

## **New Practically Focused Graduate Programs in Electronics offered by RMIT University.**

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### **Abstract**

The Department of Communication and Electronic Engineering at RMIT University has always had a practical “hands on” approach to teaching undergraduate engineering courses. The programs are industrially oriented with the aim of reducing the learning curve for graduates entering industry.

In 1997 the Department, in consultation with industry, introduced graduate course work programs in electronics leading to the Master’s degree. Hands on experiential learning is still emphasised and professional development opportunities are provided for practising engineers.

This paper will describe the development of the program. It will discuss the rationale for introduction, the aims and objectives, the program structure, and the first year of delivery. In conclusion the paper will outline modifications and new initiatives planned for 1998.

### **Introduction**

RMIT (Royal Melbourne Institute of Technology) is a dual sector university providing higher education and TAFE (Technical and Further Education) programs to 38,000 students in the Melbourne metropolitan area. RMIT is internationally respected for its intellectual rigour and practically focused courses and has developed strong links and partnerships with business, industry, and the public sector. It is known throughout Australia and overseas as an innovative leader in education.

The Department of Communication and Electronic Engineering at RMIT is one of the leading providers of communication and electronic engineering education in Australia and offers a wide range of short courses, undergraduate and graduate degree programs. The Department strives to produce graduates who are immediately productive on entering the workplace or at a minimum have significantly reduced learning curves. The Department places heavy emphasis on state of the art practical skills to meet the needs of today’s fast changing engineering environment. Practical work is designed to reinforce the material that is covered in the lectures and each course has an associated laboratory<sup>1</sup>. The Department also has a strong enterprise engineering focus which integrates business and personal skills development with the technical aspects of the program<sup>2</sup>.

In 1997 the Department introduced a graduate course work program in electronics that would complement the undergraduate program and lead to the Master's degree. The same practically focused philosophy is still maintained, with each course having a corresponding laboratory. The aim is to provide professional development opportunities for practising engineers through "hands on" experiential learning of new technologies, new design methodologies and tools, new products and manufacturing techniques and regulatory and standards issues. The program provides opportunities to hone personal competencies, personal attributes and business skills in preparation for leadership roles.

The graduate course work program consists of three stages, with an award being given after each stage. At the end of the first stage, which corresponds to one semester of full time study, a Graduate Certificate is awarded. At the end of an additional semester of full time study a Graduate Diploma is awarded. If the student completes one more semester of full time study a Master's degree is awarded.

### **Rationale for Introduction**

Prior to 1997 graduate study in Electronics was available by research (a non course work option involving a major thesis) but it was believed that the course work options would attract a large number of part-time students working in industry, for whom a research qualification is often not practicable. It was also felt that the course work options would attract overseas students, particularly from the Asia Pacific region. This was substantiated by the fact that the then recently introduced graduate programs by course work in Telecommunications attracted many part time students from local industry plus full time students from the Asia Pacific region. It was felt that the new programs would complement the Telecommunications program, providing opportunities for advanced study by course work outside of the Telecommunications area.

RMIT has been a major provider of graduate electronics and communications engineers and this fundamental position ensures that RMIT maintains wide exposure within relevant industries. Participation in course work graduate studies in Electronics as well as Telecommunications, should therefore be widely accepted as a logical progression.

In addition, the current broadening and generalisation of undergraduate programs leaves scope for special focus material to be incorporated into graduate course work qualifications. The Graduate Certificate, Graduate Diploma, and Master's qualifications by course work enable specialisation to be taken to a greater depth which is a developing trend both in the United States and Australia. Australia needs a strong design and manufacturing focus, incorporating concurrent engineering, in order to be competitive into the next century. The graduate programs outlined in this paper enhance the quality of graduate engineering education and more effectively develop the competencies and characteristics essential for graduate engineers taking leadership responsibility in a competitive, international business environment driven by fast technological

change. The graduate course work is designed to meet the professional development needs of engineers employed in the Australian and overseas electronics industry.

### **Consultation with Industry**

The Department of Communication and Electronic Engineering has an active Course Advisory Committee whose membership includes individuals from leading edge companies in the Melbourne metropolitan area. The graduate course work proposal was first developed in consultation with this Committee. It was felt that the industrial community as a whole should also provide input into the proposed program and consequently a survey was designed and developed to obtain feedback from industry about the possible demand and support for the program, to obtain information about desired courses and input about the program structure. Key individuals at companies were first contacted by telephone and the proposed graduate program was discussed. Following these conversations the surveys were sent to the appropriate engineering groups. The results were then presented to the Course Advisory Committee and the final structure of the program was developed with the endorsement of the Committee.

### **Aims and Objectives**

The Graduate Certificate, Graduate Diploma and Master's in Electronics will help to meet the goals of the Department in several ways. The new program introductions will provide those engineers already employed full time in industry with a vehicle to upgrade their qualifications and increase their knowledge while continuing full time employment. The courses will introduce them to cutting edge technologies which they will then take back to the workplace.

It is also intended that these graduate courses be offered as three day short courses. Participants who elect to take later assessment and are successful will be credited with corresponding grades towards the Graduate Certificate and Graduate Diploma.

It is also expected that the new courses will attract considerable interest from overseas students wishing to continue study on a full time basis. It is believed that many of these students will be from the Asia-Pacific region since the courses will focus on material which is very relevant to industry in that area, such as electronic manufacturing. This directly meets the objectives of the Department's mission and will generate significant revenue for the Faculty of Engineering.

The new courses will contain a strong enterprise engineering element, thereby providing students with the innovative approach required of today's engineers. The industrial contacts developed between faculty members and students employed full time in industry are expected to generate considerable opportunities for consulting and research.

The mission of the Department of Communication and Electronic Engineering, as described above, is consistent with the Faculty of Engineering Strategic Plan which states the following:

‘We develop and deliver, in Australia and overseas, innovative engineering education, research and development, and consulting, to address real world issues.’

RMIT’s Strategic Plan for the years 1995 - 2000 outlines key strategies in different critical areas. The key strategy in the area of Education and Training is to offer programs in emerging or growth industries. The programs in the Graduate Certificate, Graduate Diploma and Master’s of Electronics do this by concentrating on the three focus areas of Electronic Design, Electronic Manufacture and Signal Processing.

The Electronic Design core subjects are chosen to offer students the opportunity to increase their expertise in both analog and digital design. Opportunities are also available for students wishing to study in the area of radio frequency (RF) design.

The Electronic Manufacturing core subjects are designed to introduce students to some of the key issues involved in electronic manufacturing, thereby enabling them to better liaise with, and participate in, the manufacturing sector. The goal is to promote concurrent engineering by orienting engineers to electronic technology and manufacturing processes<sup>3</sup>.

The Signal Processing core subjects are designed to cover a wide range of topic areas in this field, including sensor technology, signal acquisition, aspects of biomedical engineering and digital signal processing (DSP).

The purpose of the program is to develop specialisation and encourage professional development in electronics, with particular relevance to industry, beyond the level of the Bachelor’s degree. Emphasis is still on developing the attributes of knowledge, creativity and critical thinking. Leadership capabilities and employability are further enhanced.

The course delivery is in accordance with the guidelines of the Faculty of Engineering Teaching and Learning Strategy which was developed in 1995. Emphasis is placed on adopting a continuous improvement strategy for both the course delivery and student outcomes.

## **Program Structure**

The program is structured to provide flexibility for the participants with a choice to complete the Master’s in Electronics degree or to break with a Graduate Diploma or Graduate Certificate in Electronics. The areas of study are divided between the electronics courses (referred to as the Electronics Cluster) and Technical elective courses (referred to as the Technical Elective Cluster). The time required to complete each stage is:

Graduate Certificate: 1 semester full time study ( 8 courses)

Graduate Diploma: 2 semesters full time study ( 16 courses)

Master’s in Electronics: 3 semesters full time study ( 16 courses plus minor thesis)

Note: one course corresponds to two contact hours per week for the duration of the semester

## Electronics Cluster

Three focus areas are defined: Electronic Design, Electronic Manufacturing, Signal Processing. Students are required to take Integrated Circuit Design Approaches, Electromagnetic Compatibility and Test and Design for Test regardless of the focus area. They then may choose a minimum of one course for the Graduate Certificate and five courses for the Graduate Diploma/Masters from any of the three focus areas. Minimum requirement is 8 courses for the Graduate Diploma and 4 courses for the Graduate Certificate.

<b><i>Required Courses</i></b>
<b>Integrated Circuit Design Approaches</b>
<b>Electromagnetic Compatibility</b>
<b>Test and Design for Test</b>
<b><i>Electronic Design</i></b>
Advanced Circuit Simulation
Analog Integrated Circuit Design
Discrete Electronic Circuit Design
Receivers and Transmitters
Communication Circuit Design
Microwave and UHF Circuits and Systems
<b><i>Electronic Manufacturing</i></b>
Integrated Circuit Fabrication
PWB Technology and IC Packaging
Design for Manufacture
Design for Quality and Reliability
Automation and Robotics
Production and Inventory Control

<b><i>Signal Processing</i></b>
Measurements and Instruments
Optoelectronics
Sensors and Actuators
Signal Acquisition and Filtering
Biomedical Signal Processing
Digital Signal Processing
Medical Engineering
and other Electronic Engineering Electives as approved by the Course Leader

### **Technical Elective Cluster**

The program provides maximum flexibility for professional development by allowing students to choose electives from graduate programs across the university, tailoring skills development to their personal needs. A maximum of 4 courses can be taken for the Graduate Certificate and a maximum of 8 courses for the Graduate Diploma/Masters. Courses can be taken from the following areas:

Note: Based on one course being equivalent to two contact hours per week for the duration of the semester.

Computer Systems Engineering
Computer Science
Statistics and Operations Research
Mathematics
Management
Business
Communications & Electronic Engineering

### **Minor Thesis**

For students progressing beyond the Graduate Diploma stage, the Master's of Electronics involves a further semester (full time) during which participants undertake a Minor Thesis project. The project can be proposed by the student and should be in a current electronics area.

Industry related projects are encouraged and are ideal for students working in the electronics area. The project can be carried out on campus or at the work place.

### **The First Year of Operation**

University approval to offer the new programs in Electronics was obtained in November 1996 and although there was little lead time to promote the programs, it was deemed appropriate to begin offering courses in the first semester of 1997. In late November the new programs were advertised in a national newspaper. Managers in local industry were contacted and asked to announce the program introduction, and this was followed by sending fliers. Program fliers were also sent to all alumni. Additionally the programs were advertised through the RMIT campus in Malaysia and through various contacts overseas. Advertising was continued prior to the second semester which started in July 1997.

A total 8 students were attracted into the program for 1997 which was sufficient to launch it. It was expected that numbers would be small initially, due to the late advertising and promoting of the programs. Many local students make decisions about degree programs and gain university acceptance several months before the semester commences. Overseas students also need considerable lead time to be able to organise residency and visa requirements. In light of the above the small number of students was felt to be reasonable.

All the students were part-time and most working in industry. Some of the students who had been out of school for some time found that considerable effort was required to come up to speed with the level of the material. This of course required extra time with the courses and dictated the loads for the second semester.

Overall the first year of operation was successful with a considerable effort being made in new course development.

### **Conclusion**

Based on the operational experience with Electronics in 1997 and that of the related Telecommunications program, a number of structural changes have been made for 1998.

Time allocation has been increased for the electronics courses from two contact hours per week to three contact hours, allowing students more time to assimilate the material. This effectively reduces the number of courses required for the Graduate Certificate and the Graduate Diploma from 8 to 6 and 16 to 12 respectively.

The programs have been made more flexible inasmuch as the core requirement previously discussed has been relaxed.

A program which has been very successful at the undergraduate level and is being incorporated into the Master's by course work Electronics program for 1998, is the CEED (Cooperative Education for Enterprise Development) program<sup>4</sup>. It is being introduced to meet the minor

thesis requirement and also for the many advantages it has to offer students. CEED is an industrially related project activity whereby students work on industry projects which form the basis of the minor thesis. These projects will typically be conducted at the company site with an industry adviser and an RMIT adviser. CEED projects are specifically geared and particularly relevant and valuable for non working students and overseas students. Students are paid for work on CEED projects and can earn up to A\$7,500.00 for the semester. These projects provide students, especially from overseas, with the opportunity to gain valuable experience in industry and to also get paid.

Extensive advertising is being continued, both in the home and overseas markets, and it is expected that student numbers will increase significantly for 1998. As the programs become more mature and well known it is believed that Electronics will complement the already successful Telecommunications programs which have been running now for three years.

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