

NEW DEGREE PROGRAMMES TO COPE WITH THE MARKET DEMAND

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Abstract $\frac{3}{4}$ The paper presents the process undergone to formulate three new undergraduate degree programmes in the Department of Electrical Engineering, University of Dar es Salaam. The new degree programmes are: B.Sc. in Computer Engineering and Information Technology, B.Sc. in Electrical Power Engineering, B.Sc. in Telecommunications Engineering. The three new degree programmes are in addition to the long time existing general B.Sc. in Engineering degree programme. The three new degree programmes have officially started in the 1999/2000 academic year as a result, the department is now offering a total of four degree programmes. The total enrollment of the department has increased from 49 students in the 1998/1999 academic year to 80 students in the 2000/2001 academic year. The new degree programmes have been formulated in response to the current and foreseeable future employment market demand for specialization coupled with the increase in the number of applicants who want to enroll for Electrical Engineering courses. At the same time, due to infancy level of industrial sector in the country, the old general degree programme has been retained. However, the curricula for the general electrical engineering programme has been revised so that to inject some more materials related to computers, electronics, telecommunications and microprocessors. The paper will narrate in detail the influx of market demand of engineers in the fields of Computers and Telecommunications which led to the formulation of the new degree programmes.

Index Terms $\frac{3}{4}$ new degree programmes, undergraduate degree programmes, old degree programme.

INTRODUCTION

The Department of Electrical Engineering (EE) at the University of Dar es Salaam (UDSM) in Tanzania is among the first three Departments established under the Faculty of Engineering (FoE). The Department had its first undergraduate students intake in 1973 with only one degree programme namely B.Sc. in Engineering and a planned annual intake of only 20 students [1].

Up to date, the Department is the sole entity in Tanzania offering degree level training in the fields of Electrical Engineering. Taking into consideration the current technological development and awareness, this situation gives an alarm that there is very high demand of human resource in the area of Electrical Engineering and related fields of specialization such as Computer Engineering, Information and Communication Technology (ICT),

Electronics Engineering and Telecommunications Engineering [2-3].

The single general Electrical Engineering degree programme offered by the Department of EE since its establishment, gradually became too congested due to the need to accommodate more and more current technological developments into its curriculum. Apart from a steady increase of demand for training places in the general field of Electrical Engineering, there is a vivid indication of a market demand for more specialized training which call for curriculum review as a short term solution and establishing new degree programmes as a long term solution.

In order to address the issue of growing demand of enrollment in the general field of Electrical Engineering, the Department stretched itself year after year to increase the annual intake, and by 1998/1999 academic year, the annual student intake was already more than double the original plan of 20. On the other hand, in order to accommodate the growing demand of specialization, the Department of Electrical Engineering has been reviewing the undergraduate curriculum regularly. However, as of 1999/2000 academic year, the Department had to resort into a long term solution of accommodating the growing demand of specialized fields by establishing three new degree programmes. However, in order to safeguard the small scale and less sophisticated industries that may not necessarily need specialized engineers, the general Electrical Engineering programme is still offered. In that respect, as from 1999/2000, the Department started to offer a total of four degree programmes namely, B.Sc. in Computer Engineering and Information Technology, B.Sc. in Electrical Power Engineering, B.Sc. in Telecommunications Engineering and B.Sc. Engineering (Electrical) [4].

The paper presents the factors and/or situations considered in achieving the decision on the choice of the new established academic programmes.

SITUATION AT THE TIME OF ESTABLISHMENT OF THE ELECTRICAL ENGINEERING DEPARTMENT

Just after independence in 1961, Tanzania was in a situation that, essentially there were only few native qualified human resources. Therefore, one of the objectives of the newly independent government was to train highly qualified native human resources. In line with this determination, the University of Dar es Salaam was started as a College of the University of London in 1961, with only one Faculty, the Faculty of Law. In 1963, it became a constituent college of the University of East Africa that included the University

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college of Nairobi in Kenya and Makerere in Uganda. The University of Dar es Salaam (UDSM) was formally established on July 1, 1970 and detached from being one of the Constituent College of the University of East Africa [5]. The UDSM started with the Faculty of Law then Faculty of Arts and Social Sciences, and later the Faculty of Science were established.

The Faculty of Engineering (FoE) was established in 1973 under the help of the German Government [1]. The intention of the establishment of the FoE was to train native Tanzanian in the field of Engineering. The FoE started with three Departments namely, Department of Civil Engineering (CE), Department of Mechanical Engineering (ME) and Department of Electrical Engineering (EE). Later on the Department of Chemical and Process Engineering (CPE) was established.

At the time of establishment of the department of EE, and the FoE as a whole, the situation of the industry in the country was at infancy and primitive stage. In that case, in view of the scarce qualified human resources, the main objective of engineering training at the time of establishment of the FoE was to strive to train as many as it could be reasonably accommodated into a four year B.Sc. (Engineering) degree programme curriculum. In that respect, looking into the field of Electrical Engineering, the curriculum contained the whole range of subjects from power engineering, electronics, telecommunications, control and microcomputers. The idea was that graduands may be deployed and redeployed in almost all sectors in need of expertise in electrical engineering and related fields. Due to the technological advancement, it is evident that, in order to accommodate this kind of diverse range of knowledge into a single degree programme today, the students will be somehow overloaded and some sort of deficiencies may surface. However, the graduands could fairly follow and manage to cope with daily activities at their work place.

SITUATION SUBSEQUENT TO THE ESTABLISHMENT OF EE DEPARTMENT

At the time of establishment of the FoE, the Department of EE was the smallest with annual intake of only 20 students. Up to 1991/1992 academic year, the total annual intake in the FoE was 160 and the distribution was as shown in TABLE I. As it can be seen in TABLE I, at the time of establishment of the FoE, the trend was that Civil Engineering was at very high demand followed by Mechanical Engineering, Chemical Engineering and the last was Electrical Engineering. At those times this trend was evident due to the need for erecting new infrastructure and manufacturing industry. The need for Electrical Engineering expertise for the most of the employers at those times could be assumed that was mainly maintenance and repairs that could reasonably be taken care off by technicians and artisans.

TABLE I
ANNUAL INTAKE IN THE FoE FOR 1973 - 1991

Department	Annual intake
Civil Engineering	60
Mechanical Engineering	40
Chemical & Process Engineering	40
Electrical Engineering	20
Total intake in the FoE	160

As time went by, there was a steady growth of the number of applicants in the Department of EE. At the same time, there were strong indications that there was a steady growth of market demand for Electrical Engineers. Since the Department of EE was established to accommodate the annual intake of only 20 students, the Department was reluctant to increase the student intake with the same training facilities and physical infrastructure.

However, due to ever increasing pressure from the labour market as well as the increase in highly qualified applicants, the Department started to increase the annual intake gradually. In terms of teaching facilities (laboratories), the department of EE made use of the limited available facilities by dividing the students into several groups so that to achieve effective training. From 1992/1993, the Department stretched itself year after year in order to accommodate the growing demand and by 1998/1999, the annual student intake was 45 students, which is already more than double of the planned annual intake capacity of 20 students. TABLE II gives a summary of EE Department's graduands for the last ten years. From TABLE II, it can be seen that there is an overall increase of the annual student intake. Note that there are some cases of dropouts and/or repetitions for each academic year.

TABLE II
GRADUANDS FOR ACADEMIC YEARS 1990/1991 – 1999/2000

Academic Year	Graduands	Academic Year	Graduands
1990/1991	16	1995/1996	46
1991/1992	13	1996/1997	40
1992/1993	17	1997/1998	42
1993/1994	20	1998/1999	41
1994/1995	18	1999/2000	34

ESTABLISHMENT OF NEW ACADEMIC PROGRAMMES

Over the years after establishment of the Department of EE, there has been a clear indication that there is a steep growth of labour market of the graduands. Furthermore, some informal studies indicated that, majority of the newly employed graduands have to go through some kind of short but intensive specialized training. The purpose of short intensive training is to bridge the gap between the general knowledge acquired by the graduands from the Department of EE and the more specialized knowledge required by employers. In most cases, the specialized knowledge imparted to the fresh Electrical Engineers is related to Computers and/or Telecommunications. In that case, though

the fresh Electrical Engineers with diverse general knowledge would be the best choice for employers dealing with Computers and/or Telecommunication business, they are still lacking specific expertise requirements. Lack of specialization in the general degree programme offered by the Department of EE propagated a signal for the need to establish new programmes in order to accommodate the market demand.

Recent studies have shown that 65% or more of the qualified applicants to the FoE choose to join Electrical Engineering [6]. FIGURE 1 shows the number of applicants to the FoE with Electrical Engineering as their first choice. It can be seen that the increase of the number of applicants is approaching exponential. It is important to note that the trend shown in FIGURE 1 is between 1994/1995 and 1998/1999 when the new programmes were not yet in place. The indication is that, after establishment of the new programmes, the number of applicants to the Department will be increasing at even higher rate. This is because the applicants will be assured of the specific specialization within the Department.

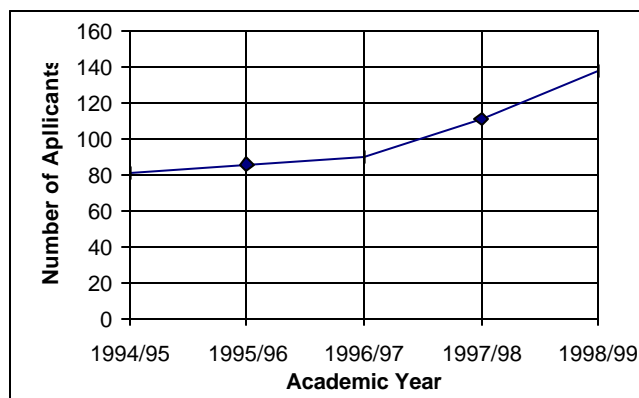


FIGURE. 1
NUMBER OF APPLICANTS TO THE FoE WITH ELECTRICAL
ENGINEERING AS THEIR FIRST CHOICE

The main reason for high percentage of the applicants to the Department of EE, even before establishment of the new programmes, is that the employers find it easier to transform an Electrical Engineer into other closely related fields such as Computers and/or Telecommunications. This means that, the employers would readily absorb graduates in Computer Engineering and Telecommunications Engineering if they would be available. This situation has been substantiated by a market study conducted by the Faculty of Engineering in 1999 on demand of graduates in various fields of Engineering [7]. The market study has shown that the demand for training places in Electrical Engineering is a true reflection of the labour market demands. Furthermore, the results of the market study have called upon the need for specialisation in the areas related to Computer and Telecommunications Engineering. This is due to the

liberalized economies in Telecommunications and Information Technology. This situation indicated by the market study posed a challenge to the Department of EE to consider the establishment of new academic programmes that will cope with the market demand.

To that effect, the Department of Electrical Engineering then proposed to start offering three new undergraduate degree programmes while maintaining the existing old one. The proposal was approved by the Senate of the University of Dar es Salaam in July, 1999 [4] and the three new degree programmes started to be offered during the 1999/2000 academic year. In order to accommodate the employers who are in need of the general purpose Electrical Engineers, the Department has retained the old degree programme which is now called "Bachelor of Science in Electrical Engineering". The three newly established undergraduate degree programmes are:

- (a) B.Sc. in Telecommunications Engineering
- (b) B.Sc. in Computer Engineering and Information Technology
- (c) B.Sc. in Electrical Power Engineering

The three new degree programmes are in addition to the old degree programme.

HARMONIZATION OF THE CURRICULUM

It is the objective of the Department of EE to deliver up-to-date training for all the four undergraduate programmes, the new ones and the old one. To this effect, in the process of establishing the three new programmes, the Department had an opportunity to revisit the curriculum of the old degree programme, apart from formulating the curriculum of the new degree programmes. The goal is to train engineers with reasonably adequate knowledge of computer hardware and software and electronics regardless of the degree programme followed. In order to achieve this goal with effective utilization of limited available human resources, the curriculum for the first four teaching semesters (or first two academic years) is common for all the four degree programmes. With this arrangement, the students belonging to the four academic programmes follow the basic and general courses in mathematics, mechanics, computers, magnetics, circuits, electronics and alike. These basic and general courses intend to build a foundation which is required for the students to be able to follow the more specialized courses during the last 4 teaching semesters (or last two academic years) [8].

It is during the last four semesters when the specialized course are offered to the students registered in the four degree programmes. However, even during the last four semesters, there are several courses which cut across all the four degree programmes. These courses are such as Control Engineering, Microprocessors, Safety and Maintenance, Electrical Engineering Materials, Engineering Management, Intreneuershship and Law, just to mention some. These

common courses are considered to be the most important to all the students in the four degree programmes.

In addition to the common courses, during the last four semesters, students in each degree programme, can opt to take more specialized courses in Power Engineering, Computer Engineering and Telecommunications Engineering for the three new degree programmes. On the other hand, the students in the general degree programme, have to take more courses in the areas of Power Engineering and Telecommunications Engineering. Therefore, after harmonization of the curriculum, students in the general degree programme acquire all the knowledge which was offered before the establishment of the new degree programmes, plus some basic concepts in computer hardware and software.

CONSTRAINTS

The establishment of the new degree programmes in the Department of EE, though a success, there are three main constraints which need to be sorted out in order to continue to deliver effective Engineering Education.

Physical Infrastructure

The Department of EE was established with annual intake of only 20 students, the smallest in the FoE. Therefore, the training facilities were set to be proportional to this low level of students' annual intake. With only 20 students annual intake, the laboratory facilities were adequate to accommodate all of them in one group per session.

The expansion of annual student intake is effected while the physical space allocated to the Department of EE remained the same up to date. At present, the limited physical space has forced the Department to split the students into four groups per laboratory session. The implication is that, both, technical and academic staff members (or laboratory assistants) have to spend four times the amount of time they would have spend when the students would have been accommodated in a single group with adequate physical space. Furthermore, the students in the new degree programmes will be entering their third year of study in 2001/2002 academic year and here are several courses which accompanied with laboratory work. However, as of May, 2001, the physical infrastructure for these laboratories have not yet been clearly identified.

Academic Staff

Since its establishment, the Department of EE strived to foster "Tanzanization" of academic staff. This has been effected by retaining and recruiting the graduates in the Department with highest performance. These graduates were then trained up to Ph.D. level so that they can save as academic staff in the Department. For years, this policy has been applied in almost all entities across the University of Dar es Salaam. Because of financial constraints, this policy was suspended in 1990.

Due to a high market demand of Electrical Engineering and related expertise within Tanzania, in Africa and all over the world, the Department has lost a total of nine fully trained and highly qualified Tanzanian academic staff members. This loss leaves the Department of EE with a total of only nine academic staff members on post which gives a student to staff ratio of about 30. The enormous loss of academic staff by the Department brings a constraint of overloading the academic staff members on post. New recruitment of qualified academic staff from industry has been almost unrealizable due to high market demand of Electrical, Computer and Telecommunications Engineers. Furthermore, as normally the case all over the globe, the remuneration offered by the University is not competitive as compared to that offered by the industry. Both reasons instigate the loss of academic staff member by the Department of EE, at the same time make it difficult to recruit such staff members from industry.

Training Equipment

This constraint goes hand in hand with that of inadequate physical infrastructure for the Department. Due to ever increasing number of students in the Department, the training equipment have become inadequate. This situation alarms a danger of not achieving the main objective of the department of EE, that is effective delivery of Engineering Education.

One way to alleviate this situation is to split the class into small groups such as to ensure full participation of the students in the laboratory sessions and/or tutorial sessions. However, as already narrated before, splitting the class into small groups implies more working hours and/or more academic and supporting staff.

CONCLUSIONS

The paper gives an account on the process undergone to establish three new programmes in the Department of Electrical Engineering, University of Dar es Salaam. The new programmes have been established as a result of the very high market demand for Electrical Engineers, Computer Engineers and Telecommunications Engineers.

In consideration of the small scale industry and other factors, the old degree programme has been retained. However, the curriculum for all the four degree programmes has been harmonized in such a way that the rapid technological advancements, especially in computer related fields, have been incorporated in all the four degree programmes.

In the process of implementation, the main objective of effective delivery of Engineering Education, the Department faces some serious constraints. These constraints are limited physical infrastructure, shortage of academic staff and deficiency of training facilities and equipment.

REFERENCES

- [1] Faculty of Engineering, "Annual Reports", 1974 - 1998.
- [2] Ran Giladi, "An Undergraduate Degree Program for Communication Systems Engineering", *IEEE Transactions on Education*, Vol. 42, No. 4, November 1999, pp. 295-304
- [3] Shlomo Waks and Moti Frank, "Engineering Curriculum versus Industry Needs-A case Study", *IEEE Transactions on Education*, Vol. 43, No. 3, August 2000, pp. 349-352.
- [4] Faculty of Engineering, "A Proposal Report to Establish Three New Programmes", June 1999.
- [5] University of Dar es Salaam: Facts and Figures.
- [6] Faculty of Engineering, "Annual Reports", 1974 - 1999.
- [7] Chambega D. J., et al, "Market Study of New Programmes for The Faculty of Engineering", Faculty of Engineering, University of Dar es Salaam, April/May 1999.
- [8] Robert W. Nowlin and Raji Sundararajan, "A Forward-looking Electronics and Computer Engineering Technology Program", *IEEE Transactions on Education*, Vol. 42, No. 2, May 1999, pp. 118-123.