AC 2009-434: MODERNIZING THE USSR ERA-CURRICULUM FOR ELECTRICAL ENGINEERING AT KABUL POLYTECHNIC UNIVERSITY

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Dr. BAHAWODIN BAHHA has been teaching at University of Brighton since 1989. He received his BS from Kabul University and his M.Sc. and Ph.D. degrees in Electrical Engineering from the Universities of Salford and Brighton respectively. He has conducted a survey for the Afghan government and UNDP about the current state of Technical, Vocational Education (TVE) and Engineering Institutions in Afghanistan in 2004. In addition, he has been actively involved to help engineering education in Afghanistan, especially at Kabul University (KU) and Kabul Polytechnic University (KPU) since 2005. Since December 2006, Dr. B. Baha has been helping Engineering Educational Institutions in Afghanistan under a DFID funded project, which is called Developing Partnership on Higher Education (DelpHE); this programme is managed by the British Council. The details about various activities of this project can be found at the following website: <http://www.uobkupartnership.talktalk.net>.

The University of Brighton has recently signed a major partnership contract with Kabul Polytechnic University (KPU) and the Ministry of Higher Education in Afghanistan under the World Bank sponsored programme, which is called Strengthening Higher Education Programme (SHEP). The project is aimed at improving Engineering Education in subjects related to electrical, electronics, communication and computer engineering at KPU. Dr. B. Baha is the principle investigator of this project. He has published many papers at well known journals and international conferences on electronics and engineering education in Afghanistan.

Tim Katz, University of Brighton

Dr Tim Katz obtained a Doctorate in Solid-state Physics at Brighton Polytechnic in 1985. Instead of further specialisation in the subject area, he has diversified and now delivers product design courses as a Principal Lecturer for undergraduate and MSc levels, as well as supervising PhD students in the domain. However, a definitive thread through this has been a commitment to education that has resulted in many course validations and accreditations, conference and journal papers and a joint editorship of a book. At an operational level, he has trained colleagues when seconded to the Centre for Learning and Teaching, and focuses on facilitation and empowerment of students to become independent, life-long learners. He also practices project-based learning in context, following many partnerships with industrial collaborators.

Modernizing the USSR era Curriculum for Electrical Engineering at Kabul Polytechnic University

Abstract

This paper discusses the challenges of modernizing the USSR-era curriculum for the department of electrical engineering (EE) at Kabul Polytechnic University (KPU), which was put in place several decades ago. A new curriculum has been proposed to address the short coming of the old curriculum and to integrate experimental work at its core because of the lack of suitable industrial base in the country. The paper outlines the present situation, considers important challenges, and discusses the routes to progress. The discussions and conclusions outline promising directions for this work and consider the lessons learned.

1. Introduction

Kabul Polytechnic Institute was founded with the technical assistance from the USSR in 1963. The Polytechnic had eleven degree awarding departments and the curriculum of all the departments were developed using models from Polytechnics that existed in the USSR at that time. Furthermore, the laboratory equipment to support the curriculum was also based on the technology in the USSR at the time. The curriculum was developed over three decades ago and has not been updated in the light of new technological development around the world.

Since then, the beautiful campus of KPU has reverted to a wilderness and the buildings have been severely damaged due to neglect and war damage. Furthermore, some of the academics have been killed or forced to leave the country and those who stayed behind have been isolated from the rest of the world for decades. In addition, the learning resources such as libraries, laboratories and IT equipment have been looted or burned during the war.

After the intervention of the international community and the establishment of new government in Afghanistan in 2002, several new universities and colleges have been founded predominantly in northern and central Afghanistan. Regrettably, such institutions were established for political expediency without a cohesive strategic plan. At the same time, Kabul Polytechnic, that only had three faculties was converted to a University and has been renamed as KPU.

Most of the international community sponsored projects are primarily concentrated on security in the country. However, infrastructure projects in road building, agriculture and telecommunication communication networks have also benefited compared to some other sectors. These improvements imply increased servicing and a greater requirement for trained technical staff.

Limited progress has been achieved in the higher education sector with the main support from the World Bank sponsored, Strengthening Higher Education Project (SHEP). A component of this program is to establish partnerships between Afghan universities with well-established universities in the developed world. The KPU has established a partnership with the University of Brighton (UoB) and the aim of this program is to revise the curriculum, equip the laboratories to support that revision, provide faculty training and improve academic practices within the department of power engineering at KPU.

This paper focuses (i) on the challenges and rationale of updating the curriculum and (ii) the details of curriculum development for the proposed department in KPU and its suitability for the region. The conclusion (iii) discusses how any lessons learned can be transferred to other situations and contexts.

2. The challenges

The UoB – KPU partnership, referred to earlier, provided a unique opportunity to revise and update the curriculum with the view to integrating the recent developments in electrical engineering into the new curriculum for the department of EE at KPU.

A fact-finding mission was carried by certain UoB faculties who have visited KPU to evaluate their main needs. In order to improve the quality of education offered by the KPU, the following issues have been identified as major priorities:

- To update the curriculum, which has not been updated for decades
- To train the academics in modern electrical engineering subjects
- To develop a more relevant and reflective pedagogy into the institution
- To integrate experimental and practical work within the curriculum
- To identify suitable equipment and components for the laboratories supporting the new curriculum
- To recommend computing facilities and other learning resources such as text books, manuals and the like.

Addressing the above issues are discussed in more detail in later sections of this paper.

3. The existing curriculum and the rationale for change

One of the major issues to be addressed is to update the curriculum at the department of EE, which has not been updated for decades. Many new technologies and modern

teaching methods and paradigms have been developed during the last three decades across the world. Therefore, there is an urgent need to update the curricula of all subjects, especially science and engineering at KPU.

The list of the subjects in the existing curriculum (without any modification) is shown in appendix 1. The course description for these subjects in the curriculum does not exist and the teaching material has been based on old notes that were translated from Russian to local languages, i.e. Pashto and Dari over thirty years ago. Furthermore, the curriculum is not supported by any experimental work because of the lack of proper laboratory and equipment. This archaic curriculum is not compatible with the needs of the nation or the students' career development. It has very limited or no balance between theoretical and experimental knowledge and approaches, out of step with most universities across the world, providing little context or practice into the learning. Furthermore, the level of some subjects in the curriculum may not be suitable for degree level courses.

In order to develop the curriculum for subjects related to electrical engineering, the following two approaches have been considered:

- (i) The *first approach* was a traditional method where the curriculum of a typical university in the developed world is adopted with a few minor modifications. This transplant could easily suffer from local rejection.
- (ii) The *second approach* was more pragmatic, where the present applications of various disciplines are carefully assessed against the requirement to educate and prepare a qualified workforce to address the local needs. Then decisions are made on the type of courses that should be designed and can be delivered by the higher education institutions in Afghanistan.

The author's recommendation was the combination of the above two methods, and prepared a curriculum that is forward looking and which addresses the current needs for the immediate future of Afghanistan, and that will also move towards meeting international standards.¹

4. The developing curriculum

The present curriculum at the department of EE is unique, and perhaps may not exist at any other university around the world. The list of subjects in its original form can be seen in appendix 1.²

The curriculum development for the department of EE at KPU is a complex issue as there are common subject elements that the department of EE shares with other departments within the KPU. The common subjects are: Mathematics, Chemistry, Physics, IT and social science and the authors are unaware of the KPU plan to update or integrate these subjects. However, the curriculum for subjects related to electrical engineering has been updated in order to:

- Provide a basic knowledge of electrical engineering principles along with the required supporting knowledge of mathematics, science, computing, and engineering fundamentals.
- Develop the basic skills needed to design and build basic electrical and electronic circuits and projects.
- Develop the ability to formulate problems and projects and to plan a process for their solution, taking advantage of diverse technical knowledge and skills.
- Develop the ability to organize and present information and to communicate it through effective written and spoken English.
- Provide sufficient breadth and depth for successful subsequent graduate study, post-graduate study, or lifelong learning programs.
- Embed a broader professional practice, including skills in teamwork, leadership, safety, service, economics, and access to professional organizations.
- Equip the students with practical skills in specific disciplines within EE, which is highly desirable in the country.

The curriculum to address some of the above issues has been developed and a full list of subjects is presented in Table 1.

The content of subjects related to electronics is not very strong in the old curriculum; however, as modern electrical machines are always controlled by microprocessors, it will be imperative to integrate the fundamental theory and practice of analogue, digital and power electronics.

As there has been strong resistance especially amongst the senior lecturers at KPU for rapid change, nevertheless, an attempt has been made to include the core modules of electrical and electronic engineering into the curriculum. However, there are still some subjects that the KPU lecturers are keen to retain in the new curriculum, even though there are better, practical alternatives. These, such as the "Environment" and "Safety" modules, would be far better delivered intrinsically within other more practical modules, where the context would make learning far more relevant. However, this could be planned as a further development once the value of the new modules can be seen.

5. Faculty training

The majority of the academic staff in this department has graduated from the KPU themselves, without receiving external postgraduate studies at established universities in the developed world. Therefore, their knowledge and academic practices have become insular and esoteric at this department. Under the proposed partnership, the University of Brighton has organized several activities to enhance the knowledge and experience of

their counterparts at KPU. The main in-house training has been focused onto the following issues:

- Specific topics in electrical engineering, communication and electronic computer aided design.
- The importance of ICT and its integration into higher education
- Improving communication skills
- Pedagogy and curriculum development
- Integrating experimental work within the curriculum

It is essential for all the members of staff at KPU to properly update their knowledge and to acquire the necessary attitudes and skills that are needed to run a professional department within an engineering education institution. One way to gain such knowledge, attitudes and skills will be to study at postgraduate courses in a well-established institution in the developed world.

Therefore, selected young colleagues at KPU in EE and some other disciplines will be trained at MSc courses offered by UoB.

The main purpose of the MSc course for KPU colleagues are to:

- Update their knowledge in their specific subjects
- Learn about recent advances in new technologies
- Introduce new courses in modern engineering disciplines that do not yet exist at KPU.
- Develop an understanding of a more modern technical education paradigm;
- Learn research and consultancy skills and then be able to write successful project reports, dissertations and proposals.

Talented young graduates have been recruited as junior lecturers at KPU and some of them have already arrived at UoB , studying an MSc preparatory course, and will start their MSc courses in September 2009. Other groups are expected to arrive during the course of this academic year who will be studying English language courses for the first six months and then entering their MSc preparatory courses and following MSc courses at the University in 2010.

5. Equipping the labs

At present, one of the laboratories for the department of electrical engineering has been specified to support the teaching of subjects related to basic electrical and electronic engineering. The equipment list was provided for the basic electronics lab and the details were submitted to KPU in the last progress report. The equipment list for the machine lab will be finalized at a later stage. These lists were based on both the fundamental electronic knowledge base recognized across the discipline internationally, and the specific requirements of the local context.

The KPU young lecturers attending the MSc course at UoB will be trained to integrate experimental work within the proposed curriculum for their department at KPU. Exposure to the educational paradigm prevalent at UoB, recognized as high teaching quality by recent Higher Education Funding Council in England (HEFCE) and professional reviews, will be reinforced by reflective work on educational themes through specialist tutorials.

6. Discussion and Conclusions

A new curriculum for the department of Electrical Engineering has been developed in a view to train the future work force in electrical engineering for Afghanistan. Their existing curriculum has been reviewed and updated to certain degree; however, because of the strong resistance from the senior academics in that department, it has not been possible to introduce major changes. It is thought that the obsolescence of some subjects in the new curriculum that could be replaced by more suitable subjects has led to a protectionist and defensive response from these senior staff. This may therefore also be a challenge for the younger staff willing to come for training in two ways:

1. Being seen to be co-operative will “single you out” and may jeopardize your academic future; and
2. It may be very hard to continue to embed developments on returning to the original context and pressures.

In retrospect, the resistance from senior staff is not particularly surprising, as they have been starved of resources for many years but now see external influence threatening their existing values and way of life, even though it brings material improvements. A major challenge is to find ways that they can engage with these changes and feel ownership of the outcome.

It is hoped that this department will be a good example at KPU to update other departments within KPU in the long term, but it is essential to be able to engender institutional change and bring the senior academics along. Help is being sought for the means to embed institutional change from the UoB business school.

The full implementation of the proposed curriculum is the responsibility of the KPU management and the MoHE. The quality of electrical engineering education at KPU will be immensely improved; provided that the proposed curriculum is implemented, the laboratories are equipped and the knowledge of the academic staff is reasonably updated.

Recommendations

The following recommendations are given to further improve the curriculum in the future:

1. To increase two further mathematics courses
2. Experimental and practical work is integrated within the main subjects by removing most one-credit courses from the curriculum
3. The suitability of subjects such as environment, electrical properties of materials, safety techniques, electrical apparatus, electrical energy production process, transitional process of power systems and installation and maintenance of electrical equipment are evaluated and complemented, modified, enhanced or replaced by more suitable course blocks such as further control theory, signal and systems, microprocessors and microcontrollers.
4. Some of the subjects in the proposed curriculum can be combined with other subjects once the junior lecturers return back from their studies at UoB.
5. Attention is focused on the philosophical and pedagogic aspects of the curriculum and its educational paradigms, both for those in training and the “gate keepers” in senior positions at KPU.
6. Due consideration is given to the mechanisms of institutional change and resource applied to ensuring that developments are embedded and long lasting.
7. A more formal evaluation of attitudes of the senior and junior lecturers will be sought.

Bibliography

1. Baha, B., “Modernizing the curriculum for the department of electrical engineering of Kabul University”, SAE Conference, 17-18 Dec 2005, Kabul, Afghanistan.
2. Kabul Polytechnic University (KPU), Curriculum.

Table 1: lists of subjects in the proposed curriculum

1st Year

1st semester

Subjects	Credits
Mathematics I	4
Chemistry I	4
Foreign Language I	2
Intro. to Electrical Eng.	2
Engineering Drawing	2
Physics I	4
*Social Studies I	1
*Modern History of Afghanistan	2
Physical Education	0
Total	21

2nd semester

Subjects	Credits
Mathematics I	4
Applied Mechanic	2
Foreign Language II	2
Circuit Analysis I	2
Circuit analysis I lab	1
Physics II	4
* Social Studies II	1
**Environment	2
IT Essentials I	2
Total	20

2nd Year

3rd semester

Subjects	Credits
Mathematics III	4
Electrical Measurement	2
Foreign Language III	2
***Circuit Analysis II	2
***Circuit Analysis II lab	1
Physics III	4
* Social Studies III	1
**Electrical Properties of Materials	2
IT Essentials II	2
Total	19

4th semester

Subjects	Credits
Mathematics IV	4
Electromagnetic Field	3
Foreign Language IV	3
***Analogue and digital Electronics	3
***Analogue and digital Electronics lab	1
Electrical Machines I	4
* Social Studies IV	1
Total	18

3rd Year

5th semester

Subjects	Credits
***Thermodynamics and Heat Transfer I	3
***Thermodynamics lab	1
Electrical Machines II	2
Electrical Machines II lab	1
Power System Analysis I	3
Power Generation I	3
* Social Studies V	1

6th semester

Subjects	Credits
Power Generation II	3
Power System Analysis II	3
Power Electronics II	3
Thermodynamics and Heat Transfer II	3
***Electrical Drives I	2
***Electrical Drives I Lab	1
**Safety Techniques	2

Power Electronics I	3
Electrical Apparatus	2
Total	19

Electrical Energy Production Process	2
* Social Studies VI	1
Total	20

4th Year

7th semester

Subjects	Credits
***Electrical Drives II	2
*** Electrical Drives II lab	1
Control Theory	3
Power System Protection I	3
**Transitional Process in Power Systems	3
Power Distribution and Unitization I	3
* Social Studies VII	1
Management	3
Projects on Electrical System	2
Total	20

8th semester

Subjects	Credits
Power System Protection II	3
Power Distribution and Unitization II	3
**Installation and maintenance of Electrical Equipment	3
Projects on Power Distribution and Utilization	3
Electrical Wiring	2
Computer Aided Design of Power Systems	2
Engineering Economics	2
* Social Studies VIII	1
Work Placement	2
Total	21

5th Year 9th Semester

Subjects	Credits
Project Management	1
Projects	8
Total	9

* Compulsory subjects which are proposed by the government.

** The subjects under this category need to be revised and perhaps replaced by other subjects.

*** The experimental work can be integrated within the main subjects in this category.

Appendix 1: The list of subjects at the present curriculum for the department of EE at KPU at its original form without any modifications

No.	Subjects	Semesters									
		1	2	3	4	5	6	7	8	9	10
1	Islamic culture	2	2	2	2						
2	Foreign languages	6	8	4							
3	Higher Mathematics	10	8	6	4						
4	Chemistry	6	8								
5	Descriptive Geometry	4	4								
6	Engineering Drawing	4	2	4							
7	Modern History of Afghanistan	2	2								
8	Physical education	2	2								
9	Physics			6	6	6					
10	Theoretical Mechanics			4	4						
11	Hydraulics and hydraulic Machines					2					
12	Theoretical Fundamentals of Electrical Engineering			8	8	8					
13	Computer Basic				4						
14	Electrical Measurements				4						
15	Electrical Engineering Material				4						
16	Electrical Networks and Systems					6	5	2			
17	Industrial Electronics					4	4				
18	Electrical Machines					6	6				
19	Applied mechanics					4	4				
20	Power Plant and Substations						5	5	2		
21	Energy Supply and Installations						5	6			
22	Electrical Apparatus						4				
23	Computer Applications						3	3	4	3	
24	Automatic Control Theory							3			
25	Automated Electric Drives							4	5		
26	Transitional Process in Power Systems							4	5	4	
27	Professional Economics							3	2		
28	Environmental Protection							2			
29	Organization, planning and Management of Industrial institution								3	3	
30	Labor Protection								4		
31	Power Supply of industrial institution								6		
32	Relays protection, Automatics and Telemechanics of Power Supply Systems							4	5	2	
33	Electro Technological Installations									3	
34	Mounting and Exploitation of Electrical Equipments									3	
35	Typical Electrical Drives									3	
36	Course before Diploma project									3	
Total hours in a week		36	36	36	36	36	36	36	36	36	36

Diploma Projects