Int. J. Engng Ed. Vol. 11, No. 3, pp. 175–184, 1995
Printed in Great Britain.

0949–149X/91 $3.00+0.00

Undergraduate Academic Programme: Planning, Development, Implementation and Evaluation

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The goal of the undergraduate engineering education at the NTU and the desired qualifications of its graduates are presented. The guidelines and structures adopted for the curricula, with emphasis on professional orientation are described. A semester-based Academic Unit System has been adopted as an instrument to measure students' academic performance. The system also helps students to broaden their learning experience and progress at a pace suited to individual needs. Various forms of evaluation and quality assurance practices, such as accreditation, external examinership and student feedback, are implemented to assess the effectiveness of the degree programme in meeting the goal and qualifications.

GOAL AND QUALIFICATIONS

THE GOAL of undergraduate engineering education at the Nanyang Technological University (NTU) is to produce sufficient practice-oriented engineers to meet the demands of the restructured economy of Singapore, as called for by the Council for Professional and Technical Education [1]. The curriculum is therefore designed with the objective of preparing students with standards of education and professional competence that will enable them to play an effective role in industry soon after graduation.

The NTU's degree programmes in civil, electrical and mechanical engineering were initially offered by the three founding Schools of Civil and Structural Engineering, Electrical and Electronic Engineering, and Mechanical and Production Engineering. Newer degree programmes, such as Computer Engineering and Material Engineering, were introduced by the School of Applied Science in 1989 and 1991, respectively. Depending upon the field of specialization, 'practice-oriented' engineers from the NTU are expected to play a key role in the planning, design, development, production/construction, operation/maintenance or management functions of various engineering-related projects.

The desired qualifications of these graduates are specified below under the categories of knowledge, skills and attitudes [2]:

- In terms of knowledge, NTU graduates are required to possess a sound command of the fundamental principles of engineering science and technology, a working knowledge of mathematics, economics, accounting, management, law and marketing in their fields of specialization, the ability to perform computations and handle dimensions as well as the understanding of construction practices, production techniques and/or operating procedures.
- In terms of skills, it is essential that NTU graduates have the ability to perform or direct laboratory project or site work, to analyse problems and synthesize solutions by reference to current practice, to communicate clearly and succinctly and to work in teams and to manage resources effectively.
- In terms of attitudes, NTU graduates are expected to develop a sense of integrity and responsibility to the society and the engineering profession, a concern for the environment, an awareness of the need to turn to specialists when the situation arises, and a motivation and interest for further learning throughout their professional career.

CURRICULA

The curricula of the engineering and applied science courses were designed primarily on the bases of the needs of the industrial, social and economic development of Singapore and the region, and the academic background and aptitudes of the students. To achieve the main objective of educating practice-oriented engineers at university level, and the specific qualifications desired from the graduates, the curricula were designed to provide a uniform mix of fundamental principles

and empiricism throughout the entire span of the courses [3].

Some of the guiding principles used in the design of curriculum are as follows:

- The main field should be developed as rapidly as possible to allow maximum time for students to gain practical experience.
- The depth of treatment and choice of topics in a subsidiary field should be chosen with reference to the needs of the main field.
- The material for courses in mathematics, computing, communication skills, economics, accounting, law, etc., should also reflect the needs of the main field.
- More emphasis should be placed on design, laboratory, projects and practical work.
- Much attention should be given to the balance of 'breadth' and 'depth' of knowledge, skills and attitudes in the curriculum.
- A broader range of knowledge and skills should be introduced in the junior years, whereas more in-depth training of specialized subjects should be given in the senior years.

Civil, electrical and mechanical engineering courses

First-year curriculum. The first-year curriculum, common to all engineering students, has been designed to provide a broadly based coverage of mathematics, computer programming, engineering graphics, economics, basic engineering, physics, material science, workshop/laboratory and technical communications.

Through the subjects of basic engineering and physics, students are introduced to such concepts as mechanics, strength of materials, thermodynamics, fluid mechanics, properties of materials, electricity and electronics.

Second-year curriculum. The second-year curriculum introduces the basic core subjects in each of the engineering schools, supplemented by laboratory, design and workshop projects.

The aim is to introduce as many core or main-field subjects as possible. The early introduction of basic core subjects will allow maximum time for students to learn engineering applications and to gain practical experience [3]. Further, this will provide more opportunity to motivate students' interest in his or her main field.

Aside from the core subjects, two common subjects, 'engineering mathematics and computing' and 'communication skills', are introduced in the second year. The contents of 'engineering mathematics and computing' vary among three schools to reflect the needs and emphases of the respective schools. Communication skills are incorporated in the curriculum to improve the art and practice of written, oral and visual communications useful in engineering. The intention for introducing the subject in the second year is to facilitate effective practice of the communication skills in the subsequent years of study.

A 10-week (shortened to 8 weeks starting with the academic year 1994–95) in-house practical training (IHPT) is scheduled at the end of the second-year course. The training session is planned and supervised by the staff of each engineering school. The intensive training session is ideal for conducting hands-on training, which cannot be effectively implemented during the normal term period. It also provides an excellent opportunity to facilitate staff–student interaction whereby the students' attitude towards the engineering profession can be best inculcated. A detailed description of the IHPT programmes is presented in the paper entitled 'The In-House Practical Training Programme' of this special issue.

Third-year curriculum. The third-year curriculum comprises the follow-on core subjects to apply or reinforce the basic knowledge and skills learnt from the previous years. In addition to the core subjects, engineering economics/financial accounting is introduced.

In the second half of the year, a 24-week industrial attachment (IA) is introduced. The purposes of this training programme are: to gain first-hand knowledge of day-to-day operations in the engineering profession, to apply the acquired professional knowledge and skills in actual planning, design, production, construction or operation/maintenance, to acquire first-hand experience of working with people, and to learn about the problems and requirements of industry leading to the choice of field of specialization in the final year. Details of the IA programme are presented in another paper of this issue entitled 'Industrial Attachment in Engineering—NTU's Experience'.

Final-year curriculum. In the final year, engineering/industrial management, human resources management, contract law, professional ethics, and entrepreneurship are introduced in addition to technical subjects. In this respect, the IA experience in the third year helps the students to gain a firmer grasp of the management subjects by relating theory to real-life practice. Appropriate optional subjects in selected fields of the individual schools are offered so that the student will have more in-depth training of his or her chosen field of specialization. The provision of more optional subjects in the final-year curriculum is considered appropriate because of conflicting demands for more engineering specialization to fit in with graduate degree programmes and the market demand for engineers with a broader inter-disciplinary orientation.

The final-year students are also required to conduct an in-depth project work, preferably within their fields of specialization. Problems encountered by local industry as well as topics relevant to national development and regional needs may form the bases for the final-year

projects. These projects are beneficial in several ways:

- In developing students' ability to apply and integrate the acquired knowledge and skills in solving problems arising in modern industry.
- In reinforcing knowledge and skills, both in the students' special field of interest and in fundamental areas.
- In developing the ability to tackle problems independently.

The IHPT in the second year, the IA in the third year and the student project in the final year are some of the special features incorporated in the curricula to enhance students' awareness and ability to tackle real-world problems in engineering practice.

Computer and materials engineering courses

The curriculum of the computer engineering course is designed to give students an opportunity to acquire in-depth understanding of computer systems and the principles underlying their construction and implementation. Comprehensive training in both the software and hardware aspects of computers prepares the graduates for a professional career in design, applications and use of computers, or to pursue further studies.

The curriculum of the materials engineering course represent a balanced integration of subject matter within the wide field of materials science and engineering. The course comprises the study of the science of the structure, properties, behaviour, and processing of materials, and their applications in engineering and industry.

Both computer and mechanical engineering courses are conducted over a three-year period leading to the pass degree of bachelor of applied science. Students may pursue an optional fourth-year course leading to an honours degree. As with the engineering courses, all students in computer technology and materials engineering are required to undergo a 10-week (shortened to 8 weeks starting with the academic year 1994–95) IHPT at the end of the first year and a 24-week industrial attachment programme in the second half of the second year. These two programmes form an integral part of the respective curricula, with the common objective of providing students with the opportunity to apply their skills and knowledge in real-world applications and particularly in an industrial environment.

Discussion on IHPT and IA

To reinforce the emphasis of professional orientation, the NTU's curricula deliberately incorporate practical elements, such as the IHPT and IA programmes. These programmes, designed to enhance students' awareness and ability to tackle real-world problems in engineering practice, are resource intensive and require a great deal of planning, co-ordination and monitoring. However, the extra efforts invested in the implementation of these programmes are paying dividends as NTU graduates are highly regarded by industry for their attainment of professional competence soon after graduation. These programmes also form the basis for both staff and students to strengthen their interaction with industry. Therefore, both programmes should be pursued if resources permit.

ACADEMIC UNIT SYSTEM

In 1990, a committee was formed to look into the future direction of the NTU. The path to be followed by the NTU was set out in a report entitled 'Future Directions for Nanyang Technological University' [4]. In the area of academic development, one of the main recommendations of the Committee was to introduce a hybrid American–British degree structure which incorporates the American credit system but with a prescribed core of essential subjects. This new system should provide the flexibility to enable students to broaden their learning experience and progress at a pace most suited to individual needs, while maintaining high academic standards.

Conversion exercise

To ensure a smooth conversion from the existing system to the hybrid academic unit (AU) system, several task committees, ranging from the school-wide task groups to the university-wide co-ordinating committee, were formed to establish the framework and to comb through every detail of the new academic system. The pros and cons of the various alternatives relating to academic calendar and curricular requirements were carefully evaluated prior to the final adoption. Typical issues deliberated by the committees were:

- the impact of the proposed academic calendar, with the main examination conducted at the end of each semester, on students' pattern of study and participation in extra-curricular activities;
- the adaptability of the new calendar system to the implementation of the 8-week IHPT and 24-week IA programmes;
- the flexibility of the new calendar system to facilitate students' participation in academic exchange programmes with overseas universities;
- the appropriateness of replacing the practice of a rigid yearly pass–fail system by the more flexible AU system subject to the constraint of prerequisite requirements;
- the balance between the AU requirements for core subjects and electives (prescribed and free);
- the ceiling on the duration and the equivalent number of AU transferred from other authorized university courses;
- the choice between the use of grade point average (GPA) and weighted average marks (based on AU of subjects) in relation to the classification of degrees;

- the equitability of excluding marks associated with free electives and grades earned from other universities (as transfer units) in computing the classifications of degree; and
- the transition arrangement for students admitted under the old academic system.

The new AU system was endorsed by the Academic Board and approved by the NTU Council for campus-wide implementation beginning in the academic year 1994–95.

The main features of the new system, called the Academic Unit System, are the 'semester' arrangement and the 'academic units' adopted. Details of the system are presented in a special publication entitled 'The Academic Unit System at the Nanyang Technological University' [5]. Although the new system is currently implemented for undergraduate courses throughout the NTU, it is readily adaptable to graduate courses in the future.

Semester arrangement

In the new academic system at the NTU, a typical academic year is divided into two semesters of 16 weeks. Each semester has a short 1-week recess in the middle. There is a 10-week vacation between the two semesters as illustrated in Table 1.

The first semester of the academic year commences on the second Monday of July. The second semester begins on Monday of the 27th week of the academic year.

An 8-week IHPT is introduced during the 10-week vacation period after the second semester of year 1 (for courses in applied science) or year 2 (for courses in engineering).

A 24-week IA is conducted in the second half of Year 2 (for courses in applied science) or year 3 (for courses in engineering). In order to incorporate the 24-week IA programmes, the teaching time for the respective academic years is reduced to one semester.

The NTU semester system, with a short recess (1 week) within each semester and with a vacation (10 weeks) between the two semesters, offers the following advantages:

- The semester system, with the main examination conducted at the end of the semester and periodic testing in between, is a more effective teaching and evaluation system. The system also helps to inculcate a more consistent learning attitude of students as they can no longer rely on last-minute study for the examination at the end of the academic year.
- The long recess period of 10 weeks reduces excessive examination consciousness on the part of students and provides a more conducive atmosphere for students to participate in extra-curricular activities (ECA), especially during the two vacations and at the beginning of each semester. In this way, the students' participation in ECA would be more evenly distributed throughout the academic year, unlike the present situation whereby students' ECA practically cease towards the end of term 2 under the three-term academic year.
- By dividing the academic year into two equal halves of a 16-week semester followed by a 10-week vacation, the system conveniently accommodates the implementation of the IHPT programmes (8 weeks) during the vacation period and the IA programmes (24 weeks) in the half-year period. In the long run, it is readily adaptable to a system with two IA sessions to be conducted in the same year, thus providing flexibility for students to choose the period of their practical training. By spreading the IA programmes into two sessions of the year, if required, there would be a continuous supply of students for the training organizations throughout the academic year. As such, placement opportunities could be doubled and the contribution of student trainees to the organizations would be enhanced.
- With the two semesters, each occurring on a separate half of the calendar year, the system facilitates students' participation in academic exchange programmes with overseas universities—irrespective of whether they wish to study in North America, or Australia for example. There is no major overlapping of the academic terms.

Academic units

An AU is adopted to provide a more consistent measure of the students' academic workload related to both class attendance and outside preparation. Associated with subjects of common duration of one semester, each AU represents an average workload of one hour per week (hr/week) in the form of lecture/tutorial classes, or 3 hr/week in the form of laboratory/field work sessions. The AU assigned to IHPT, IA and the final-year project in engineering courses are 4, 5 and 6, respectively.

Table 1

Semester 1					Semester 2				
Classes 7 wks	Recess 1 wk	Classes 6 wks	Revision/ Exam 2 wks	Vacation 10 wks	Classes 7 wks	Recess 1 wk	Classes 6 wks	Revision/ Exam 2 wks	Vacation 10 wks

The AU therefore serves as a useful instrument, or common academic 'currency' for (i) prescribing the workload requirement for the yearly progression and the completion of a degree course, (ii) computing the weightage of subjects in relation to the classification of degree, and (iii) facilitating the evaluation and transfer of credits associated with academic work performed in other universities.

Besides serving as an instrument to measure the workload with the individual subjects undertaken by a student, the AU system can be used effectively as a quantitative device in:

- prescribing the overall number of AUs required for the completion of a degree course;
- specifying the number of AUs required for yearly progression of the study;
- computing the weightage of the respective subjects in the classification of degree; and
- facilitating the evaluation and transfer of academic work taken by the students off the campus.

Curricular requirements

Classification of subjects. To achieve the objectives of providing greater flexibility in the students' selection of subjects of interest while maintaining the high academic standards required for the degree course, the subjects offered by the various courses at the NTU are classified under three main categories: core subjects, prescribed electives and free electives.

The *core subjects* are the compulsory subjects that must be passed to fulfil a given degree course requirement. Electives are subjects that add to the depth and/or breadth of knowledge and skills to be acquired by students in a degree course.

The *prescribed electives* are the electives that form a certain field of specialization in a particular course. The number and grouping of prescribed electives vary from course to course, but are generally guided by the range and level of specialization in local and regional practice, and the needs of the students and the nation.

The *free electives* are electives to be taken by the students freely and may be chosen from a broad list of subjects offered within and outside the School, on approval by the Dean concerned. For example, a student on the civil engineering course may take up an elective on financial accounting from the accountancy course, or an elective on mass communication from the communication studies course.

The core subjects and the prescribed electives should constitute at least 80% of the total number of academic units required for a degree course. This is to ensure that sufficient grounding in the essential core and specialized subjects is taken by the students before their graduation. The free electives should form not more than 20% of the overall unit requirement. However, the minimum number of AUs for free electives are specified, as shown in Table 2, to encourage students either to broaden their learning experience or to pursue more in-depth study in any specialized field of interest.

Table 2

Nature of Course	Minimum AU of Free Electives
3-year course	6
4-year course	8
Honours course	3

Curriculum structures. A summary of the minimum number of AUs required for the degree courses in civil, electrical and mechanical engineering and computer and materials engineering is shown in Table A1 (Appendix). A typical flowchart illustrating the curricular requirement and the process of academic progression, including the constraints of prerequisites, is shown in Fig. A2.

In order to complete the degree requirement within the specified period of 3 or 4 academic years, full-time students at the NTU are expected to carry an academic load of 16–21 AU per semester (approximately 4–6 subjects). Subject to approval by the Dean concerned, students may be allowed to take up to eight AUs (approximately two subjects) more or less than the normal semester academic load to enable them to pursue their studies at a pace commensurate with their needs and/or capabilities.

Administratively, students are registered as year 1, year 2, year 3 and year 4 students according to the number of AUs earned. Students are considered to have progressed from one year to the next if they have earned at least 75% of the AU specified for that year (as shown in Table A1).

To be eligible for the award of a bachelor's degree, a candidate must be a matriculated full-time student at the NTU campus for not less than 2 and 3 years for the 3- and 4-year degree courses, respectively. Further, at least 65% of the number of AUs required for the degree course must be obtained from the NTU. A student may transfer the credits, or equivalent number of AUs, earned from other universities provided that:

- the subjects taken are approved by the Dean concerned; and
- the total number of credits transferred does not exceed 35% of the total number of AUs required for the degree course.

Examinations and grades. Final examinations for the examinable subjects are held at the end of each semester. In the case of failure in prescribed or free electives, a student may offer another subject in lieu of the failed subject. This is different from the previous practice which required a

Table 3

Grade	Performance
A	Excellent
B	Very Good
C	Good
D	Pass
E	Marginal Fail
F	Fail

student to repeat all subjects of a given year if he or she failed any subject in the year-end examination.

Marks are awarded to each subject based on a student's performance throughout the semester in the form of continuous assessment and final examinations. While the marks are used for the computation of the overall academic achievement of the student, the grading system shown in Table 3 is used in the transcript. No academic unit is earned for grades 'E' and 'F'. A student is not permitted to offer a subject unless he or she obtains at least a grade 'E' in the prerequisite subject(s).

Classification of degree. Honours (first, second and third class) and pass with merit are awarded to students who have performed well academically throughout their course of study.

To provide a more precise rating of the students' achievement, the weighted average of marks (based on AU of subjects) for all years of study, instead of the GPA, is used for degree classification. To ensure equitability in the classification of degrees, only marks of core subjects and prescribed electives are used. Marks of free electives are not counted towards the classification of degree. This would encourage students to explore the various electives of interest to them with less consciousness on the grades or marks. Furthermore, since it is difficult to compare equitably the marks earned at the NTU with those obtained from elsewhere, marks or grades obtained from other institutions for transfer of credits would not be taken into consideration in the degree classification.

EVALUATION AND QUALITY ASSURANCE

The NTU has instituted a number of key practices on programme evaluation and quality assurance with the following objectives:

- to ascertain its compatibility with the goals and objectives and its relevance to societal and national needs;
- to judge the currency and quality of the programme;
- to obtain feedback and suggestions for programme improvement and innovations; and
- to ensure that the academic programme and the professional attainment of the Schools are of high international standard.

The various practices implemented in the Schools include accreditation by local and external professional bodies, appointment of external examiners and advisory committees, student feedback, staff survey and staff evaluation/review, graduate survey and industrial feedback. The annual staff evaluation exercise is covered in another paper of this special issue entitled 'Staff Recruitment and Career Development: Looking Beyond the Boundary'.

Accreditation

The prime objective of the engineering-related degree courses at the NTU is to produce professionally oriented engineers at university level to meet the demands of Singapore and the region. As such, it is important that the respective academic programmes are closely monitored and recognized by both local and international professional institutions. For external accreditation, the various engineering Schools have invited accreditation visits from the British Engineering Council through the Joint Board of Moderators of the Institution of Civil Engineers and Institution of Structural Engineers, the Institution of Electrical Engineering and the Institution of Mechanical Engineers.

The accreditation team normally review a set of the written documents about the course prepared by the School before visiting the university for a few days. During the visit, the team may hold meetings with adminstrators, academic staff and students; tour the laboratory and workshop facilities; inspect and discuss course notes, laboratory/design/project works, examination questions and scripts; scrutinize the curriculum structures, course contents and degree classifications procedures; as well as evaluate the quality and extent of staff research and consultancy services. The accreditation exercise proves to be valuable as it offers an independent and authoritative appraisal of the School's curriculum, teaching and research. The resulting formal endorsement by the British professional institutions in civil, electrical and mechanical engineering also puts our programme equal to all other accreditated programmes in the United Kingdom and Commonwealth countries. It is useful that NTU degrees are recognized outside Singapore especially if they are to have a regional appeal. Besides, the accreditation process also provides useful feedback for the School to improve the curriculum and teaching and to remove any deficiencies that are noted. For example, during the initial visit to the School of Civil and Structural Engineering, the accreditation team suggested the need to strengthen the coverage of basic properties of materials in the early years. This suggestion was subsequently reviewed and adopted by the School,

in conjunction with two other engineering schools, through modification to the common first-year engineering curriculum.

External examiners and advisory committees

A distinguished engineering educator from an established overseas university with a proven academic record in research and teaching is appointed as an external examiner to provide objective and independent evaluation on the academic standard and the curriculum of the School.

The term of the appointment for the external examinership is two years, and the examiner is expected to visit the School concerned once during the term of his or her service. The purposes of the visit are to gain familiarity with the School's teaching and learning environment and to discuss with staff and students on matters related to the operation and development of the School. In addition to reviewing the examination questions each year, the examiner also submits a confidential report to the President of the NTU, addressing issues related to curriculum development, information resources, laboratory, facilities, quality of teaching, etc.

The practice of external examinership has been very beneficial to the NTU. Apart from offering an objective evaluation of the academic standard of the School, the examiner invariably injects new ideas and critical viewpoints towards improving the academic programme of the School.

Each School has an Advisory Committee comprising senior members of the academic staff and eminent members of the engineering profession from the private and public sectors. The Committee is an important source of guidance and feedback on the effectiveness of curriculum and teaching, on the latest technological developments and practice, and on the changes in the local/regional needs of engineers for industry.

Student feedback

A system of obtaining student feedback on teaching was formally implemented in the NTU in 1985. The feedback was gathered from students through a set of questionnaires on course structures and contents, and staff teaching performance. At the initial stage, it was intended to serve primarily as a basis for self-improvement in teaching by the academic staff and for appropriate modifications to the courses.

The system was reviewed by a committee, after a three-year trial period. The objective of the review exercise was to improve the efficiency of the system and the reliability of the results. The main recommendations of the review, which have since been implemented, are as follows:

- To reduce the number of feedback exercises to one or two a year per staff for either type of teaching activity (i.e. lecture or tutorial), as a means of minimizing the burden on students and yet giving sufficient data for a fair reflection of the instructor's teaching ability.
- To use the student feedback ratings as an important input for assessing teaching ability in the annual staff assessment. To be more objective and equitable, the summary sheet(s) of student feedback should be attached to the staff annual assessment form.
- To offer staff members the option to present their views in writing on the summary sheet of their student feedback ratings.

Experience from the past nine years has shown that feedback from students represents one of the most reliable and unbiased sources of opinion on the teaching quality of the academic staff.

Survey and feedback from staff, alumni and industry

As part of the NTU's continuing efforts to improve and promote a better teaching environment, a biennial survey is conducted to solicit feedback and recommendations from the academic staff on the teaching practice. The survey covers two main areas: (i) teaching methodology and activities, and (ii) curriculum and teaching philosophy. Through this exercise, many relevant and useful information and suggestions have been raised by the respondents, such as improvements to lectures, tutorials and laboratory sessions, recognition and reward on good teaching, and improving the preparedness and participation of students in classes. The views and experience of the academic staff are vital since they are directly involved in the teaching functions.

Surveys of former students approximately five years after their graduation were also conducted by the university. One of the purposes of the survey is to evaluate the effectiveness of the NTU's curricula in meeting the desired goals and objectives. The evaluations were carried out by distributing a set of questionnaires to a large group of graduates and were followed by interviews with a smaller number of graduates.

Input from industry on the curriculum development and teaching are obtained primarily through the advisory committee of the School and the appointment of industrial practitioners as adjunct staff. Other forms of industrial input include direct and indirect feedback from the supervisors of the students undergoing IA training and from the employers of our graduates.

CONCLUSIONS

To achieve the prime objective of educating practice-oriented engineers, the curricula of engineering and applied science degree courses at the NTU were designed to provide a uniform mix of fundamental principles and empiricism throughout the entire span of the courses. To reinforce the emphasis of professional orientation, the curricula

deliberately incorporate practical elements, such as in-house practical training (IHPT) and industrial attachment (IA) programmes.

The semester-based academic unit system serves as an instrument to measure students' academic performance. It also provides a flexible and equitable mechanism for students to broaden their learning experience and progress at a pace suited to individual needs, while maintaining high academic standards.

The implementation of a number of key practices on programme evaluation and quality assurance, such as the accreditation by professional bodies, the appointment of external examiners and advisory committees and obtaining survey feedback, serves to maintain a high standard of professional attainment in the respective degree courses and to ascertain their compatibility with goals and objectives.

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APPENDIX

Table A1. A summary of academic unit requirements for selected degree courses at the NTU

Degree Course	Year of Study	Number of Academic Units (AU)		
		Core Subjects & Prescribed Electives	Free Electives	Total
Engineering (Civil)	1 2 3 4	35 43 26 32	8	144
Engineering (Electrical)	1 2 3 4	35 43 28 26	12	144
Engineering (Mechanical)	1 2 3 4	35 40 22 32	12	141
Computer Technology	1 2 3	44 24 38	6	112
	Honours	31	3	34
Materials Engineering	1 2 3	43 23 36	6	108
	Honours	30	3	33

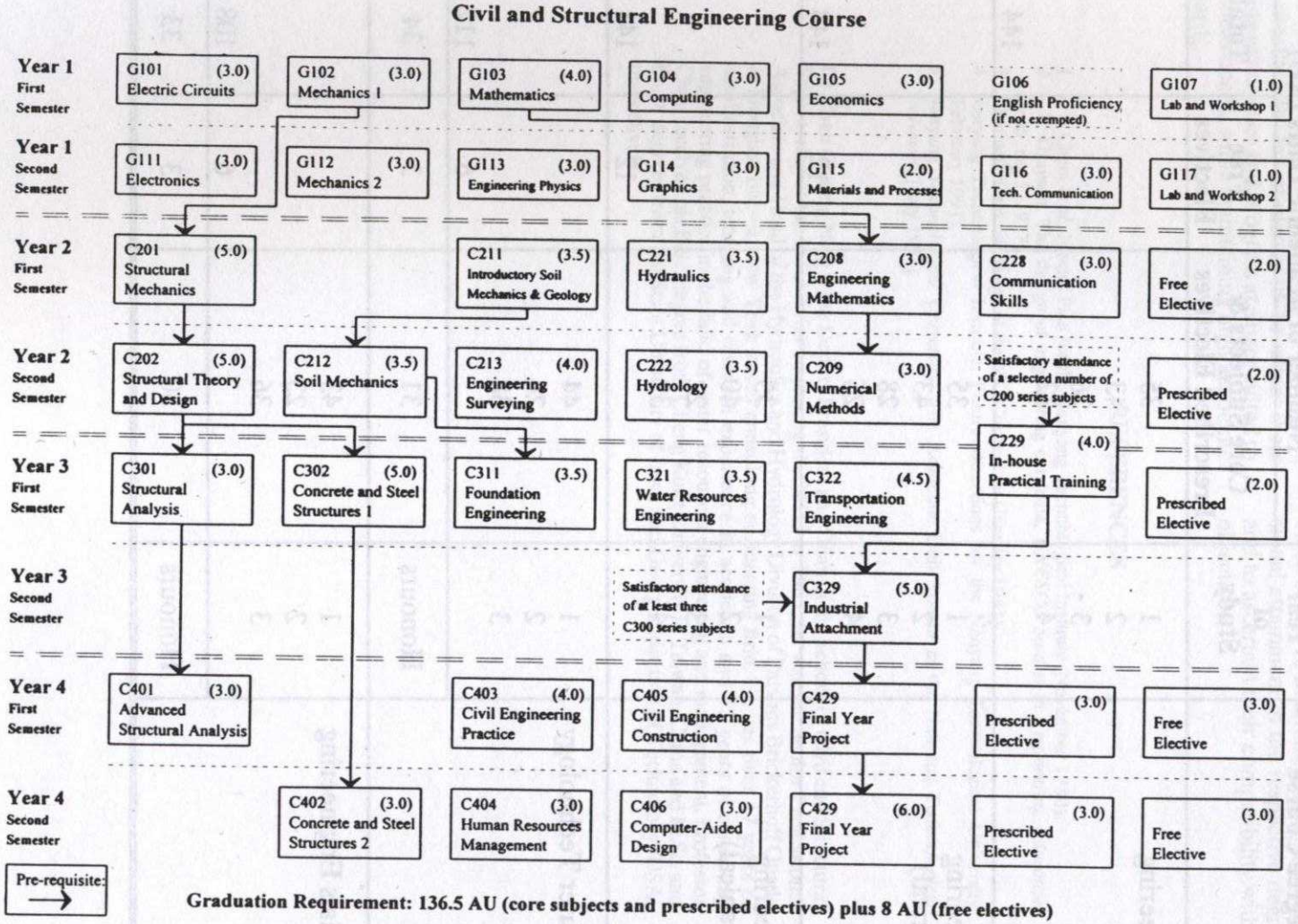

Figure A2. A flowchart of the curriculum structure of civil engineering course.