GETTING STUDENTS INTO CENTRAL EUROPE - A POSTGRADUATE DEGREE PROGRAMME AT THE GhK WITH SPECIAL EMPHASIS ON A KENYA CO-OPERATION

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ABSTRACT
Increasing globalization of the market is a challenge for international cooperation and partnership in higher education and research, especially in electrical engineering. New study programmes which take care of these new developments are attractive for young engineers both from the highly industrialized countries and the less industrialized and developing countries. The rapid growth in communications offers new opportunities for international teamworking.

I INTRODUCTION

An exploding evolution in information and communication technology has been observed during the last decade owing to the rapid progress in semiconductor technology. New materials such as the III-V semiconductor compounds with superior high electron saturation velocity have played a key role in the current technological development. Growth of bulk material can be done with thermal stability and high purity [1]. Techniques for the epitaxial growth of very thin layers (monolayers) have been developed. Bandgap-engineering involves high flexibility in the design of tailor-made devices. The continuous refinement of structuring techniques in three dimensions has led to a continuous reduction of the geometric parameters of the devices reaching the nanometer scale. The smaller size of devices permits higher operating frequencies and larger bandwidths, thus opening new industrial applications. These are found in a rapidly expanding market of wireless communications and intelligent sensor systems operating in a broad frequency range of up to about 100 GHz. Moreover, conventional analog modulation techniques are being replaced by digital methods. Regarding optical communications the transfer velocity has reached bit-rates of up to 40 Gbit/s and is being increased to 80 Gbit/s for future local area network (LAN) applications. The reliable realization of such microwave and millimeterwave components under "first pass success" condition will remain a great challenge for design engineers. Circuit realization in the microwave and millimeterwave region is usually done in monolithic technology. Conventional hybrid techniques suffer from the limited reproducibility of the wire-bonding technique. However, advanced micro-hybrid techniques including air-bridge technology for interconnections are under development and offer "quasi-monolithic" performance [2]. Sound knowledge and practical experience is needed for today's software-based design of complex circuits with increasing packaging density. Design success depends on the availability of reliable models for all basic circuit elements. This applies in particular to any active device for reason of the inherent nonlinear features. The methods of characterization, modelling and simulation of active devices under large signal stimulus go far beyond the linear S-parameter concept. Linearization of power transistors in transmit units of modern communications systems is of increasing importance with respect to higher order modulation techniques currently being developed.

Mobile communication networks behave like time-variant systems. Radio channel measurements are used to develop statistical models for the signal transfer simulation. Development and installation

need knowledge in wave propagation, in scattering of electromagnetic fields, and antennas. With growing improvement of mobile communications infrastructure the hand held phone has become more and more popular. This gives rise to the question of optimum antenna configuration and radiation pattern to minimize the interaction of electromagnetic waves with the human head. The briefly described scenario of modern communications is an attractive broad working field for young electrical engineers. As is pointed out in Ref. [3] there is some need of revision of our educational system which reflects the new technology challenge. A co-operative initiative between universities, government, and industry is needed.

II. NEW INTERNATIONAL STUDY PROGRAMME WITH EMPHASIS ON MODERN COMMUNICATIONS

In 1997 the German Minister for Education, Science, Research and Technology (BMBF), Dr. Jürgen Rüttgers started an initiative to enhance the study conditions for foreign students in Germany and to establish new international study programmes covering undergraduate, graduate and postgraduate degree programmes. English language was proposed as the language of instruction at least at the beginning of the courses. The offered academic degrees should be fully matched to the international standards, i.e. bachelor and master degrees. At Kassel University we preferred to establish a postgraduate degree programme because of the following reasons.

The undergraduate courses, in general, should take care of a sound theoretical background of electrical engineering including deepening by basic practical exercises. The experience with foreign graduates shows that on the undergraduate level the higher education at foreign universities in newly industrialized and developing countries is quite competitive. The situation at the postgraduate level may be different. According to the 'Humboldt model', which made the German universities world famous in the 19th century, and which still holds, teaching is strongly influenced by research, and current research in engineering requires technology at the forefront which involves huge investments and high costs of maintenance. Such technology resources are often not available abroad. For this reason modern advanced technology seems to be very attractive for foreign students.

In response to the initiative of the Minister of Education numerous proposals were submitted for international courses. After being subjected to a rigorous selection procedure by the German Rectors' Conference (HRK) and in co-operation with the German Academic Exchange Service (DAAD), eight institutions were selected for particular courses. Kassel University was chosen to offer a postgraduate degree programme in 'Electrical Communication Engineering'. The programmes receive financial support provided by the Education Ministry and the Foreign Affairs Ministry. Meanwhile about fifty undergraduate, graduate, and postgraduate degree programmes are supported by the DAAD [4], and an increasing number of students from abroad take the opportunity to participate in the selected study programmes.

The University of Kassel is a modern higher education institution founded in 1971 and today has some 18 000 students. It offers a broad spectrum of subjects, ranging from the humanities and social sciences to engineering and Fine arts. We are proud of our film students who were awarded the most coveted film-award, the 'Oscar' in Hollywood in 1990, and 1997 as well. The university offers a variety of degree options. Traditional courses of study lead to a German Diploma degree in physics, mathematics, English language and literature, Romance languages and literature, economic and social pedagogy, and social work. In addition the university has developed consecutive courses of study (undergraduate and postgraduate courses) in electrical, civil, and mechanical engineering, in urban and landscape planning, in ecological agriculture, architecture, and business management and economics ([5],[6]).

The structure of the consecutive bachelor-master programme in electrical engineering is the result of nearly twenty years experience, and is associated with the foundation of the School of Electrical

and Electronic Engineering in the early eighties. The establishment of a bachelor and master degree with high professional quality within the schedule of a regular traditional Diploma course seemed like the well-known trial of 'achievement of the impossible square'. This is always best demonstrated by Maxwell's theory which is known as a key subject in electrical communications. Undergraduate students need profound knowledge in this field to treat for instance antenna problems.

Fig. 1 shows the programme structure of the MSc course in Electrical Engineering at the GhK [7]. The School of Electrical Engineering offers both undergraduate (3.5 years or 7 semesters) and post-graduate (1.5 years or 3 semesters) courses of study. Industrial training (16 weeks) is mandatory for the undergraduates and is usually undertaken after the 4th semester. Practical training must have been completed before the BSc dissertation and BSc exam. The MSc Programme can be entered with the BSc degree in electrical and electronic engineering awarded by the University of Kassel or its foreign equivalent. Graduates from the German 'Fachhochschule', a higher education institution which focuses on practical higher education, have to qualify themselves by additional courses mainly in basic areas like mathematics and physics. Though the instruction language was only German until recently, the number of lectures in English are increasing continuously.

With the support of the DAAD the School of Electrical Engineering has established a first postgraduate degree programme in 'Electrical Communication Engineering' which takes care of the special requirements of qualified foreign Bachelor graduates, i.e. to provide foreign students with sufficient knowledge of German language and the specialised knowledge required for the MSc main courses so as to complete the MSc degree with high efficiency within an acceptable time. If the MSc course is finished with excellent success, the student can apply to do research for a PhD thesis.

Fig. 2 shows the structure of the master's programme. As indicated, the normal study duration is two years (four semesters) including the preparatory semester (semester 1), and the final examination and MSc dissertation semester (semester 4).

Applicants are admitted on the strength of their academic qualifications. Therefore the university offers prior to the lecture period preparatory German language courses for non-German speakers. In the preparatory semester (summer) and the following vacation German language is taught every day by the University Language Centre as is illustrated by the timetable of the first class which started last summer (Fig. 3). To accomodate the different levels of knowledge in German language students with similar language level are grouped together. After a period of five months students may sit for and pass the German language examination which principally exempts them from further language courses. However, it is recommended that they further enhance their German language knowledge. Because of the great resonance abroad, entry into the programme is now also possible in the winter semester. For non-German speakers the preparatory German language course will start in September just prior to the lectures in October.

Specialised courses offered in English accompany the language programme of the preparatory semester. These are meant to deepen and complete the fundamental knowledge required for entry into the core coures in the following semesters. In the second semester (winter), when the university academic year starts, main courses are still offered in English. The specialised courses consist of a number of subjects which are accompanied with laboratory exercises. Non-technical courses (e.g. management and law for engineers) complete the programme. In the third semester, students will be challenged to present seminars on topical issues in different subjects of electrical communications. These would lead to the topics and titles of the final MSc dissertations. The MSc dissertation duration is five months, inclusive of the fourth semester. The university awards the academic degree MSc(Eng) in addition to the German Dipl.-Ing. degree. Students who finish with an excellent master's degree can apply for admission to the doctorate programme.

The size of the class is limited to a maximum number of twenty students. Due to insufficient time for announcement of the programme the first course started with eleven highly qualified students: three from China, two from India, one from Mexico, Ethiopia, and Kenya, and three from Germans. There were several highly qualified applicants with a bachelor degree in physics who could not be accepted because of the current study and examination regulations which definitely require a degree in electrical and electronic engineering. Efforts are underway for some relaxation in particular with respect to special foreign physics curricula (e.g. 'applied physics') which often have subjects basically found in an electrical engineering course.

III. INTERNATIONAL RESEARCH NETWORKS - THE KASSEL-KENYA CO-OPERATION MODEL

Technology is a key to competitiveness and economic growth. Of all the many technologies of our time, progress in communication and information technology no doubt, continues to have the greatest influence on the global economy, making it possible to collect, process and transmit information at breathtaking speed and declining cost, thereby increasing productivity and improving quality and efficiency of all types of industries and services. According to this view, information technology provides 'windows of opportunity' for developing countries to break out of a vicious circle of economic and technological dependency and 'catch-up' with industrial leaders. The idea that developing countries such as Kenya can 'leap-frog' or 'catch-up' with industrially advanced countries has been hotly debated by it's proponents and those who are sceptical about the ability of developing countries taking advantage of communication and information revolution. What has become clear nonetheless, is that, the efficient deployment of information technology is achieving international competitiveness in the increasingly integrated information - intensive global economy.

The availability abd growth of communication and information technology in developing countries such as Kenya contrast sharply with experiences in industrialised countries. Kenya, like most developing countries, suffers from scarcity of readily available, reliable information with adverse consequences for achieving it's numerous development objectives. Worse still, the spread of information technologies across all types of industries and services in industrialised countries is so fast and pervasive with consequent improvements in price competitiveness, design and quality of products that developing countries find it increasingly difficult to compete internationally. Even technologically mature labour-intensive industries in developing countries, are experiencing diminishing competiveness in the face of new technologies and increasing effective changes in organisational practices in industrialised countries. Researchers predict that the wave of new technology sweeping the industrialised nations will widen the gap between the rich and the poor.

Researchers from developing countries who have finished their PhD in a highly industrialised country like Germany have generally no possibility to continue their research work at their home universities. Teaching based on research experience and motivated by own results is often not possible at home. Therefore, after having returned researchers may become demotivated or they may leave their countries after some time to join other international groups.

The modern communication and information technology offers new possibilities in international cooperation. Though only to a marginal extent Kenya is already benefiting from the new technology trends, today, the e-mail and the Internet are replacing most of the former telecommunications services such as telephone, fax, and mail service. These are fundamental requirements for vital international research co-operation. With this in mind the HFT started an initiative with the Kenyan Universities in the field of electrical communications which is financially supported by the DAAD within the framework of a funding programme titled 'partnerships with universities in developing countries'. The goal of this activity is the establishment of a permanent institutional link between Kassel and the Kenyan universities. Research is organized as follows. The HFT, joined with the Physics Department, supports Kenya with its expertise in technology and high frequency techniques.

Kenyan researchers having been educated at Kassel University will be fully integrated into a joint research network. Research in Kenya is mainly based on computing. Suitable workstations could be purchased within the programme.

Further extension of the co-operation is mainly in technology. A Kenyan researcher has been involved in the development of a low-cost integration technology for microwave systems. Commercial Galliumarsenid (GaAs) field-effect transistors (FET), fabricated using technologies that are too expensive for developing countries, are embedded in a silicon substrate carrying the passive circuitry such that interconnections can be fabricated using conventional thin-film techniques. The hybrid circuits under development should be affordable and offer performances comparable to microwave monolithic integrated circuits (MMIC's). In view of the lower costs required to set up such a technology, efforts are being made to set up a technological centre in Kenya to cater for local needs such as industrial sensors and to allow Kenyan graduates to participate in high level research. The Kenyan students who attend the international postgraduate programme at Kassel University will deepen and accelerate the cooperation between both countries.

CONCLUSIONS

The introduction of new international study programmes in central Europe offers international students an attractive alternative to participate in the rapid technology development. This has been exemplarily demonstrated with a new postgraduate degree programme 'Electrical Communication Engeneering' at the University of Kassel. The rapid growth of global information systems opens new possibilities in international co-operation. This has been shown by a joint initiative of the University of Kassel and the Kenyan Universities to realize a research network used for co-operation on an equal partnership basis in common research projects.

The industry, benefiting mostly from the current technology revolution, needs highly educated young engineers prepared for a globally competitive marketplace. This gives hope that the companies appreciate the great efforts of the universities assimilating the technology trends into new study programmes, and that they will strengthen their commitment in further development.

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REFERENCES

[1] M.J. Howes and D.V. Morgan (eds.): *Gallium Arsenide - Materials, Devices, and Circuits*. John Wiley & Sons (1985).

[2] E. Wasige, G. Kompa, F. van Raay, I.W. Rangelow, F. Shi, W. Scholz, R. Kassing; R. Meyer, and M.-C. Amann: Air Bridge Based Planar Hybrid Technology for Microwave and Millimeterwave Applications. Digest of 1997 IEEE MTT-S International Microwave Symposium, Denver, USA, June 8 - 13, 1997, 925-928.

[3] L. Besser: Is our Engineering Education System Suitable to fulfill the Needs of the Wireless Industry? Digest of 1998 IEEE MTT-S International Microwave Symposium, Baltimore, USA, June 7 - 12, 1998, 543-546.

[4] DAAD: *Undergraduate, Graduate and Postgraduate Degree Programmes in English and German - International Courses in Germany* (April 1998).

[5] Universität Gesamthochschule Kassel: *Postgraduate Degree Programmes* (1998).

[6] Universität Gesamthochschule Kassel: *Short Guide for International Students* (June 1998).

[7] G. Kompa (ed.): *Electrical Communication Engineering - Postgraduate Degree Programme* (October 1997).

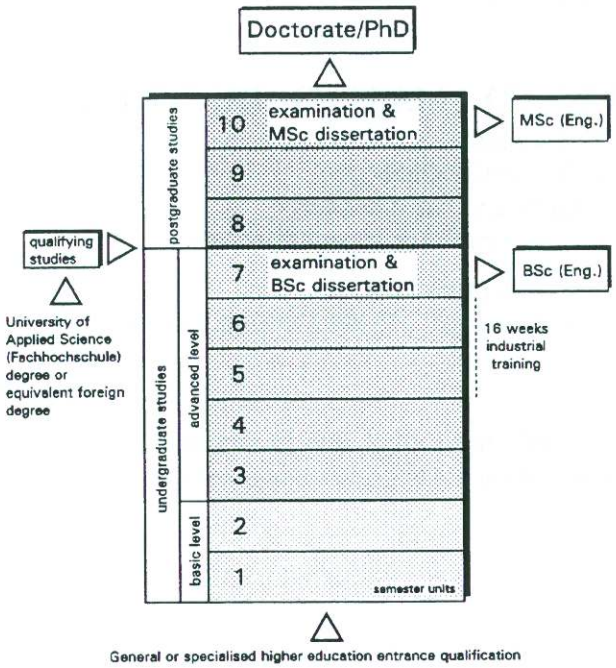

Fig. 1: Modular degree course in Electrical Engineering at the GhK.

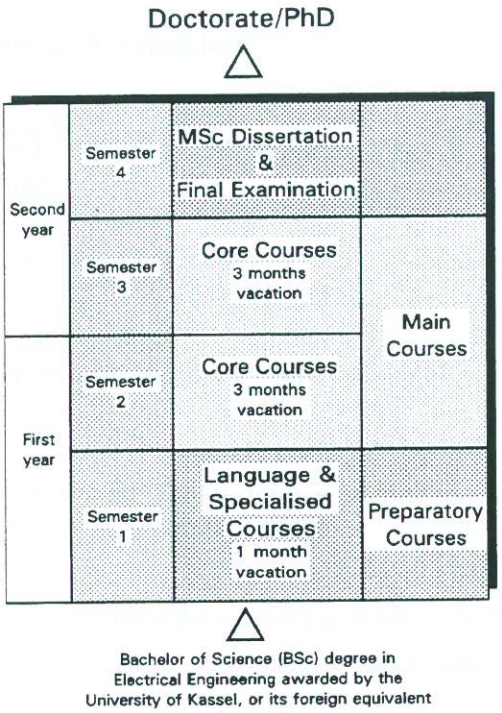

Fig. 2: Postgraduate degree programme for bachelor graduates.

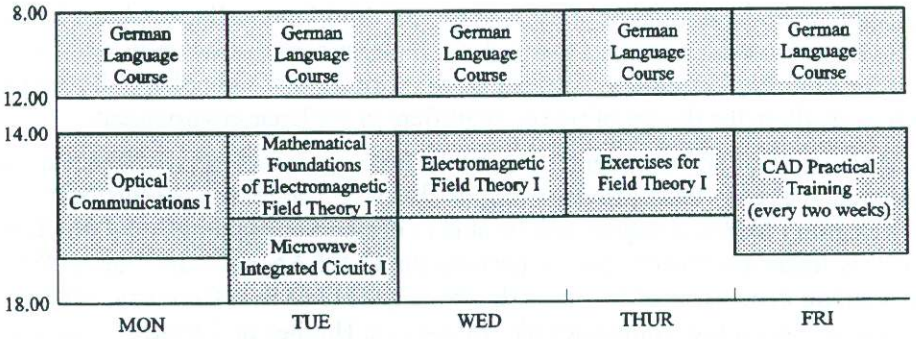

Fig. 3: Language and specified courses in the preparatory semester of the first class.

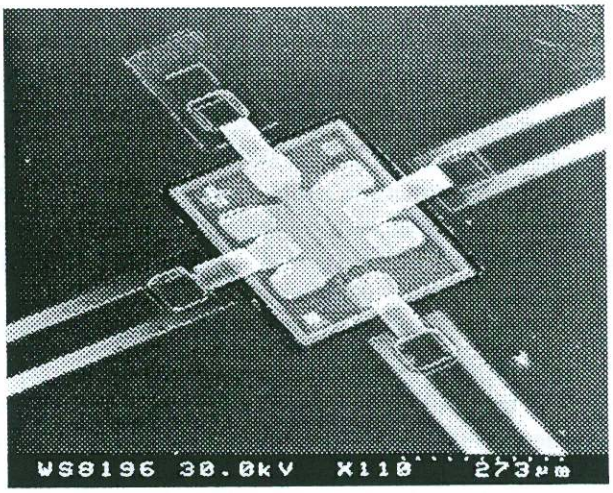

Fig. 4: Demonstration of the 'quasi-monolithic' integration technology.