th Annual Conventional, April 22-23, 1987.

"Signature Testable Design ASM-based Digital Systems," Submitted with IEE to appear in Proc. on Digital Techniques.

"Digital Logic Design: Experiment," Basic Publishers in 1988.

MEMBERSHIPS: MIEE (Pak)

COMMENTS: Specialties: Computer design and interfacing techniques, testable and fault-tolerant digital system design, computer-aided design, simulation techniques and VLSI systems.

Six publications are within last four years. In addition, he has written a laboratory textbook, *Digital Logic Design Experiments*, (1988). Organized industrial workshop on data acquisition. Director of graduate studies.

NAME: **Hameed, Abdul**
AGE: 48
RANK: Professor
AREA: Power
B.S.: 1964, UET
M.S.: 1974, UET
Ph.D.:
GRAD. COURSES: 555

PUBLICATIONS: "Introducing Diakoptics," Research Bulletin, UET, Vol. 1, No. 3, December, 1969, pp. 109-114

"Diakoptics Applied to Poisson Type Networks" 13th Annual Science Conference, 1970, Pakistan,

"Transient Performance of Induction Machines" 14th Annual Science Conference, 1971, Pakistan

"Measurement of Induction Motor Parameters From Equivalent Circuits" Research Bulletin, UET, vol. 3, No. 1, April 1972,

"Transients in Induction Machine Within the Vicinity of Steady State Operation" 15th Annual Science Conference, 1972, Pakistan

"Application of Lagrangian Equations in Tensorial Form" 15th Annual Science Conference, 1972, Pakistan

"Some Aspects of Lightning Protection of Gas Insulated Sub-Station." Research Bulletin, UET, vol. 1, No. 2, 1978, pp. 269-287.

"Simulation of an Alternator on A.P.C. for Transient Stability Studies," IEEP Journal, vol. XIX, Jan-June, 1989 (No. I-II) 7-21

"Hydro Electric Power Station on Man Made Canals in Pakistan," Accepted by IEE Journal, Ref. IEEP-153/HQ-88/309, 1988.

"New Approach for Designing Cross-Trip Scheme for Trabela Power Station," Accepted by Research Bulletin-UET, letter Ref. DR/56-Pub/476 dated 20.2.1990.

"Computer Aided Monitoring of 3-Phase Distribution Transformer Circuits," Accepted by Research Bulletin-UET, letter Ref. Dr/56- pub/796 dated 1.4.1990.

"Computer Aided Design for Lightning Protection of Structures," Accepted by Research Bulletin-UET, letter Ref.Dr/56-796 dated 1.4.1990.

"Resources Leveling for Power Transformers Using Network Technique," Accepted by Research Bulletin-UET, letter Ref.No. DR/56-pub/859 dated 5.4.1990.

"Implications of the Influencing Factors Causing Damage to the Distribution Transformers and the Remedial Measures," Accepted by Research Bulletin-UET, letter Ref. No. DR/56-pub/858 dated 5.4.1990.

"Optimization of Time Cost Schedule of a Typical 220/132 KV Station Using CPM Techniques," Accepted by Research Bulletin-UET, letter Ref.No.DR/56pub/857 dated 5.4.1990.

MEMBERSHIPS: MIEEE (USA), FIEE (Pak), MASEE (US)

COMMENTS: Specialties: power system analysis, electrical machine analysis, design and analysis of industrial power systems.

Six of publications produced between 1970 and 1974. Nine publications appeared between 1987 and 1990. Nine were in UET Research Journal.

NAME:	**Shami, Tabrez Aslam**
AGE:	46
RANK:	Professor
AREA:	Power
B.S.:	1967, UET
M.S.:	1977, UET
Ph.D.:	1985, UMIST
GRAD. COURSES:	557
PUBLICATIONS:	"Dynamic Model of a Surge Arrester for Computer Calculation of Lighting Performance of Substantion," IEE proceeding, Vol. 131, pt, C, No. 7, Nov, 1984. "Some Aspects of Modelling Surge Diverter Characteristics," UPEC-1982. "Mathematical Modelling of Current Limiting Surge Arresters for Computer Application," UPEC-1983 "The Use of Surge Arrester Model in the Digital Computation of Switching Overvoltages," UPEC-1984. "Application of Surge Arresters for the Protection of Composite Circuits," UPEC-1985. "Performance of Surge Arrester under Conditions of Temporary Over-voltage."
MEMBERSHIPS:	MIEE(Pak)
COMMENTS:	Specialties: power system protection, power system transients, high-voltage engineering, and dielectrics. All six publications appeared in 1984-85. Supervises high-voltage testing for industry.

NAME:	**Bokhari, Shahid H.**
AGE:	39
RANK:	Professor
AREA:	Computers
B.S.:	1973, UET
M.S.:	1976, U. Mass.
Ph.D.:	1978, U. Mass.
GRAD. COURSES:	573, 575, 577, 578, 579, 580
PUBLICATIONS:	Prof. Dr. Shahid H. Bokhari

"Data Storage for Adaptive Meteor Scatter Communication," IEEE Transactions on Communication, vol, 23, no. 3, pp. 397-39 March 1975. with A. Javed and M.D. Grossi.

"Distributed Processing at the University of Massachusetts," Proceedings of the Brown University Distributed Processing Workshop pp. 65-67, August 1977.

"Control of Distributed Processes," IEEE Computer, vol. 11, no. pp. 97-106, July, 1978. with Harold Stone.

Branching Processes and the Analysis of Conditional Waiting a Round- Robin Processor," Proceedings of the 1979 Johns Hopkins Conference on Computers and Information Science and Systems.

"Dual Processor Scheduling with Dynamic Reassignment," IEEE Transactions on Software Engineering vol. SE no. 4, pp. 341-349, July, 1979.

"On the Mapping Problems, "Proceeding of the 1979 International Conference on Parallel Processing, pp. 239-248, August 1979.

"The Scope for Microprocessor Arrays in Pakistan," Proceedings the 2nd National Conference on Electronics, pp. 187-199, April.

"On the Mapping Problem," IEEE Transactions on Computers, vol. no. 3, pp. 207-214, March 1981.

"Max: An algorithm for Finding Maximum on an Array Processor with a Global Bus," Proceeding of the 10th International Conference on Parallel Processing, pp. 302-303, August 1981.

"A Shortest Tree Algorithm for Optimal Assignments Across Space and Time in a Distributed Processor System," IEEE Transactions on Software Engineering, vol SE-7, no. 11, pp. 583-589, November 1981.

"Fast Orthogonal Derivatives on the STAR," Computers and Mathematics with Application, Vol. 8, no., pp. 367-377, 1982. With M.Y. Hussaini and S. A. Orszag.

"Navier-Stoeks Solution on the Cyber 203 by Pseudospectral Technique." Proceedings of the 10th. IMACS World Congress on System Simulation and Scientific Computation, pp. 305-307, 1982. with M.Y. Hussaini, S.A. Orszag and J. Lambiotte.

"Finding Maximum on an Array Processor with a Global Bus," IEEE Transactions on Computers, vol. C-33, no. 2 pp. 133-139, February 1984.

"Augmenting Computer Networks," Proceedings of the 13th. International Conference on Parallel Processing, pp. 338-345, August 1984 with A.D. Raza.

"Shuffle-Exchanges on Augmented Mashes, "Proceedings of the 1st. International Conference on Supercomputing System, pp. 613-617, December, 1985.

"A Partitioning Strategy for PDEs Across Multiprocessors," Proceedings of the 14th International Conference on Parallel Processing, pp. 166-170, August 1985, with Marsha Berger.

"Reducing the Diameters of Computer Networks," IEEE Transactions on Computers, vol.C-35, no. 8, pp. 757-761, August 1986. with A.D. Raza.

"Performance Tradeoffs in Static and Dynamic Load Balancing Strategies," Proceedings of the 15th International Conference on Parallel Processing. With M.A. Iqbal and J.H. Saltz.

"A Partitioning Strategy for Non-uniform Problem Distributed Computing."

"Partitioning Problem in Parallel, Pipelined and Distributed Computing."

"Multiprocessing the Sieve of Dratosthenes," submitted for publication.

MEMBERSHIPS: MIEEE (USA), MACM (USA)

COMMENTS: Specialties: computer engineering, parallel processing, distributed computing, and computer networks.

Many recent publications in international journals. Seven have appeared in *IEEE Transactions*, which is quite prestigious. Currently and frequently on leave at ICAS, NASA, Langley, VA. Returning in January 1991.

NAME: **Yasin, Muhammad**
AGE: 49
RANK: Associate Professor
AREA: Power
B.S.: 1964, UET
M.S.: 1972, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: high-voltage measurements of voltage distribution over string insulators.

NAME: **Saeed, Manzar**
AGE: 41
RANK: Associate Professor
AREA: Electronics
B.S.: 1970, UET
M.S.: 1981, UET
Ph.D.:
GRAD. COURSES: 560, 566, 568

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: microcomputers, microprocessors, digital and analog electronics.

Wrote a textbook for second-year class on electronic circuits and devices, which will be published next month. Has extensive industrial consulting activity. Has been in UET Ph.D. program for six years without progress. Wants to do Ph.D. in industrial automation using robots, but there is no qualified supervisor here. Feels he is too old for Ph.D. now at 41. He can play a key role in promoting department's interaction with industry.

NAME: **Suleman, Muhammad**
AGE: 43
RANK: Associate Professor
AREA: Electronics
B.S.: 1971, UET
M.S.: 1983, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: electronics.

Was not available for personal interview. Probably not a key player.

NAME: **Hassan, Hafiz Tehzibul**
AGE: 37
RANK: Associate Professor
AREA: Power
B.S.: 1975, UET
M.S.: 1986, UET
PH.D.: Going to UMIST, 1991.
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power transmission and distribution of electrical energy, power system analysis, and electrical machine analysis.

Has COST fellowship to go to UMIST for Ph.D. Plans to go in January.

NAME: **Hussain, Akhtar**
AGE: 41
RANK: Associate Professor
AREA: Power
B.S.: 1974, UET
M.S.: 1987, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power. Not available for interview.

NAME: **Khan, Ahmad Abbas**
AGE: 48
RANK: Associate Professor
AREA: Electronics
B.S.: 1962, UET
M.S.: 1969, Keiko Univ., Japan
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: Illumination. Considers himself too old for Ph.D.

NAME:	**Iqbal, Javed**
AGE:	41
RANK:	Associate Professor
AREA:	Electronics
B.S.:	1971, UET
M.S.:	1978, UET
PH.D.:	
GRAD. COURSES:	575

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: electronics. Not available for interview except for a conversation in hallway.

He is involved in his own family's manufacturing business. He sees opportunities in helping industry improve their operations by understanding technology that is purchased on turn-key basis. He could help with faculty's industrial contacts.

NAME:	**Saleem, Muhammad**
AGE:	41
RANK:	Associate Professor
AREA:	Communications
B.S.:	1972, UET
M.S.:	1979, UET
PH.D.:	
GRAD. COURSES:	562, 563, 568

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computer communications, industrial electronics, VHF communication.

He supervises several M.S. students. Has a two-year scholarship to go to Denison for Ph.D. studies, but he may be more interested in IEP support to go elsewhere. He could be a key individual in developing the electronics area.

NAME:	**Iqbal, Muhammad Ashraf**
AGE:	39
RANK:	Associate Professor
AREA:	Computers
B.S.:	1974, UET
M.S.:	1983, UET
PH.D.:	1991, UET
GRAD. COURSES:	

PUBLICATIONS:

"Efficient Algorithms for Partitioning Problems," Presented at IEEE International Conference on Parallel Processing, Chicago, August 1990.

"Efficient Algorithms for a Class of Partitioning Problems," NASA Langley Research Center, Report 90-49, July 1990.

"Efficient Algorithms for Dilated Mappings of Binary Trees," NASA Langley Research Center, Report 90-6, January 1990.

"A Comparative Analysis of Static and Dynamic Load Balancing Strategies," 15th International Conference on Parallel Processing, Co- authors: S.H. Bokhari, J.H. Saltz, 1986.

"Approximate Algorithms for Partitioning and Assignment Problems," NASA Langley Research Center, Report 86-40, 1986.

MEMBERSHIPS:

COMMENTS:

Specialties: Parallel processing and distributed computing.

Receiving second Ph.D. at UET in twenty years as a student of S. Bokhari. He spent eighteen months at NASA Langley doing some of his Ph.D. research. Was able to continue theoretical research at UET in spite of lack of computing facilities. Interested in post-doc and/or conferences in US. Paid his own money to attend international conference last year. Needs full-time M.S. students at UET in order to continue his research.

NAME: **Goryia, Irshad Ahmad**
AGE: 42
RANK: Assistant Professor
AREA: Electronics
B.S.: 1971, NED
M.S.: 1988, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: electronics.

NAME: **Aslam, Farooq**
AGE: 43
RANK: Assistant Professor
AREA: Electronics
B.S.: 1975, UET
M.S.: 1990, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: communications, electronics, data acquisition, biomedical instrumentation, computers and computer networks.

Sees opportunities for computer applications in industry and for faculty consulting. Has done projects himself, mainly in hospitals. Wants to continue postgraduate study in U.S. Has taken GRE and TOEFL.

NAME: **Ayyaz, Mohammad Naeem**
AGE: 30
RANK: Assistant Professor
AREA: Computers
B.S.: 1980, UET
M.S.: 1984, UET
PH.D.: IP, Syracuse
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computer engineering. He is presently in graduate program at Syracuse University.

NAME: **Ahmad, Hafiz Naseer**
AGE: 43
RANK: Assistant Professor
AREA: Power
B.S.: 1980, UET
M.S.:
Ph.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power systems, transmission and distribution of power.

He has completed all courses required for M.S. and is now doing a thesis with Saleem. Project involves continuous power supply using flywheel. Shami will supervise him if Saleem goes away. He has been nominated for Canadian fellowship for Ph.D. Wants to do the Ph.D., either abroad or in a sandwich program.

NAME: **Ahmad, Masood**
AGE: 30
RANK: Assistant Professor
AREA: Electronics
B.S.: 1981, UET
M.S.: IP, Texas
Ph.D.: IP
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: control and electronics.

Presently doing postgraduate degree studies at the University of Texas at Austin. He has S&T fellowship for Ph.D.

NAME: **Islam, Faheem ul**
AGE:
RANK: Assistant Professor
AREA:
B.S.:
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Left UET

NAME: **Azhar, Tahir**
AGE: 30
RANK: Assistant Professor
AREA: Electronics
B.S.: 1984, UET
M.S.: IP, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: electronics, solid-state devices, and VLSI.

He has finished his M.S. course work and is working with Saleem on a thesis concerning modular speech and digital data interfacing. This is almost finished. He is alternate for COST fellowship. Wants to go for Ph.D. to work in solid-state and VLSI areas.

NAME: **Khan, Altaf Hamid**
AGE: 34
RANK: Assistant Professor
AREA: Electronics
B.S.: 1985, Wilkes College, USA
M.S.: 1987, Penn, USA
PH.D.:
GRAD. COURSES: 558

PUBLICATIONS: A.H. Khan and J.J Santiago-Aviles, "Epitaxial Germanium Films by MOCVD", Research Soc.Symp.Proc., 102, pp.279-282, 1988.

A.H. Khan and U.R.Nejib, "Optical Logic Gates Employing Liquid Crystal Switches", Applied Optics, vol 26, pp. 270-273, 1987.

C A. Boyer, A. H. Khan, M.R. Murphy, and G.A. Solomon, "Liquid Crystal Optical Switches", in IEEE students papers, pp. 24-32, 1986.

MEMBERSHIPS:

COMMENTS: Specialties: electronics and computer systems, neural networks industrial controllers.

New on faculty after returning from U.S. Young but has good experience and perspective. Submitted a research proposal to UET administration already.

NAME:	**Khan, Zubair A.**
AGE:	36
RANK:	Assistant Professor
AREA:	Power
B.S.:	1975, UET
M.S.:	1985, UET; 1987, UMIST
PH.D.:	1990, UMIST
GRAD. COURSES:	573

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: microprocessor applications for power system analysis and design.

Just returned from UMIST with Ph.D. He will be in charge of setting up the new energy management systems laboratory that will be provided by USAID. He is bright and enthusiastic. Interacts well with the computer group in the faculty. Wants to get full-time M.S. students to do theses with him. He should be promoted very soon. He may even be promoted to professor sometime soon.

NAME:	**Ali, Hashmat**
AGE:	46
RANK:	Assistant Professor.
AREA:	Power
B.S.:	1977, UET
M.S.:	
PH.D.:	
GRAD. COURSES:	

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power distribution.

He has finished his course work for M.S. and is doing a thesis with Dean Haque on corona behavior. Wants to continue for Ph.D. but prefers to stay here.

NAME: **Alvi, Zafar Mahmood**
AGE: 30
RANK: Assistant Professor
AREA: Computers
B.S.: 1975, UET
M.S.: IP, Bradford, UK
Ph.D.: IP
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: Computers.

Currently at Bradford University in UK doing M.S. and Ph.D. He should return in two-three years.

NAME: **Khan, Wasiq M.**
AGE: 39
RANK: Assistant Professor
AREA: Communications
B.S.: 1975, UET
M.S.: 1988, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computers, image processing, pattern recognition, neural networks, speech processing with applications in manufacturing and quality control.

His M.S. thesis dealt with speech processing. He works in the evening in a computer company, working on both hardware and software problems for commercial customers. He would like to do a Ph.D. abroad.

NAME: **Qureshi, Suhail Aftab**
AGE: 30
RANK: Assistant Professor
AREA: Power
B.S.: 1976, UET
M.S.: IP, UMIST
Ph.D.: IP
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power.

Currently at UMIST doing a Ph.D. He should return in two-three years.

NAME: **Yousaf, Muhammad**
AGE: 47
RANK: Assistant Professor
AREA: Power
B.S.: 1982, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: power and industrial electronics.

He has completed his course work for M.S. and is doing a thesis with Haque on conductor design for power distribution for a particular route. No time for Ph.D. Teaches electronics courses to other departments.

NAME: **Shami, Sajjad Haider**
AGE: 27
RANK: Assistant Professor
AREA: Electronics
B.S.: 1986, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: network analysis, digital systems, and power electronics.

M.S. and other professional activities have been delayed by personal problems. Apparently not available to participate actively in department for the foreseeable future.

NAME: **Zulfiqar, Mohammad**
AGE: 49
RANK: Lecturer
AREA: Electronics
B.S.: 1984, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: Electronics.

Teaches services courses to other departments. In M.S. program but has completed only two courses. Primarily involved in teaching.

NAME: **Ahmed, Ishtiaq**
AGE: 28
RANK: Lecturer
AREA: Computers
B.S.: 1987, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computers, feedback control, instrumentation.

He has taken two courses in the M.S. program. Plans to work with Chughtai on thesis. As a lecturer, he has a heavy teaching load. He is interested in a Ph.D. program.

NAME: **Abbas, Aun**
AGE: 28
RANK: Lecturer
AREA: Communication
B.S.: 1987, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: telecommunications and microwaves.

He worked for one year in industry doing design and computer work, but he came back to the university because he likes the more theoretical and mathematical aspects. He has an S&T fellowship for a Ph.D. program abroad. Applied to Wisconsin, CMU, and others and is now waiting for replies. He sees opportunities in industry for power electronics.

NAME: **Hassan, Khalid Mahmoodul**
AGE: 29
RANK: Lecturer
AREA: Computers
B.S.: 1986, UET
M.S.: IP, UET
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computers and computer control of industrial processes.

He has completed four courses in the M.S. program. Although he needs only two more, he plans to take four. For his thesis he will work with Chughtai or Azhar Shah. He teaches the microprocessor lab, and he developed some new research. He often stays late in the lab by himself. He is very interested in a Ph.D. in the U.S. and seeks a stable environment to do research.

NAME: **Mufti, Noman Aleem**
AGE: 27
RANK: Lecturer
AREA: Communication
B.S.: 1989, UET
M.S.:
PH.D.:
GRAD. COURSES:

PUBLICATIONS:

MEMBERSHIPS:

COMMENTS: Specialties: computers and communication, artificial intelligence and expert systems.

He just joined the university last March, taking a large pay cut in coming from a private company. He worked for nine months servicing PCs. He wants to do a Ph.D. in the communications area. Quite articulate and promising.

NAME:	**Imran, Mohammad**
AGE:	28
RANK:	Lecturer
AREA:	Electronics
B.S.:	1986, UET
M.S.:	IP, UET
PH.D.:	
GRAD. COURSES:	
PUBLICATIONS:	
MEMBERSHIPS:	
COMMENTS:	Specialties: computers and communications.

He has completed the six courses for an M.S. He is now working with Saleem on a thesis on remote image data processing. Interested in doing a Ph.D. in U.S. in digital communication area.

5.7 – ISSUES DISCUSSED WITH THE DEPARTMENT CHAIRMAN

The following issues were brought up explicitly for discussion with the chairman during the assessment. Agreement or some resolution of these issues was desired as a basis for planning the IEP.

- Identification of research areas to be emphasized, with priorities. Criteria include faculty interests and capabilities and relevance to development in Pakistan.

- Identification of key faculty to participate in the IEP. This includes identification of leaders with responsibility for each research area and planning for training programs.

- Identification of desirable faculty linkages, including overseas linkages for joint research activities and contacts with Pakistani institutions on which research will be targeted and through which results will be disseminated.

- Resources needed to implement IEP effectively, including training, technical assistance, linkages, computer facilities, and laboratory equipment, with priorities.

- Plan for implementation, including schedules, management systems, and criteria for continuous evaluation.

- Prerequisites and conditions required for success of IEP at UET.

5.8 – WRAP-UP MEETING WITH THE VICE-CHANCELLOR

At the end of the Assessment Team's visit to Lahore, they had a wrap-up meeting with Vice-Chancellor Ikram-ul-Haque Dar. Also present in that meeting were representatives of the Electrical Engineering Department, USAID, and MUCIA.

The Vice-Chancellor was quite enthusiastic about the prospects for IEP and indicated that he was flexible and positive about meeting many of the conditions summarized in Section 3.4. In particular, he spoke of the following points:

- He hopes to establish regional campus centers outside of Lahore so that the undergraduate enrollment in Lahore would be reduced. This would reduce teaching loads for faculty doing research and post-graduate instruction as well as political activity and disruptions on campus.

- He was eager for his faculty to experience American education. He valued the emphasis in the U.S. on course work and mid-term exams as well as the intense level of effort on research. He clearly favors more discipline and hard work by the faculty and students in Lahore.

- He agreed that merit should be rewarded and that personnel decisions should not be made solely on the basis of seniority. He was willing to add young staff and to encourage their development with post-graduate training and promotions.

- He favored the sandwich program for Ph.D. studies to avoid a "brain drain" of trained Pakistanis and to build the research capability at UET.

- He was favorably disposed to increasing interactions with industry. Among the links he mentioned were use of internships, designing research projects relevant to industry, and offering a post-graduate curriculum useful to industry.

- He was willing to establish new assistantship positions to support graduate students doing research and to provide a probationary category for new young faculty.

- He favored a link with the Lahore University of Management Sciences, which seems to have a very high-quality program and good contacts with the private sector.

- He is cognizant of the advantages of coordinating inputs from various donor agencies. In particular, he appreciates the possibilities for leveraging the input from IEP with other groups.

- In general, the Vice-Chancellor seemed eager to facilitate the implementation of the IEP. He is supportive of the department and invited them to make proposals for resources and bureaucratic modifications that they may need.