

Articulation, Credit Transfer and Flexible Delivery of Engineering Degree Courses : Australia, Malaysia and Hong Kong.

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Abstract

This paper describes the three different levels of undergraduate engineering courses offered by many post Dawkin universities in Australia. Emphasis is placed on the recent course review by Faculty of Engineering and Surveying at the University of Southern Queensland (USQ) and how the review has facilitated articulation between programmes of study and encourages credit transfer from universities or other institutions within and outside Australia. Articulation and credit transfer arrangements that have been developed with a number of international institutions are outlined. Flexible delivery and its influence on student demand for USQ courses are also considered.

Introduction

Engineering education in Australia is offered at trade, engineering associate, engineering technologist and professional engineer levels. This paper is concerned only with the last three levels. Like many other post Dawkins universities in Australia (Blackall, 1992) engineering courses offered by USQ are at three different levels, Bachelor of Engineering (BEng), Bachelor of Technology (BTech) and Associate Degree (AD), formerly the Associate Diploma. Bachelor of Engineering courses, offered at honours and pass degree levels, currently involve four years of full time study or seven years of mixed mode study (a combination of external and on campus study) and are designed for the education of professional engineers. These programmes each comprise 32 credit point units of study including a two credit point *project* unit and two single credit point *engineering management* and *engineering management science* units. A *unit* is the smallest component of a course that receives an official grade; it is often referred to as a *module* or *subject* at other institutions. Bachelor of Technology programmes involve three years of full time study or six years of part time, external study and graduates practise as engineering technologists. There are twenty four credit point units in these courses. Associate Degree courses are for educating engineering associates and consist of two years of full time study or four years of part time, external study. The number of credit point units in these courses is sixteen. All of these courses are offered in a range of discipline areas.

Course Review and Articulation

At the end of 1995, the Faculty of Engineering and Surveying at USQ decided to review all of its programmes to make them more industrially-orientated, better articulated and more externally focused (IEAust, 1996) so that they would be more attractive to prospective and existing students, both domestic and international. The new course structures will be implemented in February 1998 and all programmes, including the Bachelor of Engineering by eight years of part time, external study, have been formally accredited by the Institution of Engineers, Australia (IEAust). The course structure for the discipline area of *mechanical engineering* will be used for discussion purposes. The course structure of the Bachelor of Engineering (honours or pass degree programme) is given in table 1. Similarly, the course structures for both the Bachelor of Technology and the Associate Degree are shown in tables 2 and 3 respectively.

The Bachelor of Technology programme has been revised to enable graduates to complete the Bachelor of Engineering programme in a shorter period of time. Comparing tables 1 and 2, it can be seen that twelve (12) credit point units and four (4) *practice* units are common to the two courses. However, because of the equivalence of content of other units and depending on their choice of elective units, students who complete the Bachelor of Technology programme are eligible for 17-19 credit points of advanced standing and exempt from attending four *practice* units if they transfer to the Bachelor of Engineering course. Therefore students articulating from the Bachelor of Technology course to the Bachelor of Engineering are normally able to complete the Bachelor of Engineering course in a further eighteen months of study. *Practice* units must be completed by students but do not carry any credit point value towards the award. These units are primarily concerned with the acquisition of practical skills and the building of group interaction abilities.

The former Associate Diploma courses have been developed and reclassified as Associate Degree programmes. The Associate Diploma programme is a subset of the Bachelor of Technology course; comprising the first two years of this course. Associate Diploma holders are therefore only required to study eight credit point units over two semesters to be eligible for the award of Bachelor of Technology.

Credit Transfer for Australian Institutions

Students, both domestic and international, studying the same level of course at another Australian university will usually obtain credit transfer on a unit to unit basis. The Faculty will also endeavour to exempt these students from the elective studies on the merits of their previous study, so that they may be able to complete their degrees in the least possible time. This approach is also extended to students studying at the same level of programme in any of the tertiary institutions of countries whose professional engineering institutions are signatories to the Washington Accord. USQ has reacted positively to the recommendation 9.3 of the Review of Engineering Education of Australia, 1996 (IEAust, 1996) by admitting a considerable number of students from non-traditional backgrounds. Holders of Associate Diplomas awarded by Technical and Further Education (TAFE) institutes within Australia will usually earn 12 credit points of exemption if they wish to study for the award of Bachelor of Technology in the same discipline area and at least eight credit points of exemption from the Bachelor of Engineering.

Table 1: Course Structure of Bachelor of Engineering (Honours or Pass Degree Programme) majoring in Mechanical Engineering

BACHELOR OF ENGINEERING - MECHANICAL ENGINEERING

Unit		Year and semester in which unit is normally studied						
		Day Mode Course		External Mode Course		Mixed Mode Course		
						External Component		Full Time On Campus
		Year	Sem	Year	Sem	Year	Sem	Year 7
E0001	Computers in Engineering	1	S1	1	S1	1	S1	
64612	Algebra and Calculus I	1	S1	1	S1	1	S1	
70245	Engineering Materials	1	S1	2	S1	2	S1	
65901	Physics and Instrumentation	1	S1	2	S1	2	S1	
E0006	Engineering Design and Drafting	1	S2	1	S2	1	S2	
70210	Engineering Communications and Case Studies	1	S2	1	S2	1	S2	
70230	Electrical Technology	1	S2	2	S2	2	S2	
70270	Engineering Statics	1	S2	2	S2	2	S2	
70051	Engineering Practice 1	1	S12	2	S1	2	S1	
64001	Data Analysis	2	S1	3	S1	3	S1	
70341	Thermodynamics	2	S1	3	S1	3	S1	
70350	Dynamics I	2	S1	4	S1	4	S1	
70370	Stress Analysis	2	S1	4	S1	4	S1	
73051	Mechanical Practice 1	2	S12	3	S1	3	S1	
64613	Algebra and Calculus II	2	S2	3	S2	3	S2	
64623	Numerical Computing	2	S2	3	S2	3	S2	
70445	Manufacturing Processes	2	S2	4	S2	4	S2	
70650	Design of Machine Elements	2	S2	4	S2	4	S2	
73052	Mechanical Practice 2	2	S12	4	S2	4	S2	
70541	Fluid Mechanics	3	S1	5	S1	5	S1	
70545	Materials Technology	3	S1	5	S1	5	S1	
70651	Computer Aided Design and Analysis	3	S1	6	S1	6	S1	
70641	Heat and Mass Transfer	3	S1	6	S1	6	S1	
73053	Mechanical Practice 3	3	S12	5	S1	5	S1	
70320	Linear Systems and Control	3	S2	5	S2	5	S2	
70750	Dynamics II	3	S2	5	S2	5	S2	
70845	Production Engineering	3	S2	6	S2	6	S2	
70950	System Design	3	S2	6	S2			S2
73054	Mechanical Practice 4	3	S12	6	S2	6	S2	
70708	Engineering Management	4	S1	7	S1			S1
*****	Australian Study #	4	S1	8	S1			S1
*****	Elective	4	S1	8	S1			S1
70712	Project (2 credit points)	4	S12	8	S12			S12
64636	Advanced Engineering Mathematics A(Honours only)	4	S2	7	S2			S2
OR								
*****	Elective	4	S2	7	S2			S2
*****	Elective	4	S2	7	S2	6	S2	
70709	Engineering Management Science	4	S2	7	S2			S2
70061	Professional Practice 1	4	S12	7	S2	7	S2	
70062	Professional Practice 2	4	S12	8	S12			S12

Table 1: Course Structure of Bachelor of Engineering (Honours or Pass Degree Programme) majoring in Mechanical Engineering (Continued)

Electives

Unit	Semester in which unit is normally taken	
	On Campus	External
51345 Quality Management	S1	S1
70326 Electronic Circuits	S1	S1
70335 Computer Engineering I	S1	S1
70456 Mining Technology		S2
70470 Structural Design I	S2	S2
70520 Computer Controlled Systems	S1	S1
70665 Agricultural Materials and Crop Storage	S2	S1
70920 Robotics and Machine Vision	S2	S2
70940 Energy Technology	S2	
70945 Modern Manufacturing	S1	
Australian Study # (Compulsory)		
Select one of the following units:		
51395 Environmental politics and Policy	S2	S2
51382 Australian Political Institutions	S2	S2
51383 Australian Public Administration	S1	S1
90502 Australia, Asia and the Pacific	S1	S1

Table 2: Course Structure of Bachelor of Technology majoring in Mechanical Engineering

BACHELOR OF TECHNOLOGY - MECHANICAL ENGINEERING

Unit		Day Mode Course		External Mode Course	
		Year	Sem	Year	Sem
60041	Foundation Mathematics	1	S1	1	S1
E0006	Engineering Design and Drafting	1	S1	1	S1
E0001	Computers in Engineering	1	S1	2	S1
65901	Physics and Instrumentation	1	S1	2	S1
70210	Engineering Communications and Case Studies	1	S2	1	S2
E0004	Applied Mechanics	1	S2	1	S2
E3006	Thermodynamics	1	S2	2	S2
70245	Engineering Materials	1	S2	2	S2
70051	Engineering Practice 1	1	S12	1	S1
E0003	Electrotechnology	2	S1	3	S1
E3003	Mechanical Drafting	2	S1	3	S1
E3004	Machine Stress	2	S1	4	S1
E3007	Machine Dynamics	2	S1	4	S1
73051	Mechanical Practice 1	2	S12	3	S1
70445	Manufacturing Processes	2	S2	3	S2
E3001	Fluid Mechanics	2	S2	3	S2
E3002	Trade Techniques	2	S2	4	S2
70650	Design of Machine Elements	2	S2	4	S2
73052	Mechanical Practice 2	2	S12	4	S2
70708	Engineering Management	3	S1	5	S1
64001	Data Analysis	3	S1	5	S1
*****	Australian Study #	3	S1	6	S1
*****	Elective	3	S1	6	S1
E0009	Project	3	S12	6	S12
70845	Production Engineering	3	S2	5	S2
70709	Engineering Management Science	3	S2	5	S2
*****	Elective	3	S2	6	S2
73053	Mechanical Practice 3	3	S12	5	S2

Table 2: Course Structure of Bachelor of Technology majoring in Mechanical Engineering (Continued)

Electives

UNIT		SEMESTER IN WHICH NORMALLY OFFERED	
		ON CAMPUS	EXTERNAL
E1007	Steel and Building Technology	S2	S2
E3010	Advanced Mechanical Drawing		S2
64612	Algebra and Calculus I	S1	S1
70430	Electrical Plant	S2	S1
70545	Materials Technology	S1	S1
A maximum of one unit may be selected from the following			
51005	Introduction to Law	S1	S1, S2
51008	Business Economics	S1	S1, S2
51345	Quality Management	S1	S1
51361	Introductory Marketing	S2	S2
51190	Commercial Analysis	S1	S1
Australian Study # (Compulsory)			
Select one of the following units:			
51395	Environmental politics and Policy	S2	S2
51382	Australian Political Institutions	S1	S1
51383	Australian Public Administration	S1	S1
90502	Australia, Asia and the Pacific	S1, S2	S1, S2

Table 3: Course Structure of Associate Degree in Mechanical Engineering**ASSOCIATE DEGREE IN MECHANICAL ENGINEERING**

Unit		Day Mode Course		External Mode Course	
		Year	Sem	Year	Sem
60041	Foundation Mathematics	1	S1	1	S1
E0006	Engineering Design and Drafting	1	S1	1	S1
E0001	Computers in Engineering	1	S1	2	S1
65901	Physics and Instrumentation	1	S1	2	S1
70210	Engineering Communications and Case Studies	1	S2	1	S2
E0004	Applied Mechanics	1	S2	1	S2
E3006	Thermodynamics	1	S2	2	S2
70245	Engineering Materials	1	S2	2	S2
70051	Engineering Practice 1	1	S12	1	S1
73051	Mechanical Practice 1	1	S12	2	S1
E0003	Electrotechnology	2	S1	3	S1
E3003	Mechanical Drafting	2	S1	3	S1
E3004	Machine Stress	2	S1	4	S1
E3007	Machine Dynamics	2	S1	4	S1
73052	Mechanical Practice 2	2	S12	3	S2
70445	Manufacturing Processes	2	S2	3	S2
E3001	Fluid Mechanics	2	S2	3	S2
E3002	Trade Techniques	2	S2	4	S2
*****	Elective	2	S2	4	S2
73053	Mechanical Practice 3	2	S12	4	S2

Electives

Select one of the following elective units

UNIT	SEMESTER IN WHICH NORMALLY OFFERED	
	ON CAMPUS	EXTERNAL
E3010 Advanced Mechanical Drawing		S2
70650 Design of Machine Elements	S2	S2
70845 Production Engineering	S2	S2

Credit Transfer for Overseas Institutions

Australian engineering graduates have been readily accepted into industries and universities in the United Kingdom and North America (IEAust, 1996) and at the same time Australian universities have also become accepted in Asia Pacific Rim regions as a provider of quality undergraduate and postgraduate engineering courses at reasonable costs. An Organisation for Economic Cooperation and Development (OECD) review of higher education also pays a high tribute to the resilience, capability and strength of Australian universities and their staff (Richardson, 1997). We therefore believe that Australian universities, including USQ, are very competitive in the world higher education market.

Currently the Faculty's main sources of international students are Malaysia and Hong Kong (Swannell, 1996). In Malaysia, twinning arrangements have been negotiated with two private colleges, Informatics College, Kuala Lumpur and First Robotics Industrial Science (FRIS) Institute, Penang. Graduates of the twinning programme conducted by Informatics College

receive an Advanced Diploma and are eligible for 16 credit points of advanced standing in the Bachelor of Engineering (Honours). They may complete this award in a further two years of full-time study in Australia. Students who complete six or eight semesters of study at FRIS Institute and who are awarded a Diploma or Advanced Diploma by that Institution are eligible for 20 and 24 credit points of advanced standing respectively in the Bachelor of Engineering (Honours). Graduates from both organisations may also complete a Bachelor of Technology by full time, on campus study or by distance education with an appropriate level of advanced standing. (The University has ruled that students must complete at least eight credit point units of a course in order to be eligible for an undergraduate degree award.)

In Hong Kong, technical institute diploma holders are granted 16 credit points advanced standing towards the Bachelor of Technology programme in the same discipline area and students are able to complete the course by on campus study in one year, or by part time, distance education in Hong Kong in two years with a week visit to USQ for a residential school. To date, three students have completed their on campus studies and have qualified for the Bachelor of Technology and more are studying for the award. The number of students studying externally is also growing rapidly. All of these students have the option of progressing towards the study of Bachelor of Engineering and may be able to complete the programme in as little as 18 months. Holders of the higher diploma in engineering from the Hong Kong Polytechnic University, City University of Hong Kong and Technical Colleges (Tsing Yi and Chai Wan) will receive a minimum transfer of 16 credit points towards the study of the Bachelor of Engineering in the same or closely related discipline areas, for example marine engineering and building services engineering. Higher certificate in engineering holders will also get 16 credit points of exemption for their previous studies if they apply for admission to the Bachelor of Engineering in the same discipline area; in addition these students may receive extra exemptions on a unit for unit basis if they hold other relevant qualifications such as an endorsement to a higher certificate in engineering in a closely related discipline area.

In Singapore, local partners for twinning programmes are being sought by the Associate Dean (Planning), Associate Professor Mick Morgan and the University is currently finalising a memorandum of understanding with the Singapore Institute of Engineering Technologists (SIET) for the offering of its distance education programmes in Singapore. Similar arrangements are being considered for other countries in the Asia Pacific Rim, Southern Africa, India and South America.

Flexible Delivery

In the climate generated by the current Minister for Employment, Education, Training and Youth Affairs, Senator Amanda Vanstone, Australian universities feel obliged to take more positive actions to search for funds outside the public purse and one way of doing this is to commit themselves to flexible delivery of their courses, domestically and internationally. The term *flexible delivery* (FOES, 1996) is used in preference to *external degree* because the former implies more than the use of traditional text books and study guides as is usually the practice in the latter case. Flexible delivery includes the use of videos, CD ROMs, computer mediated conferencing, the internet, SMART 2000, video conferencing and other delivery systems. USQ, one of the leading providers of external courses, has offered degree level courses by distance education within Australia since 1967, and in Hong Kong and Malaysia since 1988. To date most of the external degree programmes offered to overseas students have been confined mainly to the Faculties of Business, Commerce and Arts. The Faculty of Engineering and Surveying (FOES) only started to offer flexible delivery Bachelor of Technology programmes courses to Hong Kong students in July 1996. Now that the Bachelor of Engineering has been approved for offering by distance education by the IEAust, it is anticipated that this programme will start as

early as February 1998. Students commencing the Bachelor of Engineering will be expected to come to USQ, Australia for a total period of seven weeks for their *practice* units, over the eight year period of their study. Because these units may be grouped together in part, students may be able to complete the entire programme with only three or four short visits to Australia, making the course inexpensive compared with full time study in Australia and ideal for employed people. Students who receive advanced standing will have their periods of attendance and years of study reduced proportionately. Recently, our newly appointed Dean, Professor Derek Wilson stressed that our core business will be distance education (FOES, 1997). It is anticipated that the Faculty will be able to expand its flexible delivery programmes domestically and into most of the Asia Pacific Rim countries in the very near future and we plan to have at least 20 per cent of our students as full fee paying, international students by the year 2000.

Conclusion

From the above discussion, it is evident that the Faculty and the University are actively expanding the base of their distance education programmes. The Faculty is the leading provider of distance education programmes in engineering and surveying in Australia and views the internationalisation of its courses as very important. It provides the opportunity to offer high quality programmes of study to people who are often unable to access traditional courses and enhances the development, opportunities, challenges, and cultural interactions of the University students and staff. The Faculty will seek to extend its operations to include more countries and regions, particularly in the Asia Pacific Rim. In view of the favourable development of the internalisation of the Faculty and the University, we still have to face a number of critical challenges such as competition from our rivals nationally and internationally, and changes of foreign government policies on non higher and professional education (Tideman, 1996). USQ and other Australian universities have to change strategies while continuing to market their quality courses in these countries and regions. In the longer term, we are looking forward to further enhancing cooperation between the engineering professionals of Malaysia, Hong Kong and those of this country.

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