

# ELECTRICAL ENGINEERING BEYOND CLASSROOM: CHALLENGES AND ANTICIPATED RESOLUTIONS

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## ABSTRACT

Engineering Education (EE) plays an imperative role in the development of any country via improving the standard of life. This article highlights key issues, challenges and anticipated resolutions of Electrical Engineering Education in Pakistan. Data analysis imitates following problems relating to EE: dearth of professionalism in academia, insufficient educational capitals, not as much of hardware research laboratories at post graduate level, insufficient practical trainings, internships and professional skill development for improvement of hands on experience. These factors influence an Engineering graduate even after the completion of their undergraduate studies. After sorting these highlighted factors, this work has presented a framework for the improvement in EE as, modified curriculum, e-learning environment, conduction of internships and synchronization of institutes and industries. Moreover, new trends and pedagogical techniques to improve the status of techno-oriented Pakistan are also inspected.

**Keywords:** Engineering Education, techno-oriented Pakistan, professional skill development, pedagogical techniques.

## 1. INTRODUCTION

Engineering Education (EE) plays a significant role in human capital and national development. It promotes economic growth and enables people to lead a comfortable life so they can perform their role in the development of country. Pakistan is facing problems of gradual increase in unemployment ratio in youth, while the industry has lack of skilled and experienced man power. Improvement in EE can suppress these factors and increase economic growth for techno-oriented Pakistan.

The Higher Education Commission (HEC) of Pakistan is an established institute of funding, regulating, overseeing and accrediting higher education in Pakistan. HEC is allocating funds, updating laboratories, libraries and adopting new methods to strengthen Engineering institutes in collaboration of Pakistan Engineering Council (PEC). PEC is a statutory body that determines the

quality of engineering disciplines.

The demand of EE increased owing to scientific and technological progresses which bring the challenges for the institutes. More traditional and teacher centered methods have proved to be ineffective when applied on massive level (Schofer *et al.*, 2005). This situation led to an adjustment in teaching strategies and a greater focus on students learning methods (Ramsden *et al.*, 1987; Felder *et al.*, 1999). In a research survey referenced by Khalid (2011) various techniques, tools and methods are examined to enhance teaching methods and learning of students.

This paper highlights the problems faced by Engineering students in educational and professional life and also proposing the possible solutions to cope up with these problems. And analysis is done by conducting questionnaire on Electrical Engineering student's perceptions and satisfaction. The choice of using questionnaire as a survey tool is proved to be

Electrical engineering beyond classroom effective and also showing the results of previous experiences implemented by the authors (Metraglia *et al.*, 2015).

### **1.1 Pakistan Engineering Council: Standards governing unit for Engineering Education**

PEC is a statutory federal institution for accreditation of Engineers. It is dedicated to promote EE in Pakistan and represents the Engineering community in the country. PEC assists the government at the Federal, Provincial level and also grants license of registration of Engineers, consulting Engineers and operators. PEC acts as a think tank to the government and undertakes efforts to establish scientific standards for Engineering innovations and services (PEC *et al.*, 2017). It has a full signatory status with Washington Accord and offers following framework to Engineering institutes. Figure 1 demonstrates the framework offered by PEC to all Engineering institutes of Pakistan (PEC *et al.*, 2017). It is offering standards for institutions along with the students (PEC *et al.*, 2017). These standards are discussed in appendix I.

### **1.2 HEC criteria for Engineering Curricula**

Figure 2 shows domains of Engineering curricula given by Higher Education Commission (HEC) for Electrical Engineering students. The curriculum is shown in form of pie chart (Curriculum of Electrical Engineering *et al.*, 2012) and consists of major as well as minor courses.

## **2. MATERIALS AND METHODS**

The presented survey is qualitative in nature and was carried out by participants of universities: Lahore College for Women University (LCWU), University of Engineering and Technology (UET), Government College University (GCU), Bahauddin Zakaria University (BZU), COMSATS, Air University (AU)

and University of Lahore (UoL). Electrical Engineering department was targeted in above mentioned universities. All the participants were informed that their identities will be kept secret and used only for research purpose. The quantitative response of students based on Likert scale in which five qualitative responses mapped with five numbers to quantify the collected data (Rudy *et al.*, 2017).

### **2.1 Data Collection**

Figure 3 shows the distribution of students targeted from government and private universities. These universities are chosen on the basis of prominence and maximum productivity of Engineers. Sample size for analysis of proposed work was 199. Since LCWU has more participants than all other universities but the results are consolidated as the ratio of other participants. Individual sample size for each university is presented in Table 1. The minimum qualification for participants were BSc or BE Engineering. Response of Engineers was taken by filling questionnaire online and offline as well. Their responses were taken in form of MCQs and suggestions.

### **2.2 Existing Issues for EE**

There are some obstacles in existing framework imposed by PEC and HEC include: percentage of non-engineering subjects, eligibility criteria for students in final examination, criteria for industrial visits and internships, appointing lab Engineers and one year paid internships/jobs after graduation.

This section highlights main issues faced by the students of EE in class and beyond class (Figure 4). Solid lines show the existence of difficulties in theoretical, practical and industrial fields and strong linkage between each other. Dash line shows partial connection between practical and theoretical studies

whereas, dotted line indicates weakest link between practical and industrial learnings.

### 3. RESULTS AND DISCUSSION

This section deals with suggested improvements in existing framework concluded by responses of participants. These suggestions are discussed in four phases as: in class, beyond class, in practical life and in industrial life.

Figure 5 deals with issues faced by engineers in their study period.

- According to some researches, it is found that teachers do not use new methods and strategies of teaching and learning (Rehman *et al.*, 2011). In UNESCO report, quality of the instruction and teachers in Engineering institutes is not satisfactory (Ahmad *et al.*, 2014). They should rely on new methods of teaching to provide better opportunities for students and also new techniques which compel them to participate with complete attention. Faculty needs well qualified teachers to show professional attitude to follow duty ethics.
- The curriculum of EE does not meet the requirements of the current time. Students are not equipped with the latest technological trends, which causes the lack of interest in attending lectures. The survey indicates that curriculum of EE is outdated and needs to modify according to new trends in technology. The government should appoint policymakers to draft a comprehensive and uniform curriculum.
- Professional skill describes the disciplinary knowledge and practical learnings for graduate training. Lack of professional skills lead to problems for students as well as for institutes. To overcome deficiency of professionalism it is

important to teach courses and to conduct such sessions and trainings which develop and improve professional skills among the students.

- In Engineering institutes there is no enough equipment available and most of the equipment provided in the universities is either faulty or of low-priced quality. This problem might be caused by lack of funds, corruption or negligence of institutes and government. Most of participants suggested to evaluate lab equipment weekly or once in a month. They also suggested that the higher authorities arranged unannounced visits to universities for inspections of laboratories.
- In Electrical Engineering studies software are the tools which simulate the complex and challenging programs, provide the learning of practical concepts in an effective manner and also prevent the expense of hardware implementation. To learn different software tools there should be conduction of workshops and trainings to improve software knowledge of students.

Figure 6 above shows the issues beyond classroom faced by the participants and also their suggested possible solutions to cope up these issues.

- Most of the Engineering institutes are situated in developed cities of our country. Students from distant areas have to travel longer to seek knowledge. To eradicate this problem, e-learning environment should be introduced in institutes as technology allows students to learn through virtual environment.
- Job fairs are potential events to meet employers and learn about job opportunities. In educational system there are fewer trends to conduct job fairs for students so they face difficulties in finding jobs. There is a great need of conducting job fairs

Electrical engineering beyond classroom in engineering institutes to rectify the unemployment ratio.

- Figure 6 depicts absence of industry-institutes linkage and participants were with the opinion that; measures for industrial and professional training are elementary to make them ready to meet challenges of innovating technologies. In our country, there is a weaker connection between industries and institutes. Participants suggested that there is a need of balanced statute between both communities to support each other and increase the economy of country.
- Lack of funds is always considered as barrier to quality education and training. Most of education expenditure consists of salaries, allowances and accommodation but a small percentage is composed of development expenditures that is not enough to raise standard of education. A sufficient budget needs to be specified for educational improvement in national Gross Domestic Product (GDP). The present state of funding for education in recent years with respect to the constitutional framework is presented in (R. *Met al.*, 2015).
- Perusing higher education is vital for the development of a state. But cost of higher studies is very high and is unaffordable for our society. In most of the Pakistani universities and colleges there is no proper scholarship program for higher studies. Education institutes need to allocate a fixed budget for higher studies and give more opportunities to bright students.

In practical field of engineering, students face problems shown in figure 7, these problems include: internships, industrial visits, workshops and short courses. Here we are discussing the solutions of

mentioned problems as well;

- In order to prepare students for professional life Engineering institutes should equip them with field training and knowledge. But they offer less internship opportunities to students. Also there are no criteria for industrial visits and internships in PEC and HEC manual. Engineering institutes should arrange technical experts from renowned industries to share their professional experience. These visits will help the students to solve their queries related to final year project.
- Practical training provides an opportunity to the students to put theoretical concepts into practical. The aim of practical training is to help students to develop skills and abilities that support professional studies and prepare them for work later on. But absence of practical learning leads to difficulties which students face in their professional life at industrial level. To overcome the deficiency of practical knowledge, institutions have to arrange workshops and seminars to strengthen practical learning and provide them better understanding of theoretical concepts.
- The final year project introduces the students to professional engineering practice (Jacek *et al.*, 2015). The goal of a final year project is to create the better understanding of concepts and knowledge with the help of supervisor. For the purpose of best selection of final year project, industrialists should visit institutions to assign their existing problems to the students of final year. This will increase the industrial exposure in students as well as opportunities of jobs in industries.

Above figure 8 is about issues of industrial life as participants' ranked importance of field practice in

practical life very high. They were with the opinion to develop field practice during their studies and other issues are;

- The purpose of field practice is to prepare students for practical work by providing them opportunities and make them professional into their relative field. Universities should take proper measures to train their students by collaborating with industries. It makes sure that every student has been done field practice in accordance to their Engineering discipline.
- Most of the public and private industries demand experienced engineers to manage and operate their firms. Most of the students suggest optimistic solution that there should a certain criteria of one year internship program offered by PEC and HEC for graduate Engineers just like the custom of MBBS doctors. PEC has to mention the post of lab engineer in its manual and departments have to appoint bright students for this post. So that they may become lecturer after completing their Master's degree or 18 years of education.

## CHALLENGES

Engineering challenges related to internal and external factors are: female teaching faculty and students, symmetry between theoretical and practical lectures, upper and lower bound for internships, credit hours for industrial visits in HEC rules and absence of research laboratories. The solutions of these problems suggested by results of questionnaire are:

- The ratio of female students in Electrical engineering is insufficient. Female are of fifty percent but their ratio in engineering is very low which needs to increase. Same as in teaching faculty of Electrical engineering, most of engineering institutes prefer male teaching staff

as compare to the female. The survey shows that female can deal with theoretical and male deal with practical or industrial aspects very well. Therefore there is need to improve participation of female in the field of engineering.

- Many students face the problem of poor understanding of lectures due to unsymmetrical deliverance. In engineering institutes there should balance synchronization between theory and practical lectures so that students may get practical knowledge as well.
- In PEC and HEC manuals, criteria for maximum or minimum internships should be mentioned. According to the results taken by survey, students of different universities either government or private suggested to have at least three or four internships in four year degree program to build technical and professional abilities of students.
- HEC has mentioned industrial visits in its manual but due to assigning no credit hour (Curriculum of Electrical Engineering *et al.*, 2012). These visits are neglected by most of the engineering institutes. One of the main reasons of under developing practical knowledge among students is absence of industrial visits. HEC should assign credit hour to industrial visits so the students can understand theoretical phenomena by experiencing it practically.
- Pakistan is a developing country and currently making its progress in the field of Science and Technology. It is facing lackness in research laboratories as compared to developed countries. Funds should be allotted for the establishment and development of research laboratories.

## CONCLUSION



Electrical engineering beyond classroom

The assessment and analysis done in this review artefact is an attempt to highlight the problems and challenges that are being faced by Electrical Engineers within the classroom, beyond classroom and at industrial level. One of the concluding facts was that the most of the Engineering undergraduates were agreed to have more workshops, trainings and internships during their undergraduate studies. However, some of them suggested increasing the number of Instrument Development Engineering and Evaluation (IDEE) courses. Another important factor recognized was the requisite training of undergraduates before they are expelled to the industry, emphasizing the need to build efficient institute-industry linkage. At last, we infer that there is a severe need of closed loop process for Engineering Education (EE) system. That can yield competency, improvement and modification for the betterment of EE country wide.

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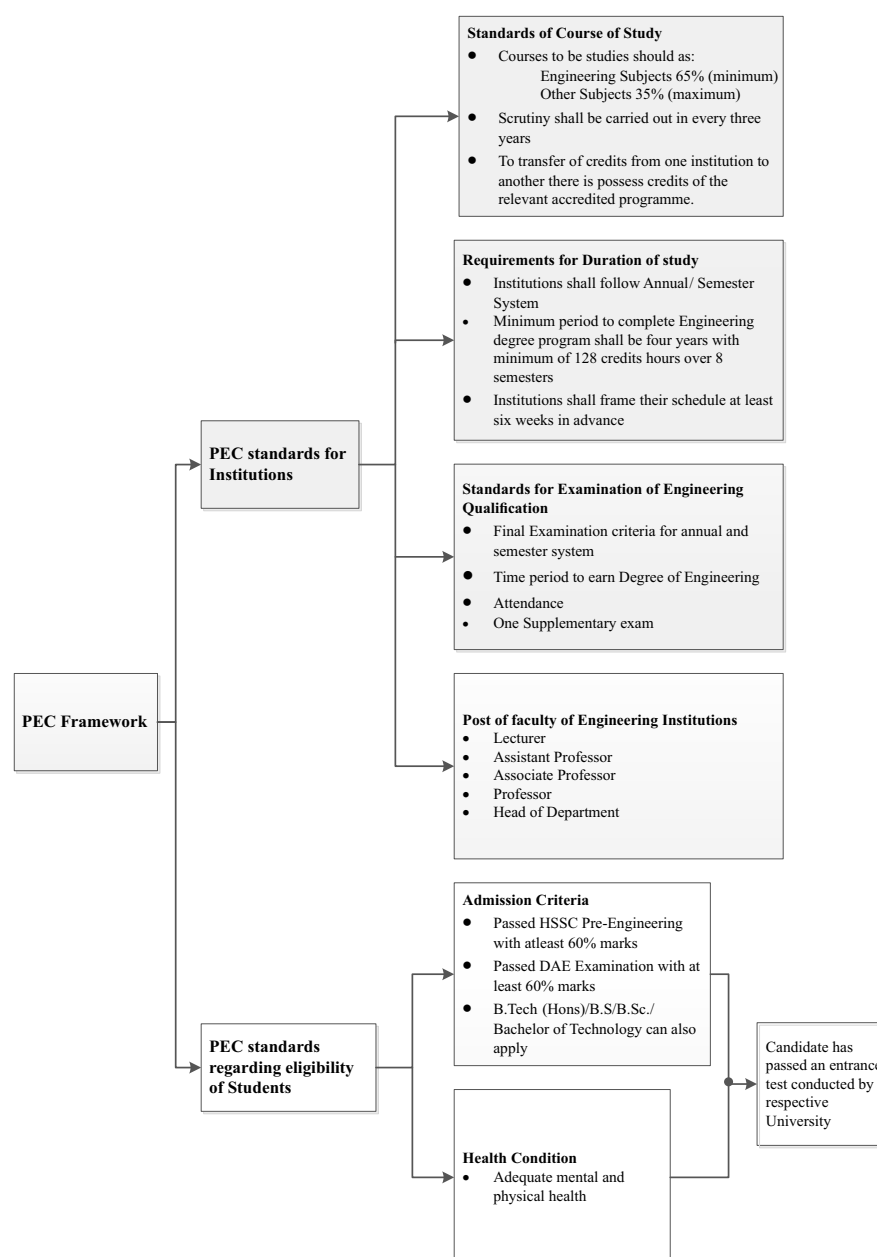
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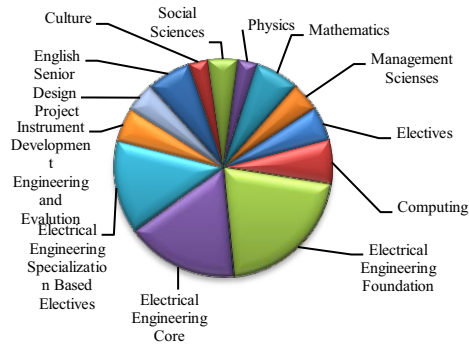
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**Table 1: Individual sample size for each university.**

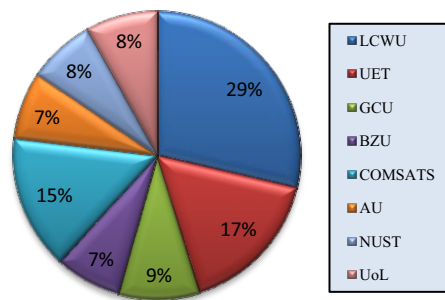
<b>Government Universities</b>	<b>Sample Size</b>	<b>Private Universities</b>	<b>Sample Size</b>
LCWU	57	COMSETS	30
UET	33	AU	15
GCU	18	UoL	16
BZU	15	NUST	15



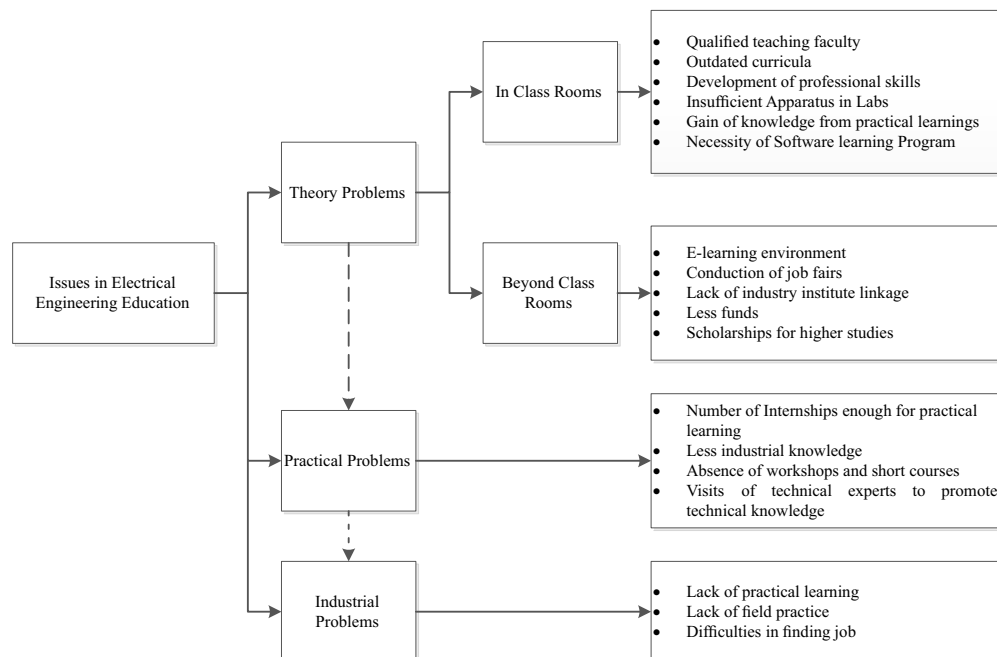
**Figure 1: Framework of Pakistan Engineering Council (PEC *et al.*, 2017).**



**Figure 2: Distribution of Engineering curricula by HEC**



**Figure 3: Distribution of students targeted in different universities**



**Figure 4: Issues faced by Electrical Engineers inside and beyond the class**





