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THE ACADEMIC ACHIEVEMENT OF UPPER-LEVEL STUDENTS  
IN ENGINEERING TECHNOLOGY CURRICULA: A PREDICTION STUDY

by

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Engineering Technology programs. Intellectual and nonintellectual independent variables were used to describe the 202 transfer students selected as the population for the study.

The multiple regression analysis was used to determine the strength of relationships between academic achievement (dependent) variable and the grades earned in mathematics, science, technical specialty, GPA, and age of the transfer students, as independent variables. The results of the multiple regression analysis revealed a correlation coefficient  $R = .708$ ,  $R^2 = .502$ , accounting for 50.2% of explained variance in the dependent variable, when all the predictor variables were considered jointly. The grade earned in technical specialty course(s) in a lower-division (community) college program was the best predictor of academic achievement, among other variables. The remaining variables that showed a form of relationship are overall grade point average, grades earned by a transfer student in science and grades earned by a transfer student in mathematics.

These substantive findings have some valuable and practical implications for educators, policymakers, and administrators involved in counseling and admission of students who transfer from lower-division (community) college programs into the upper-division Engineering Technology curricula for a degree.

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(ABSTRACT)

A major thrust for Technical Education in the 1980s is the emerging identity of Engineering Technology. During the past four decades the Bachelor of Science degree in Engineering Technology has become increasingly popular as a means of entry into industrially related mid-careers. An increasing number of colleges that offer majors in Engineering Technology have been experiencing dramatic increases in the number of program applicants, with community college transfer students accounting for a significant percentage of the total mix. There is a concern among Engineering Technology professionals regarding the emerging source of transfer students who have insufficient academic preparation to earn a Bachelor of Science degree in the upper-division of the Engineering Technology curricula.

The purpose of this study was to investigate and describe the strength of the relationships between selected previous academic work and the subsequent upper-division academic achievement of students who transfer from lower-division (community) colleges to the upper-division

## DEDICATION

This dissertation is dedicated with sincere love and appreciation to my dear wife Atim Ukutt, to my great sons, to my lovely late mother - Mrs. Adiaha E. UdoAka, who continued to understand the need for my long periods of isolation and absence. Atim's unrelenting support and encouragement were invaluable during the entire period of my career and during the period of this study. More especially my sons' and Atim's tolerance of my moods each time I emerged from my study hideout cannot be overlooked. Praise God for we can now say that we all did it.



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## CHAPTER I

### INTRODUCTION

During the past four decades, the Bachelor of Science degree in Engineering Technology has become increasingly popular as a means of entry into industrially-related careers (see Appendixes A and B). Will (1975) stated that "growth in the number of institutions offering Bachelor of Engineering Technology (BET) programs seems to be leveling off" (p. 179). In three recent surveys, Ellis (1986), Goodson (1987), and Wolf (1987) reported that such a trend has changed. Goodson's report on "Developments and Trends in Four-Year Engineering Technology Programs" concluded that some trends were favorable to the continued growth of Engineering Technology. Renner (1987) reported that Northern Illinois University's enrollment figures reached a record-breaking 23,118 in fall of 1987, despite suffering from budget cuts (see Appendixes C-F). The College of Engineering and Engineering Technology had the highest (19.3%) increase. An increasing number of colleges across the United States are offering majors in varied industrially-related programs. These institutions have experienced dramatic increases in the number of program applicants.

As the number of applicants has increased, the general mix of applicants has become more heterogeneous and admission decisions have become more complex. Admission is no longer limited to high school graduates. According to Hexter and Andersen (1987), 92% of the

colleges and universities accept credit for noncollegiate learning without a traditional high school diploma. Community colleges have joined to accommodate students' needs through the two-plus-two (articulation) plan (see Appendixes G-L). According to Ellis (1986), there are indications that the number of participants in Engineering Technology has been growing. Ludwig (1987) reported that community college students accounted for the lion's share of total enrollment last year, making up 41.9% of total college enrollment. "The number of schools with accreditation in Engineering Technology is also increasing" (p. 58). Between 1984 and 1985, Engineering Manpower Commission (1986) studies reported an increase of 251% for degrees conferred on full-time Engineering Technology students enrolled in curricula approved by the Accreditation Board for Engineering and Technology between 1982 and 1983 (see Appendix B).

With the increasing prominence of the community colleges to serve as feeder sources to the various four-year Engineering Technology schools, O'Dell (1986) expressed concern that students with associate degrees in applied science have often been frustrated in their desire to pursue a baccalaureate degree because few four-year (Engineering Technology) institutions offer transfer credits for coursework. Because community college students must transfer to other institutions in order to earn the bachelor's degree, articulation agreements specifying the transferability of course credits have existed from the beginning of the junior college movement (Palmer, 1986). These agreements generally take three forms: "documents in the form of equivalency guides issued by institutions, agreements negotiated by

individual colleges and universities or by segments within a state, and guidelines and policies developed and controlled by state agencies or commissions" (Kintzer & Wattenbarger, 1985, p. 21). Such agreements, at least on the surface, can ease the flow of community college students to baccalaureate-granting institutions, but they do not assure that community college transfer students will have the competencies requisite for academic achievement.

Those studying articulation, therefore, are now focusing on the transferability of competencies as well as credits. This lack of recognition for coursework is, in part, based on the results of studies by Knight (1978) and others. Knight's comparative study indicated that native students were generally better academic achievers, had more academic ability, and had a better retention rate than transfer students. Knoell and Medsker (1965) conducted a national study on the ability level of transfer students from junior to senior colleges. They concluded that:

The average ability level of graduates who were freshmen in the major universities is higher than that of their counterparts who began their baccalaureate degree program in two-year colleges, although there is considerable overlap in the ability of the students in [the] two types of colleges. Differences in their university grades reflect this difference in average ability, which is compounded by the often difficult academic and personal adjustment which the transfer students must make when they enter the university as juniors. When groups of comparable ability compete for grades in the upper division, as in the teachers colleges, the chances are good that the transfer students will earn grades which are as high as those of the native students. Few junior college students with high ability and good junior college grades are handicapped after transfer when competing with native students for grades which would qualify them for admission to graduate school. (p. 94)



Palmer (1986) was concerned that the issue of student competency had become especially urgent in light of evidence indicating that community college studies may not be sufficiently rigorous. Richardson (1984) reported that community college instructors "teach down" to the level of their students, thus doing little to raise the reading, writing, and mathematical competencies of the large number of underprepared students entering community colleges. Taking a similar view, Russell and Perez (1980) argued that large enrollments of nontransfer students have caused instructors in the physical sciences to weaken the academic rigor of their courses, much to the detriment of those who will have to compete with university students later on. Garnutt (1985) made a parallel observation about mathematics instruction, charging that instructors "all too often underestimate their audiences by concentrating on mathematical fun and games or consumer mathematics" (p. 27). Finally, Cohen (1983) pointed out a concomitant academic problem, the tendency of the community college curriculum to assume a flat configuration consisting primarily of remedial and introductory courses with few opportunities for study at the sophomore level. It is not surprising, therefore, that many observers question the validity of articulation agreements based on course titles and descriptions rather than actual student outcomes. Decker and Silverman (1984), for example, stressed that "it is not sufficient to ensure the acceptance of credits from one segment to another; it is also necessary to ascertain whether those credits carry with them the necessary acquired skills and academic competencies expected of transfer students" (p. 82).

How is this to be accomplished? One alternative is to facilitate faculty dialog between the various sectors of higher education in an attempt "to determine the proper academic rigor and expected competencies of students completing courses within given disciplines" (Decker & Silverman, 1984, p. 82). Another approach, suggested by Russell and Perez (1980), is to appoint community college faculty members on a temporary basis as visiting instructors at four-year institutions and universities. This would reacquaint the instructors with the university students and the rigor needed for success at the upper-division. A third method is the establishment of exit-testing programs for transfer students. In Florida, for example, all students (including community college transfers) must pass a College-Level Academic Skills Test (CLAST) before assuming upper-division studies at public universities. The test, mandated by the state legislature, assures that students entering the junior year have demonstrated minimum competency in mathematics, reading, and writing (Florida State Department of Education, 1982).

Except for the application of CLAST, the literature documents relatively few attempts to articulate lower- and upper-division studies on the basis of student competencies. It has become clear, however, that articulation, if it is to enhance the college transfer function, should be based on student knowledge as well as on course titles and units.

Hoyt and Munday (1966) concluded that junior college students are academically less able than their peers in senior colleges.

Eaton (1985) made some noteworthy comments regarding the challenge for a change at the community college:

The academic enterprise in community colleges was at one time primarily identified with the transfer function. . . . Since use of transfer and degree functions have dwindled, other structures need to be developed. . . . Future curricula will have to provide new academic approaches to replace indiscriminate course-taking. The past practice of limiting the demanding quality of academic programs has resulted in lowered expectations of student performance and work. Future efforts will emphasize course standards. Enhanced support services such as advising, testing, mentoring, and tutoring will help under-prepared students to meet the challenge of this renewed emphasis. This will enrich student preparation and will constitute an important alternative to diluting course substance and reducing expectations. (p. 9)

In The Neglected Majority, Pamell (1985) pointed out that in developing academic preparation for college, the college board involved "comparatively few community, technical, or junior college personnel" (p. 49). Confident once again of their mission, the high schools and the four-year colleges will be developing a coherent course of study based upon traditional disciplines: English, mathematics, physical and biological sciences, foreign languages, history, and the arts. In so doing, the high school to four-year college model (4 + 4) remains the ruling paradigm.

Dunford (1986) advised that economic necessity, enrollment planning (a bit of euphemism), and precedence will ensure four-year colleges' interest in encouraging students to transfer from community colleges. As the liberal arts curriculum reasserts itself, however, two-year and four-year colleges that offer Engineering Technology curricula may find their articulation statements antiquated or impractical. These institutions would do well in these

days of resurgence of liberal arts to initiate articulation activities. The community colleges may also wish to encourage communications (especially at the divisional level) with four-year colleges participating in liberal arts reassessments and high school articulation. Likewise, community colleges engaged in articulation with secondary systems cannot ignore the undergraduate models generated by a renewed interest in the four-year colleges.

College counselors, educators, psychologists, and in recent years those not directly concerned with the problem of academic achievement, have expressed strong concerns about students who transfer from two-year colleges (two-plus-two plan) to upper-division four-year Engineering Technology programs. Turner and Gerardo (1983) summarized this situation as follows:

The engineering technology faculty at the University of Alabama analyzed curricula and student performance to upgrade the quality of graduates without expending additional resources, and identified a screening mechanism which could be employed if it became necessary to cap enrollment. (p. 802)

Although the college admission-selection research literature is voluminous, only a few studies have dealt with the prediction of student success in Engineering Technology. Attempts have been made to isolate some of the factors which could explain why some students have made the most of their potential and others do not achieve according to ability. Broedel, Ohlsen and Proff (1958), Gough (1956), Holland (1959), Shaw and Brown (1958), and Shaw and Grubb (1958) have indicated that this phenomenon may be due to several intellectual and nonintellectual factors.

These researchers commented that the logical way to better understand this problem and make more accurate predictions with regard to a student's chances of success in academic endeavors would be to consider selected personality, scholastic, and special aptitude measures.

For most colleges, the probabilities are 50-50 or less than an entering student will graduate (Iffert, 1956). Consequently, if it was possible to predict early, "what kind of person is likely to have what kind of success in what kind of college," much savings would result in time, money, energy, emotional wear and tear on the student, the family, the faculty, and society at large (Barton, 1961, p. 97).

The need is obvious. Efforts to cope have, with few exceptions, met with little success. For the past 40 or 50 years correlations between intellectual predictors and college success have hovered around .50. When antecedent and personality factors are used as sole predictors, the situation is hardly better. Furthermore, when the latter are combined with intellectual predictors, the gain in the multiple correlation is minimal (Fishman, 1961).

Higher education (including Engineering Technology) is currently in a monetary crisis. Reduced budgets and a public mandate for accountability in all aspects of education may be the dual forces which will necessitate that community and four-year colleges (with Engineering Technology curricula) work together to provide a practical solution to students' academic performance and achievement. The aforementioned situation presents a problem with important implications for admissions,

counseling, placement into class sections, and scholarship selection (Eells, 1961; Morecroft & Ameen, 1987).

#### STATEMENT OF THE PROBLEM

In a comparative research study of the articulation of transfer and traditional students of the engineering program at Auburn University, Knight (1978) raised the important question: "How successful academically were the students from the community colleges after transfer to the School of Engineering at Auburn University?" (p. 11). Perreault (1986), in a similar effort, used the Delphi technique to identify research problems inherent to technology programs and raised an identical question. These and other research results suggest that future research be conducted in the problems faced by Engineering Technology programs, particularly the articulation (two-plus-two) plan of transfer students who are admitted to four-year Engineering Technology programs and who do not graduate.

Accurate data, however, allowing for a comparison of transfer rates over time and providing a mechanism for the evaluation of special intervention efforts, are simply not available (Palmer, 1986). Wilson and Davis (1985) stressed that "further study is needed to find better predictors of success" (p. 66). They advocated strongly that:

With our nation's entry into an era of rapid technological change, demand for access to limited seats in technical and engineering classrooms has rapidly increased. Careers have become more dependent on technical information and skills. Both society and individuals seek technology's benefits.

One result of our technological plunge is that postsecondary and higher education faces an increasingly difficult process of finding and allocating resources. Acceptance of a student into a technical curriculum represents a major societal investment, an investment which may be made at the expense of the student who is not accepted. Failure of a student is costly. Accurate prediction for selection and early identification of students who may need special assistance assume critical importance. (p. 65)

Today's efforts to strengthen the transfer function, however, represent a multifaceted attempt to place the community college more securely in the educational mainstream. Focusing not only on the transfer of course credits from two-year to four-year colleges, these efforts have included (a) programs to better prepare students for college work before they enter the community colleges, (b) attempts to equalize the academic rigor of lower-division courses taught at community colleges and senior institutions, (c) college matriculation plans that stress the identification and achievement of student goals, and (d) information systems designed to monitor and support student flow from matriculation through transfer. Each represents a significant departure from the community education emphasis on the ad hoc educational needs of adults who are not in the educational pipeline of the baccalaureate degree.

Will these efforts succeed in raising transfer rates? Answering this question requires colleges to gather and provide information on transfer students. As long as current data collection systems stress headcount enrollment rather than achievement and persistence, it will be difficult to gauge the success of transfer improvement projects. Colleges should be provided with incentives to collect accurate student

follow-up data. Perhaps this could be accomplished through funding mechanisms that reward colleges for the number of students who matriculate. In any case, changes in information-gathering policies are clearly needed to assess the progress community colleges make in helping students move along toward the baccalaureate degree (BS).

Palmer (1986) advised that:

The success of current efforts to improve transfer between two-year and four-year institutions depends largely on the development of information systems that serve both college personnel and students. College educators need to identify potential transfer students, gather information on their skills deficiencies (if any), accumulate data on student progress through the educational program, and provide indices of the success students have in transferring and subsequently attaining the baccalaureate. Students also need information, including feedback on their educational progress, information on college support services, and information on the transferability of coursework. (p. 58)

The problem of this study was to investigate the criteria that relate to prediction of academic achievement of transfer students applying for admission into Engineering Technology programs. The purpose of this study was to determine and to describe the strength of relationships between the lower-division previous academic work (using intellectual and nonintellectual factors) and the subsequent upper-division academic achievement of students who transfer to the Northern Illinois University Engineering Technology programs through the articulation (two-plus-two) plan. Such intellectual and nonintellectual factors include the following: independent variables (grade earned in a lower-division mathematics course, grade earned in a lower-division science course, grade earned in a lower-division



technical specialty, grade point average earned in a lower-division Engineering Technology program, sex, age, race, and community college location) and the dependent variable (academic achievement). To carry out the purpose of this study, the answers to the following research questions were sought:

1. What is the strength of the relationship between the grade earned in a lower-division mathematics course(s) and upper-division academic achievement?
2. What is the strength of the relationship between the grade earned in a lower-division science course(s) and upper-division academic achievement?
3. What is the strength of the relationship between the grade earned in a lower-division technical specialty course(s) and the upper-division academic achievement?
4. What is the strength of the relationship between the overall grade point average earned in the lower-division program and the upper-division academic achievement?
5. What is the strength of the relationship between selected demographic (sex, age, race, and community college location) factors and upper-division academic achievement?

#### SIGNIFICANCE OF THE STUDY

Many studies have been conducted on students' academic achievement, but none has attempted to investigate the academic achievement of

students who transfer (utilizing the two-plus-two plan) into the four-year Engineering Technology curricula at Northern Illinois University. It is a problem with important implications for admission, counseling, and placement into class sections.

The interest concerning academic achievement of transfer students, which has been on-going for the past 20 years, has not changed. One reason for this situation has been the increased growth in the student population. On the college level, the increase has outstripped the expansion of facilities. Consequently, this has heightened the competition for admission, especially at the more prestigious universities and colleges. For college admissions officers, the selection of students has been more difficult than ever before because the increase in the number of applicants is paralleled by growth in the number of highly-qualified candidates. Thus, the responsibility of universities to be as certain as possible that the students selected will perform better than those excluded is becoming increasingly frustrating.

A second source of concern and interest relates to the insufficient academic preparation of students who transfer to complete their last two years in four-year Engineering Technology programs. Collison (1987) was concerned that "since most classes at community colleges are geared to underprepared students, the courses may not challenge the better-prepared students. Consequently, many two-year college students are not sufficiently prepared for the academic environment which they are likely to encounter at the four-year college. Hence, students commonly suffer from what educators call 'transfer shock'" (p. 85).

Traditionally, academic administrators have used college entrance Scholastic Aptitude Test (SAT) data as predictors to limit enrollment into the lower-division undergraduate college programs. However, it has been reported by Juola (1966) and Wilson and Davis (1985, p. 66) that the predictive validity of such precollege "traditional predictors of academic achievement are less accurate for technical curricula than for others" and steadily decrease over successive academic terms. The combination of high school grade point average and Scholastic Aptitude Test (SAT) scores only accounted for 30% of the students' grade point variance (Marsicano, 1975). Using a combination of five tests chosen to maximize the prediction of the grades of engineering students, Eells (1961) was only able to attain a .47 correlation.

Historically, academic administrators have not used precollege data to limit enrollment into the upper-division undergraduate programs. The usefulness of lower-division previous academic work in predictive studies cannot be overemphasized. Academic administrators of Engineering Technology programs are currently faced with a large student demand for their programs. Juola (1966) suggested that the use of lower-division intellectual and nonintellectual indicators is a more accurate predictor of upper-division academic achievement than are traditional precollege predictors.

This study is significant because it provides valuable information to aid educators and policymakers in their efforts to establish rational upper-division college admission criteria. The identification of such criteria enables educators to select those

students who have the best chance of succeeding in upper-division Engineering Technology undergraduate programs. Moreover, the results of this study:

1. Add to the relatively sparse body of knowledge concerning the prediction of upper-division academic achievement of students using lower-division academic work as a dependent variable.
2. Provide students with a mechanism to predict their relative chances of success.
3. Encourage students to work harder for higher grades in the lower-division programs.
4. Increase the effectiveness of student counseling.
5. Encourage better use of limited resources.
6. Provide a source of insights that lead to theoretical formulations in education (Pedhazur, 1982, p. 136).

#### LIMITATIONS OF THE STUDY

The following limitations are applicable to this study:

1. This study was limited to Engineering Technology programs which admit two-plus-two transfer students into the upper-level (last two years) of Engineering Technology at four-year colleges.
2. This study was limited to the Engineering Technology program offered at Northern Illinois University, DeKalb, Illinois. A representative group of transfer students who may or may not have graduated from this institution was used.

3. Due to the homogeneous characteristics of the group described in this study, the prediction method, the variables, and the specific regression weights, the generalization of the findings to a population with significantly different characteristics should be done with limitation.

#### ASSUMPTIONS

The following assumptions were used for this study:

1. The criteria upon which previous course grades were based were stable.
2. Withdrawal and failure for other than academic reasons had no significant effect on the final course grade data base.
3. There were some underlying commonalities among two-plus-two (articulation plan) programs which provided the possibility of generalizing across these programs.
4. The official records from which information was obtained were accurate.
5. Academic achievement used in this study was measured in terms of the student's ability to earn or not earn a degree in Engineering Technology from Northern Illinois University (NIU).
6. Previous academic work was measured in terms of grades and grade point average.

## DEFINITION OF TERMS

There were several significant terms used in defining the research problem. Inasmuch as some of these terms have varied and broad meanings in the literature, each was defined as it applied to this study.

ABET. The Accreditation Board for Engineering and Technology. ABET carries out a comprehensive program of accreditation activities of curricula leading to higher education degrees in Engineering and Technology (ABET, 1986, p. 1).

Academic Achievement. Academic achievement was denoted by a transfer student's ability to earn or not earn a degree from the Engineering Technology (ET) programs at Northern Illinois University (NIU), DeKalb. Academic achievement was used as the dependent variable.

Accredited Community College. Accredited community college referred to all community colleges which had achieved accreditation status from a state board of education and/or a regional accrediting agency.

Articulation. Referred to the arrangement and extent to which community colleges and senior colleges cooperate and interrelate their curricula, to provide for the continuous educational progress of students (who may transfer to a four-year college upper-division) in order to eliminate repetition of coursework and its resultant economic inefficiency.

Community College Data. Information pertaining to student academic work while attending junior college. Examples included course grades, semester grades, grade point average, and demographic data.

Community College. Referred to publicly supported, locally controlled accredited and nonaccredited two-year colleges which offer lower-division or pre-engineering and/or vocational-technical education programs designed to prepare students for entry into business occupations and/or transfer students into upper-division work in a senior college.

EET. Referred to the Electrical Engineering Technology major offered as one of the Engineering Technology programs at NIU.

Engineering Technology. A part of the continuum of work roles extending from the craftsman to the engineer. Located nearest to the engineer, it requires the application of scientific and engineering principles in support of engineering activities (ABET, 1986, p. 1).

Engineering Technology Program. A planned sequence of [a four-year] college-level courses [curricula] designed to prepare students to work in the field of Engineering Technology [in industries]. The term "college level" indicated the rigor and degree of achievement required by the ABET (ABET, 1986, p. 1).

Lower-Division. The first two years of a two-plus-two program offered in junior (community) colleges and in senior (four-year) colleges.

MET. Referred to the Mechanical Engineering Technology major offered as one of the Engineering Technology programs at NIU.

Previous Academic Work. Information pertaining to student academic work earned prior to attending the upper-division Engineering Technology programs offered at NIU. Examples include grades and scores earned in a lower-division (community) college coursework. It is used synonymously with community college data.

Senior College. Referred to a publicly supported four-year college or university awarding a baccalaureate degree or a college offering junior and senior level programs leading toward a baccalaureate degree.

Transfer Students. Those students who earned a minimum of 30 semester or 45 quarter credit hours in a community college and who transferred to the upper-division Engineering Technology programs at Northern Illinois University, DeKalb, between 1980-1985.

Two-Plus-Two (Articulation) Program. A collegiate articulation program of curricula of study which awards an associate degree after the completion of two years of study and a baccalaureate degree after the completion of an additional two years of study.

Upper-Division. The last two years of a two-plus-two (articulation) plan spent in a four-year college by a transfer student.

#### SUMMARY

This chapter has provided the framework for an investigation into the prediction of the academic achievement of upper-division students who transferred into Engineering Technology curricula at NIU. The academic



achievement of students who transfer from a lower-division (two-plus-two) articulation plan to complete their upper-division courses in Engineering Technology has been an important issue of concern for advocates of excellence in education and administrators during the past two decades. Faced with high enrollments, a shortage of faculty, and limited financial resources, administrators and educators of Engineering Technology are searching for methods, criteria, and a screening mechanism which would: (a) maximize transfer students' academic achievement, and (b) identify students with the highest potential to benefit from the Engineering Technology curricula at NIU. Limited ability to recognize and identify transfer students who would succeed in advanced-level Engineering Technology programs is a significant problem faced by four-year colleges.

## CHAPTER II

### REVIEW OF LITERATURE

#### INTRODUCTION

The review of relevant literature includes the examination of studies on the prediction of academic achievement of upper-division students who transferred from community college pre-engineering programs to four-year Engineering Technology programs. A major aim of the literature review is to identify the variables used by other educators in similar research. As stated by Pedhazur (1982), "theory is the best guide in the selection of criteria and predictors, as well as in the development of measures of such variables" (p. 132). Particular emphasis was on those studies which dealt with the academic achievement of college transfer students while in attendance at four-year college upper-division programs. Such a theoretical background was necessary to gain a thorough understanding of the phenomenon. Finally, the dependent and the independent variables of the study are discussed.

#### MEASURES OF PREVIOUS ACADEMIC WORK IN LOWER-DIVISION

##### ENGINEERING TECHNOLOGY PROGRAMS AND THEIR USAGE

Many different types of measures have been used constantly to quantify and describe previous academic work of students. Grades frequently have descriptions of what they represent other than average, superior, below average, etc., because such grades may have been assigned from a norm reference group or by criterion-referenced procedures.

Lavin (1965) stated that "academic performance [academic work] refers to some method of expressing a student's scholastic standing" (p. 18). Usually this is based on a grade for a course, an average for a group of courses in a subject area, or an average for all courses expressed on a 0-100 or other quantitative scale. Often, particularly on the college level, the grade of academic work is first expressed nominally (A, B, C) and is then converted to a numerical value (such as A = 4, B = 3, C = 2, etc.) so that a grade point average (GPA) for all courses can be computed.

Studies have probed the relationship between previous academic work and successive academic achievement in two-plus-two programs. There is an assumption that a relationship exists between previous academic work in the lower-division (community) college pre-engineering program and the academic achievement in the upper-division of Engineering Technology programs. This assumption remains a continuing part of the selection process of transfer students for admission into four-year college upper-division Engineering Technology programs.

Review of available research showed that previous academic work has been the chief interest of educators and policymakers. As Hoyt (1965) pointed out, previous academic work has been widely used to evaluate applicants for admissions. Admission requirements vary from university to university. Within universities there may be specific requirements for admission to particular majors or departments. Some elements are common among the requirements, but departments and majors vary the emphasis placed on each criterion. "The factor most commonly

considered in admitting a student to a major is the previous cumulative grade point average" (Morecroft & Ameen, 1987, p. 44) of previous academic work.

In Engineering Technology programs, the ABET (1986) required that previous academic work, when used for admission decisions of transfer students, should include quantitative (mathematics), sciences, technical specialty (electives in mechanical, electronics, electrical, design, etc.), and communication criteria. Factors most commonly considered in admitting a student to Engineering Technology programs are the scores on Scholastic Achievement Tests and high school academic standings. But, because a number of Engineering Technology programs divide their curricula into two divisions (lower- and upper-divisions) to be able to admit transfer students from the two-plus-two (articulation) plan, often they do not admit transfer students until the lower-division academic work is completed. The required lower-division academic work (GPA, and grades of "C" or better) in foundation and core courses (mathematics, science, technical specialty, and communication) constitute the community college data required for graduation.

The question that this requirement raises is whether students who meet these lower-division admission requirements are more likely to obtain a degree at the end of their upper-division Engineering Technology program. Baird (1985) examined the relationship between previous academic work and successive accomplishment by reviewing a wide range of literature. The author asked the question, "Do previous

grades made in a particular major relate with a student's ability to graduate in the same subsequent major?" and argued that:

It is important to understand the relationship because admission to many colleges is based primarily on academic ability. Academic ability is also a prime consideration in the award of scholarships and financial aid. Finally, academic ability and success are often considerations in hiring people for jobs in industry, education, and government. To justify these practices, it needs to be shown that selection on academic ability leads to the choice of people of above average potential. (p. 3)

Seligman (1980) described previous academic work as looking backward to assess how much students have learned in certain majors or how much they have gained in a course(s) or from some part of their education.

As a result of the above notion, Super and Crites (1982) hypothesized and highlighted that previous academic measures earned in school would predict future academic achievement as well as or better than standardized intelligence tests. This and other works strengthened Seligman's efforts to enumerate that such previous work can be used for the following purposes:

1. To provide an objective measure of how much a person has learned.
2. To indicate the relative standing of that person's level of learning in a group (class, school, nationwide sample).
3. To indicate whether, and in what educational area, a person is in need of remediation.
4. To indicate in what technical specialty a person seems to have marked academic strength. (p. 38)

For a prediction study to be of value as a counseling tool, evaluation of students' previous performance always lends itself to a descriptive rating scale that explains what is being evaluated and lends itself to understanding the strength of such relationships (Travers, 1964, p. 364). In 1975, Marsicano reported that "(Previous academic work] as measured on the Scholastic Aptitude Test of the College Entrance Examination Board was used as predictors of academic achievement for most applicants to The Pennsylvania State University (PSU), including most Engineering Technology applicants" (p. 268).

Transfer students generally have a widely dispersed distribution of grade point averages. Except for marginal performers who completed or failed with poor academic work, the vast majority will graduate with superior academic work. Many studies reveal that previous academic work has been widely used as a predictor of academic achievement. Priede (1982), however, argued that factors such as college or department types to which students belong, technical specialty, and demographic (sex, age, race) factors can influence academic achievement variability.

The notion that there is a relationship between previous academic work of the lower-division and subsequent upper-division academic achievement is commonly assumed by educators and policymakers alike. In other words, the basic assumption of admission policies is that the two-plus-two transfer students with superior lower-division academic work are those most likely to attain academic achievement in the subsequent upper-division programs of Engineering Technology.

The assumption therefore underlies the widespread use of previous academic work measures to determine the admission status of students who transfer from lower-division (community) college programs to the upper-division of Engineering Technology programs (Buckley, 1975; Nolan & Hall, 1978; Peng & Bailey, 1977). It is noteworthy to point out that some transfer students may not attain academic achievement because of some other reasons (such as demographic factors) and not necessarily because of their previous academic work.

#### INDEPENDENT VARIABLES USED IN THIS STUDY

The prediction of academic achievement has been the concern of many investigators. Robertson (1985) reported that the "prediction of academic (criterion) [achievement] variables has traditionally been accomplished by using [independent variables] intellectual factors such as aptitude test scores, grade point averages, and course grades as predictor variables. In an attempt to account for the variability in academic [achievement] performance that is not accounted for by the use of intellectual factors, researchers explored the use of nonintellectual factors" (p. 8). Lenning, Munday, Johnson, Vander, and Bruce (1974) agreed with Robertson's findings and called for more research. Within this theoretical framework academic achievement will be regarded as a (dependent variable) function of selected intellectual and nonintellectual (independent variables) factors presented in the following discussion.

### Intellective Factors

It is a generally held belief that intelligence and ability tests measure the capacity of people to solve problems. However, there is no universal agreement as to the sources of this capacity. Lavin (1965) reported that:

Theoretical positions on this topic can be summarized under three headings: first is that the intelligence test score is an index of inherited ability; second is the environmentalist view that intelligence is largely a product of cultural factors; and finally, there is the opinion that intelligence level is determined by the interaction of hereditary and environmental factors. (p. 47)

While there is a disagreement as to the source of the intellective factors, it is obvious that certain intellective factors are required for academic achievement studies. Intelligence and academic aptitude tests and course grades are widely employed to measure these factors and predict future academic achievement. Wigdor and Garner (1982) addressed the distinction between intelligence and aptitude tests:

The term "intelligence test" became so closely identified with the commonly held concept of innate intelligence that its use is no longer politically or socially viable. Hence, what have been called intelligence tests are now generally referred to (and actually more appropriately so) as aptitude tests. There is no test (nor is there likely to be one) that measures innate intelligence. (p. 316)

Aptitude tests are frequently used to predict academic achievement and to select individuals into educational programs. Commenting on this topic, Cook and LaFleur (1975) stated that "underlying these questions is a theory that suggests that current performance in specific types of



tests will be related to later performance of similar kinds of tasks" (p. 97). Additionally, Cook and LaFleur in discussing the use of aptitude tests, reported that the "test scores of academic aptitude were assumed to predict later performance in academic programs" (p.97). The Miller Analogies Test (MAT) consists of 100 analogies items based on many areas of intellectual factors: sciences (chemistry, biology, physics, etc.), mathematics, and general knowledge. Usually graduate school tests exhibit high reliability and much lower validity coefficients. For the MAT, Sax (1974) reported that "reliability is over .85. Validity, however, yielded coefficients from  $-.31$  (using peer ratings as the criterion) to  $.73$  (course grades in elementary school supervision)" (p. 356). Scholastic aptitude tests such as the MAT are best classified as broad, general tests. If such tests are considered broad in nature, then the grades earned in an undergraduate curriculum could be regarded as very specific intellectual factors.

Siegelman (1971) conducted a similar study which used the Scholastic Aptitude Test (SAT) and high school average grade as predictors of college achievement. For males he found that the high school average was a much better predictor than the SAT results. He reported correlations of  $-.07$  to  $.04$  for the SAT and  $.24$  to  $.25$  for the high school grade average in predicting freshman grade point average (p. 948).

In comparing the use of aptitude tests and undergraduate grades as predictors of graduate program success Sax, (1974) reported that "in many instances, undergraduate grades are as good as professional and

vocational aptitude tests" (p. 356), justifying the use of alternative previous academic work for prediction.

In an effort to improve predictions, researchers frequently use batteries of factors or a multidimensional approach. Examples would include an overall grade point average and specific course grades. McLaughlin (1971) reported that a study conducted at the United States Military Academy revealed a correlation of .40 to .50 between the two measures of high school rank and GPA.

Multidimensional predictors of criteria indicate the use of a number of measures. Individual course grades and the grade point averages are some examples of intellectual factors used as multidimensional variables. Chissom and Lanier (1985) and Lenning et al. (1974) have reported the results of studies that used multidimensional intellectual factors as predictors of academic achievement. Their studies reported an overall multiple correlation of .57. Grade point averages were found to be the largest contributor to the correlation, with the mathematics score the next highest contributor.

Fisher (1955) and Horst (1957) theorized that students are good in some things and better in others. By using multidimensional predictors and multidimensional criteria, they determined the relationships between criteria and predictors, and reported median correlations of approximately .50 using the differential technique (p. 22). While Fisher and Horst found the differential technique to be effective, Eells (1961) conducted a similar study on the effectiveness

of using the differential prediction technique to predict college academic achievement. The report concluded, "it is doubtful that the development of differential test predictor batteries for different college fields is worth the increased work" (p. 471). Berdie (1955) reported similar results when attempting to "predict grades in several courses from differential abilities measures" (p. 114). Lavin (1965), in summarizing many studies, found that "of all the measures used in prediction batteries, the one that consistently emerges as the best single predictor was the grade point average" (p. 52). In commenting on the use of intellectual factors in academic prediction, Khan (1969) stated "the numerous studies on academic prediction might be summarized by stating that the average relationship between intellectual variables, whether taken singly or in multiples, and achievement criterion ranges between .50 to .75" (p. 217). These intellectual factors will be discussed individually in the next section.

#### Grade Earned in a Lower-Division Mathematics Course(s) and Subsequent Upper-Division Academic Achievement

The relationship between grade earned in a mathematics course(s) and the academic achievement of students has been the focus of some studies. The source which discusses the grade earned in a mathematics course(s) was the effort of Eells (1961). Eells hypothesized that academic achievement is dependent primarily upon quantitative aptitudes and skills. The author reported that, among other variables used in the model, the mathematics course showed a significantly higher correlation.

Eells concluded that "it is possible that the more able and better prepared students are more likely to take analytical geometry, while the less able students are more likely to take lower level mathematics courses" (p. 9).

Coleman, Talmadge and Bolte (1984) compared the performance of students in Engineering Technology and Computer Science with emphasis on students' mathematics preparation. The findings revealed that a substantially greater percentage of students who completed the calculus mathematics sequence with a grade of "C" or better had a higher graduation rate than their counterparts who did not complete the lower-division mathematics sequence.

In 1983, Turner and Gerardo examined the records of Engineering Technology transfer students to determine (a) if the grades earned in mathematics and six other courses were related to their academic achievement, and (b) whether mathematics could be used as an admission screening device. The authors identified a relationship between preparatory course grades and professional course success. Mathematics courses alone had a weak correlation of .40. When "mathematics and mechanics courses were combined in the regression model, a stronger correlation of .65 was revealed" (Turner & Gerardo, 1983, p. 802).

Bell's findings (1984) and the ABET (1986) requirements were in agreement with the above studies. In other studies, Johnson and Mottley (1986) and Robertson (1985), different findings were reported. The researchers argued that the grade earned in a lower-

division mathematics course had a moderate and significant correlation of .77 with subsequent upper-division academic achievement measures (grade point average).

Grade Earned in a Lower-Division Science Course(s) and Subsequent Upper-Division Academic Achievement

The Accreditation Board for Engineering and Technology (ABET) in 1986 determined that subject matter in Engineering Technology programs has its roots in basic mathematics and science, and applied that knowledge to practical situations. Because science courses are designated to supply the core of technological knowledge students need in their chosen profession, sciences must be included in the programs' requirements. According to ABET, "the basic sciences component of Engineering Technology program may include physics, chemistry, and the life and earth sciences in accordance with specific program needs" (p. 7).

The literature addressing the association of the grade earned in a lower-division science course and the subsequent upper-division academic achievement in Engineering Technology is very meager indeed. However, Juola (1966) addressed the question, "Do test scores secured when students were freshmen in college contribute anything to predictions made on the basis of cumulative grades alone?" (p. 191). The investigator reported that quantitative physical sciences aided in prediction of academic success in specific courses. In conclusion, Juola explained that the results indicated that after the student's first

term, the best indicator of future attainment in a given area is the student's previous (lower-division) academic work in that area. The research results reported by Bell (1984), Crowl (1983), Johnson and Mottley (1986), Martin (1987) and Zingg (1983) support the above conclusions about the relationship between lower-level grades in science and/or test scores and subsequent academic achievement.

Grade Earned in a Lower-Division Technical Specialty Course(s) and Subsequent Upper-Division Academic Achievement

Advocates of excellence in education (Baird, 1985; Brumback, 1987) argued that academic ability is clearly a prerequisite to higher levels of education and thus a prerequisite to get into various high level occupations. Baird stated there is a relationship between superior academic achievement in a person's area of specialty and high level job accomplishment. According to the ABET (1986), technical specialty (electives) "are courses in which students would acquire the necessary skills and knowledge of appropriate methods, procedures, and techniques such as graphics, problem solving, processes, construction techniques, instrumentation techniques, production methods, field operations, plant operations, safety, and maintenance" (p. 6). ABET requires that a student must specialize in some technical areas and must be in good standing before such a student can be accorded graduation recognition (see Appendix M).

The literature suggested that previous academic work in the technical specialty course(s) correlates highly with later academic achievement. Robertson (1985) pooled grade point averages of technical

specialty courses in a study and reported that the coefficient of correlation for the technical specialty courses ranged between .59 and .66. In an earlier study, Priede (1982) disagreed with Robertson, but agreed with Morecroft's and Ameen's (1987) study.

#### Grade Point Average (GPA) Earned in a Lower-Division Program and Subsequent Upper-Division Academic Achievement

It was discussed previously in this chapter that a grade point average of many different types of courses has been used as a criterion for college admission decisions because "it provides a point of comparison between students" (Durio, Helmick & Slover, 1982, p. 44) and majors (Gold, 1980). Durio et al. (1982) compared aptitude and academic achievement of transfer engineering students and reported that the academic achievement of students was best predicted by transfer grade point averages. It accounted for 19% of the differences in cumulative academic achievement.

GPA has been widely used as a predictor of academic achievement. In 1986, Noble reported that of the six predictor variables used to determine the strength of the relationship of each selected variable, GPA was the strongest predictor. Others agreed with him that GPA is a strong predictor of students' academic ability (Healey & Mourton, 1987; McClure, Wells & Bowerman, 1986). Consistent with the above results, Robertson (1985) reported that GPA exhibited a strong correlation ranging between .70 and .77.

### Nonintellective Factors

Lenning et al. (1974) argued that although intellective factors are generally regarded as the best single type of predictors, they do not account for all the variation in academic performance. To account for the remaining variation, researchers focused their attention on nonintellective factors. Khan (1969) reported that "early attempts to predict individual differences in intellectual achievement by means of nonintellective variables were limited to the use of personality inventories, attitude and interest questionnaires, and projective devices" (p. 217).

Other researchers have extended the practice to include additional nonintellective factors. In many cases, the researcher selected predictors on the basis of a hunch or guess that they may be related to academic achievement rather than a conclusion drawn from an organized body of theory.

In this connection, Priede (1982) commented that:

It is of interest to institutional researchers and academic administrators to gain some understanding of which factors influence academic achievement as measured by the grade point average. One would surmise, a priori, that demographic factors such as race, sex, age, and community college location might have some impact on grade point averages.

However, demographic factors alone will in all likelihood fail to explain much of the variation in grade point averages. Some data relevant to student ability is present, such as ACT test scores and high school percentile ranks. These measures are imperfect and cannot be considered as final authoritative measures of ability.



The question that we shall seek to answer is this: to what extent do the various demographic factors influence grade point averages and which of these are significant? We shall answer this question with the help of regression analysis in which we plot the dependent variable to be explained (GPA) as a function of the various independent explanatory variables (i.e., demographic variables). (p. 1)

Priede's (1982) study revealed that the linear regression model yielded a coefficient of determination (R-Squared) of .346, a result which the researcher reported as statistically significant. While nearly two-thirds of the variation in the GPA was explained by nonintellective factors, slightly over one-third of the variation was explained by intellective (grade point average) factors. In conclusion the author stated, "this study of grade point averages has revealed significant effects attributable to demographic (nonintellective) and ability (intellective) factors" (p. 5). Priede's point of view on the use of nonintellective variables in the prediction of academic achievement is that due to the wide range of nonintellective factors selected for study by researchers, it is possible to choose a single to a few variables and to a broader multivariate approach which will provide answers to specific research questions.

Priede (1982) offered a solution to the imperfections associated with the study of academic achievement. Although demographic factors alone would fail to explain much of the variability in academic achievement, Priede suggested that demographic (nonintellective) variables like sex, age, race, etc. offer additional explanation of the variations in academic achievement. Throughout this review, some of the

promising demographic (nonintellective) variables used extensively by other researchers include sex, age, race, and community college location.

Lenning et al. (1974) said, "such nonintellective variables are usually not useful for certain prediction studies" (p. 36). However, other authors argued that because individuals differ significantly in many ways, certain demographic variables deserve attention in some predictive studies. Priede (1982) supported the above idea and argued that test scores and grades certainly weigh heavily in the study of academic achievement. Nevertheless, these intellective measures should not be considered as the final authoritative measures of academic achievement. According to the author, they are weak, imperfect, and cannot explain much of the variation in academic achievement.

#### Sex of Transfer Students

Gender is among the attributes that influence everyday decisions. The choice of Engineering Technology curriculum is probably influenced by individual and contextual attributes such as sex. Despite an extensive body of research designed to explain why men, on the average, achieve higher grades than females, and are more likely to choose Engineering Technology among other curricula, no consistent conclusions have been forthcoming.

However, Hallinan and Sørensen (1987) and McClure, Wells and Bowerman (1986) have suggested that females develop negative attitudes toward Engineering Technology, because they view it as a stereotypically

male curricula, they (females) have fewer role models of successful Engineering Technology than males, and they received pressure from male peers not to excel in Engineering Technology. The authors maintained that this structural explanation points to the typical avoidance of rigorous Engineering Technology courses by females as a reason for their lack of academic success in Engineering Technology and the low probability that they will pursue Engineering Technology as a career. The fact is females are underrepresented in Engineering Technology programs. It is possible this situation, in turn, can affect females' academic achievement.

While Seligman (1980) contended that the academic achievement by sex is not necessarily significant because it has a negligible relationship, Herr and Cramer (1982) argued that females tend to mature earlier than males and this affects their academic decision and achievement. Ethington and Wolfle (1986), Fennema and Sherman (1977), Lenning et al. (1974), Marsh, Parker and Barnes (1985), and Priede (1982) proposed that there is a significant difference between male and female in academic achievement which may be due to the differential socialization process, motivation, socioeconomic status, and marital status.

#### Age of Transfer Students

"Among college students it is estimated that age is likely to affect their career" in Engineering Technology (Healy & Mourton, 1987, p. 28). Age is related to career attitudes, a correlate of career

development skills (Healy, O'Shea & Crook, 1985) and older students. seem to earn higher grades and perform better than younger students. Healy and Mourton (1987) investigated the relationship of career exploration, college jobs, and grade point average. In their findings, they reported that "age correlates significantly with GPA" (p. 16).

Similar results were reported by Marsh, Parker, and Barnes (1985) and McClure, Wells, and Bowerman (1986). While the results reported by Marsh et al. were moderate, statistically significant, and accounted for 5.6% of the variance, the results reported by McClure et al. (1986) revealed that age is a useful predictor of successive academic achievement. This is quite contrary to the results reported by Shapiro and Gould (1980), that age is not a useful predictor of academic achievement.

#### Race of Transfer Students

Porter (1974) and Portes and Wilson (1976) suggested that race is a strong predictor of academic achievement. Hallinan and Sørensen (1987) examined how race affects the assignment of students to ability groups in schools. They found no discrimination towards black and white students. The authors explained that the high ability group tended to be larger in majority black classrooms than in majority white classrooms, giving black students an increased probability of being assigned to the high group. Hallinan and Sørensen concluded that one way students learn is by imitation. If students are disproportionately assigned to the high-ability group by race, then high-ability students will interact more with this learning model than other students.

Priede's (1982) study provided more light on how to minimize academic achievement across different races, especially in heterogeneous societies. Priede's results read:

Turning to the demographic variables, non-white minorities performed at a considerably lower level than white caucasian students. The regression coefficient indicated that a minority student performed at a level of .17 grade points lower than his white caucasian counterpart. Even though the evidence suggests that race is significant in a statistical sense, a .17 grade point difference need not necessarily be critical to a minority student's chances for success, however. (pp. 10-11)

#### Community College Location and Academic Achievement of Transfer Students

In a study conducted by Durio, Helmick, and Slover (1982) to compare the aptitude and achievement between transfer engineering students and students entering engineering as freshmen at a major university, Durio et al. found no distinctions between engineering native and transfer students. However, among transfer engineering students, the study reported that white male engineering students who transferred from in-state junior colleges were more likely to achieve at lower levels than other transfer students. Female engineering transfer students were superior in achievement to other students. These authors did not say whether these students transferred from urban or suburban junior colleges and if they all had the same characteristics/background.

Priede's 1982 study reported the opposite findings. The author found that transfer students who came from suburban areas were more likely to attend suburban junior colleges. This group of students were more likely to transfer to neighboring senior colleges.

Priede's study revealed that transfer students performed at .07 grade points better than native students and that students who transferred from suburban community colleges performed at .09 grade points lower than other students.

There is no consensus regarding the academic performance of students who transfer from urban or suburban community colleges to senior colleges. As recent trends in senior college enrollment indicate, the number of transfer students both from junior colleges located in urban and suburban areas is on the increase. Of the total NIU enrollment for 1986, 34% of the enrollment was accounted for by students who transferred from the lower-division public community colleges to the upper-division programs at NIU. As shown in Appendixes D-F, the number of students who transferred from public community colleges into NIU programs in 1986 accounted for 65% of the year's total enrollment. Ludwig (1987) reported that community college students accounted for 41.9% of the national total college enrollment for 1986, while there was a drop in freshman enrollment. His study confirms the enrollment trend and the need to address it.

#### SUMMARY

The review of literature in this chapter provided relevant background information needed for this study. An effort was made to review related information from previous studies, especially those concerning the relationship between academic achievement and various other intellectual and nonintellectual predictor variables.

Although there was no specific study available on the prediction of academic achievement of students who transferred (through the two-plus-two articulation plan) into the Engineering Technology program at Northern Illinois University, available literature surveyed contained several scattered studies that are related and relevant to this study. More than 50% of the studies reviewed indicated, in general, that native students' academic achievement was superior to that of transfer students; and that native students were more successful in obtaining a bachelor's degree in Engineering Technology primarily due to the superior performance in selected core courses in the lower-division Engineering Technology program. To mention a few, Anderson and Riehl (1974), Castaneda and Winer (1985), Duro et al. (1982), Grover (1967), Hodgson and Dickinson (1974), Knight (1978), Knoell and Medsker (1965), Marsh et al. (1985), Marsicano (1975), Robertson (1985), Scheehan and Reti (1974), Spangler and Wellman (1961), Turner and Gerardo (1983), and Voyles (1971) reported that the academic achievement of native students was superior to that of the transfer students. Studies by Bird (1956), Irving (1966), Laudicina (1974), Siemans (1943), and the University of Missouri (Columbia) Admissions Staff (1974) refuted that the performance and success rate of students who transfer from junior colleges to complete their upper-level Engineering Technology was inferior to native students' academic achievement. Hills (1965) reviewed 33 sets of data with regard to academic achievement and concluded that 22 of the 33 studies indicated superior academic achievement by native students. Only four indicated superior academic

performance and achievement by the transfer students and seven indicated that the performance was approximately equal.

Another observation, revealed in the literature, is that different independent variables were used by different investigators. Among the variables used most are grades earned in mathematics, science (e.g., physics, chemistry, biology), grade point average (GPA), sex, race, and grades earned in the student's major. This observation agrees with Pedhazur's (1982) advice that "the researcher must select the variables on the basis of the specific means, needs, and circumstances" (p. 151).

Intellective and nonintellective factors such as course grades were found to be reliable predictors of academic achievement in this study. Precollege test data such as aptitude tests and grades were found to be widely used to predict success in college. However, Joula (1963) reported that the validity of such factors steadily decreases over successive academic terms. In reporting on that finding, Joula (1966) also stated that "previous academic achievement correlates much higher with later attainment than do any of the freshman level standardized tests" (p. 93). These findings suggest that precollege data would have limited validity if used to predict college success beyond the freshman year. The findings also suggest that the use of collegiate data such as college grades may be a useful predictor of later collegiate academic achievement.

Above all, the literature revealed different methodologies used by the different investigators. Among these methodologies, more than 50% of the cases were correlational studies using different types of



samples, populations, designs, data, and multivariate statistical analysis as suggested by Durio et al. (1982), Castaneda and Winer (1985), Gnauck and Kaczkowski (1961), Kerlinger (1973), Mann (1961), McClure et al. (1986), Marsh et al. (1985), Morris (1986), Newman et al. (1981), Oliver and Hinkle (1982), and Pedhazur (1982).

As revealed in the literature, higher education departments of Engineering Technology are experiencing considerable demand for their programs. These programs have limited ability to respond to this demand and must limit enrollments. As the literature suggests, existing methods used in limiting lower-division enrollments will not necessarily limit upper-division enrollments. The two-plus-two program administrators, in response to this high demand, are attempting to limit upper-division enrollments.

## CHAPTER III

### METHODOLOGY

#### INTRODUCTION

This chapter describes the research methodology which includes design, population, data collection, and the statistical procedures for data analysis of this study. "To implement general plans of research, methods of observation, and methods of data collection must be used" (Kerlinger, 1973, p. 478).

#### DESIGN OF THE STUDY

Kerlinger (1973, p. 300) said, "Research design is the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance." As explained by Labovitz and Hagedorn (1981), research design is a set of logical procedures that, if followed, designates the logical manner in which interpretation can be made from the data.

The study presented here was a descriptive research study designed to investigate and describe the correlational relationships between the lower-division academic work and the subsequent upper-division academic achievement of students in two-plus-two Engineering Technology programs. Ary, Jacobs, and Razavieh (1979) explained that descriptive research studies are directed toward determining the nature of a situation as it exists at the time of the study, without the administration of a

"control" as a treatment. Descriptive research is of such great value because of its role in seeking answers to questions. Most descriptive studies are concerned with determining the events of situations that are developing.

Best (1977) stated, "Descriptive research seeks to find the answers to questions through the analysis of variable relationships. What factors seem to be systematically associated with certain occurrences, conditions, or types of behavior?" (p. 145). Selltitz, Wrightman, and Cook (1976), in discussing the flexibility of descriptive research, stated:

Descriptive studies are not limited to any one method of data collection. The procedures to be used in a descriptive study must be carefully planned. Because the aim is to obtain complete and accurate information, the research design must make much more provision for protection against bias than in exploratory studies. (p. 102)

Selltitz et al. (1976) also felt that descriptive research should provide for economy of research effort throughout the entire research process. Also, this study was designed to "predict" (Kerlinger, 1973; Oliver & Hinkle, 1982; Pedhazur, 1982; Sowell & Casey, 1982) a dependent variable from independent variables. One predicts the existence or nonexistence of a relationship one even predicts something that happened in the past. Ary, Jacobs, and Razavieh (1979) explained that:

Correlational studies are a frequently used type of descriptive research that is concerned with determining the extent of relationship existing between variables. They enable one to ascertain the extent to which variations in one variable are associated with variations in another. The magnitude of the relationship is determined through the use of the coefficient of correlation. For instance, on the basis of personal experiences a researcher may hypothesize that there is a relationship between performance in mathematics and performance in chemistry at the high school level. The correlational procedure will enable this researcher to test the hypothesis about the relationship between these two variables as well as to assess the magnitude of the relationship. (p. 305)

Scriven (1959) pointed out that there is "a gross difference" between prediction and explanation. Among other things, he explained that in certain situations it is possible to predict phenomena without being able to explain them and vice versa. "Roughly speaking, the prediction requires only a correlation, the explanation requires more. This difference has, as one consequence, the possibility of making predictions from indicators of causes--for example, predicting a storm from a sudden drop in pressure in our house caused the storm: It merely presaged it" (p. 480).

Kaplan (1964) maintained that from the standpoint of a philosopher of science, the ideal explanation is probably one that allows prediction. He argued that:

The converse, however, is surely questionable; predictions can be and often are made even though we are not in a position to explain what is being predicted. This capacity is characteristic of well-established empirical generalizations that have not yet been transformed into theoretical laws. . . . In short, explanations provide understanding, but we can predict without being able to understand, and we can understand without necessarily being able to predict. It remains true that if we can predict successfully

on the basis of certain explanations we have good reason, and perhaps the best sort of reason, for accepting the explanation. (pp. 349-350)

As Pedhazur (1982) states, "In predictive research, the main emphasis is on practical application" (p. 136). The main purpose of this predictive (correlational) study was to provide descriptive answers (Kerlinger, 1973; Labovitz & Hagedorn, 1981) to the following:

(a) What is the strength of the relationship between the grade earned in a lower-division mathematics course(s) and upper-division academic achievement? (b) What is the strength of the relationship between the grade earned in a lower-division science course(s) and upper-division academic achievement? (c) What is the strength of the relationship between the grade earned in a lower-division technical specialty course(s) and the upper-division academic achievement? (d) What is the strength of the relationship between the overall grade point average (GPA) earned in the lower-division program and the upper-division academic achievement? (e) What is the strength of the relationship between selected demographic (sex, age, race, and community college location) factors and upper-division academic achievement?

#### POPULATION FOR THE STUDY

The general population of concern in this study consisted of all two-plus-two (articulation plan) students who transfer from lower-division (community college) programs into the upper-division of Engineering Technology programs of four-year colleges. The most

immediate population selected for this study included all the 1980-1985 two-plus-two (articulation plan) transfer students who enrolled in the Engineering Technology programs at Northern Illinois University (NIU), DeKalb. Unsuccessful students as well as successful students were included in the study. Successful students were those who graduated after the last semester of enrollment, while unsuccessful students were those who had some difficulties and did not graduate.

The number of participants and representativeness used by a researcher in a particular study have been subjects of interest and debate by many researchers. The debate is that the adequacy of representativeness necessarily determines the range of valid generalization. The importance of representativeness in research is obvious. Ary et al. (1979) advised that:

Typically, correlational studies do not require large samples. It can be assumed that if a relationship exists, it will be evident in a sample of moderate size, for instance 50 to 100. If one is interested in making an inference about the relationship in a population, then the sample selected should be a representative sample of that population. (p. 375).

Oliver and Hinkle (1982) developed a rule of the thumb that "If the researcher does not have a random sample, all inferences must be judgmental and, if made, should be made by the user of the research rather than by the researcher" (pp. 200-201). Also, strategies for obtaining representativeness of exhaustive samples of populations have been discussed by Cooper (1984), Glass, McGaw, and Smith (1981), and Hedges (1986). According to these researchers, the problem of obtaining representative samples of populations studied is constrained

by the nature of the study that has been done and, therefore, is not under the complete control of the researcher. The researcher can, however, present descriptions of the participants and examine the strength of the relationship between characteristics of these participants and study the outcomes. In selecting the participants for this study, the researcher assumed that the number of participants utilized in this study would be representative enough to allow the users of this study to judge if it is actually a subset of the larger population of all transfer students in Engineering Technology programs in the United States.

#### DATA COLLECTION

The data used as a source of information for this study were collected from students' records on file in the Office of Registration and Records, Northern Illinois University (NIU), DeKalb. In discussing different important types of available sources of data, Isaac and Michael (1983) and Kerlinger (1973) assert that "from [an] educational research viewpoint, school records are the most important available materials. Pupils' records and test scores are useful in their own right, since much can be learned about a school system from a simple statistical compilation and analysis of the quantitative data available. It would seem important, for example, to know the average achievement, intelligence, and aptitude levels of the schools in a district in which one is doing research" (p. 524).

Although some disadvantages of this type of data source have been pointed out by Isaac and Michael (1983, p. 130), the researcher used this data source because, according to Isaac and Michael, (a) the records are nonreactive, (b) they are inexpensive, (c) records often allow historical comparisons and trend analysis, and (d) if records are accurate and up-to-date, they will provide an excellent baseline for comparisons.

The Office of Registration and Records maintains a computer record of personal, precollege and collegiate data on each student throughout the student's academic career at Northern Illinois University. The data record includes the courses taken, corresponding grades earned, sex, age, race, community college attended, and technical specialty of each student. The data were available in the form of a magnetic tape with accompanying documentation. The documentation specified the exact format that was used in coding the data on the tape. The data were checked against departmental hard copy records. The results of the verification procedure indicated no discrepancies between the computer tape and hard copy records. Student names were removed from the data to protect the privacy of the individuals.

#### STATISTICAL ANALYSIS AND TREATMENT OF THE DATA

Since this study was descriptive in nature and included the total population, the statistical analysis of the data was accomplished by the use of descriptive statistical methods. Hinkle, Wiersma



(1979) have defined descriptive statistical methods as "those consisting of classifying and summarizing numerical data" (p. 9). Best (1977) stated: "Descriptive statistical analysis involves the description of a particular group" (p. 262). Van Dalen (1979) defined the utility of descriptive statistics in these words, "Descriptive statistics make it possible to obtain a single numerical value that describes a whole set of data with respect to some distributional property or the relationship between two sets of data" (p. 119).

The statistical analysis and treatment of the data included "descriptive statistics" (Oliver & Hinkle, 1982, p. 200) to be able to classify, summarize, and describe the characteristics of the group from which the data were collected. The Statistical Package for the Social Sciences (SPSS<sup>X</sup>) was utilized to perform frequencies and scattergram programs in order to describe the population, analyze the nature of the distributions of the variables, and to establish simple correlations between the dependent and independent variables.

In order to answer the research questions in Chapter I, however, the multiple regression statistical technique was used to further analyze the data. This technique was used to investigate the relationship between academic achievement (dependent) and mathematics, science, technical specialty, grade point average (GPA), sex, age, and race (predictor) variables. Dillon and Goldstein (1984), commenting on the use of this technique, stated that ". . . there are two principal uses for the multiple regression technique: (a) it yields optimum weighting for combining a series of variables in predicting a

criterion and provides an indication of the accuracy of subsequent predictions, and (b) it permits the analyzing of variation into component parts." Specifically, Dillon and Goldstein (1984) added that:

Multiple regression technique is the most widely applied set of data analytic techniques used for assessing relationships among variables. Specifically, it is used to investigate the relationship between a dependent (or response) variable  $Y$  and one or more independent (or predictor) variables  $X_1, X_2, \dots, X_p$ . (p. 209)

Kim and Kohout (1975) related the following concerning this technique:

Multiple regression is a general statistical technique through which one can analyze the relationship between a dependent or criterion variable and a set of independent or predictor variables. Multiple regression may be viewed either as a descriptive tool by which the linear dependence of one variable on others is summarized and decomposed, or as an inferential tool by which the relationships in the population are evaluated from the examination of sample data.

The most important uses of the technique as a descriptive tool are: (a) to find the best linear prediction equation and evaluate its prediction accuracy, (b) to control for other confounding factors in order to evaluate the contribution of a specific variable or set of variables, and (c) to find structural relations and provide explanations for seemingly complex multivariate relationships. (p. 321)

The stepwise regression procedure was used to determine the proportion of variance in the criterion variable that was explained by the predictor variables when all predictor variables were considered jointly. As explained by Pedhazur (1982), in the stepwise technique the correlations of all the independent variables with the dependent variable were calculated. The independent variable that had the

highest simple Pearson correlation with the dependent variable was entered first into the analysis. The "criteria for removal of predictors that are not useful may be meaningfulness, statistical significance, or a combination of both" (Pedhazur, 1982, p. 16).

The intent of using these techniques was to: (a) have the stepwise regression give an indication of the relative contribution of each variable to explained variance, (b) use this information to control for stronger variables in the partial correlation procedure, and (c) use the general multiple regression to give an indication of the overall relationship between the independent variables and the dependent variable.

#### Strength of Association

In this type of descriptive study, researchers have advised that the strength of relationship technique should be used to interpret the importance of the results of the relationships between the dependent and independent variables. Multiple regression and partial correlation involving the "coefficient of determination" constituted the type of control necessary to answer the research questions relating to the strength of association in this study.

Cohen's criteria were used as a guide to state the strength of relationship observed. Cohen (1977) suggested the following "coefficients of determination" as criteria for determining the strength of relationship existing between independent and dependent variables: "small effect size:  $r^2 = .01$  or  $r = .10$ ; medium effect size:  $r^2 = .09$  or  $r = .30$ ; large effect size:  $r^2 = .25$  or  $r = .50$ " (pp. 79-80).

## SUMMARY

The methodology used for this study was discussed in this chapter. The researcher presented a descriptive research design, population, data source and collection, and the statistical analysis technique suitable for the data analysis of this study.

The purpose of this study was to investigate and describe the strength of relationships between the dependent and independent (intellective and nonintellective) variables of 1980-1985 two-plus-two (articulation) transfer students who enrolled in Engineering Technology programs at Northern Illinois University (NIU), DeKalb. The data for this study were collected from students' records in the Office of Registration and Records, NIU, DeKalb.

There are a number of methods for analyzing the relationship between the selected variables. Since the purpose of this analysis was to describe the population selected and make a prediction, the stepwise regression statistical procedure was considered to be the strongest and more reliable method to establish predictors from patterns of relationships among the variables. This technique allows the user to establish the contributions of two or more variables to a dependent variable. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS<sup>X</sup>) at the Northern Illinois University computer facility.

## CHAPTER IV

### FINDINGS OF THE STUDY

#### INTRODUCTION

The purpose of this study was to determine and describe the strength of the relationship between previous lower-division (community) college academic work and the subsequent upper-division academic achievement of students who transfer to Northern Illinois University Engineering Technology programs through the two-plus-two (articulation) plan. The findings and results from the data collected and analyzed for this study are presented in this chapter. These descriptive findings were based on the research questions posed in Chapter I.

#### DESCRIPTION OF THE POPULATION

Graduation rate (GRADUATE). Two hundred and two students who transferred through the two-plus-two (articulation) plan, from the community college to the upper-division of the Engineering Technology program at Northern Illinois University, DeKalb, between 1980-1985 academic years, constituted the population used for this study. This population included 59 (29.2%) transferred students who did not complete and 143 (70.8%) transferred students who completed the last two years (upper-division) of the Engineering Technology programs at NIU.

Sex. Among the 202 transfer students included in this study, the results show that only 12 (5.9%) female students transferred from the two-year colleges to the last two years of the Engineering Technology programs at NIU. This is indicative of the situation as it presently exists in terms of females' representation and participation in Engineering Technology programs. With 94.1% male representation, Engineering Technology is still predominantly a male-dominated college program.

Among the 202 transfer students studied, only 12 (5.9%) were females and 94.1% were males. While males showed a little higher graduation rate (94.7%), females also had a high (91.7%) rate of graduation from the upper-division of the Engineering Technology at NIU.

Age. The age of students at the time of transfer is reported in Table 1. The average age of students who transferred from a lower-division (community) college program to the upper-division Engineering Technology program was 26.6 years, with a range from 22 years to 44 years. Students whose ages were either 25 years or younger formed 57.7% of the total number of transfer students, while those between 26 years and 30 years formed 26.8% of the population.

Race. The findings in Table 2 show the ethnic background of students who transferred from the community college to a four year college to complete the last two years of Engineering Technology programs. Transfer students from white ethnic backgrounds showed a very high rate (82.2%) of college enrollment, whereas students from Black, Asian, Hispanic, and American Indian and other ethnic backgrounds showed less

Table 1

Age of Students at the Time of Transfer (N = 202)

Age	Number	Percent
22	6	3.0
23	21	10.4
24	53	26.0
25	37	18.3
26	16	7.9
27	9	4.5
28	13	6.4
29	10	5.0
30	6	3.0
31	4	2.0
32	1	0.5
33	9	4.5
34	2	1.0
35	5	2.5
36	4	2.0
37	1	0.5
38	2	1.0

(table continues)

Table I. (continued)

Age	Number	Percent
40	1	0.5
43	1	0.5
44	<u>1</u>	<u>0.5</u>
Total	202	100.0



Table 2

Race of Transfer Students (N = 202)

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Race	Number	Percent
Black	7	3.4
White	166	82.2
Hispanic	8	4.0
Asian	13	6.4
Other	6	3.0
American Indian	1	0.5
No race information	<u>1</u>	<u>0.5</u>
Total	202	100.0

---

than 20% representation and participation among the transfer students' total population.

Community college location (CCLOCATN). The description of the community college geographic areas from where students transferred to the Engineering Technology programs at NIU is reported in Table 3. Among the 202 transfer students included in this study, about an equal number of them transferred from community colleges located in suburban areas as compared to those located in urban areas. The remaining students transferred from out-of-state or came from other countries. It is interesting to observe that 83.2% of the transfer students admitted into the upper-division of the Engineering Technology programs at NIU between 1980 and 1985 came from in-state two-year colleges.

Furthermore, 75.3% of the 81 students who transferred from community colleges located in urban areas graduated and 74.7% of the 87 students who transferred from suburban community colleges also graduated. The students who transferred from either out-of-state of Illinois or came from other countries had a 97.1% graduation rate.

Technical specialty (TECSPLTY). Table 4 summarizes the previous academic work of transfer students in their technical specialty course(s) at the time of admission into the upper-division Engineering Technology programs at NIU. The majority of the transfer students (52.5%) had average (C) grades at the time of admission. While 38.6% had above average (B) grades, only 2% of the transfer students had excellent (A) grades. The remaining 6.9% had poor (D) grades.

Table 3

Community College Location of Transfer Students (N = 202)

Location	Number	Percent
Urban	81	40.1
Suburban	87	43.1
Other	<u>34</u>	<u>16.8</u>
Total	202	100.0

Table 4

Grades Earned by Transfer Students in Their Areas of Technical  
Specialty from the Lower-Division College Programs (N = 202)

Technical specialty grade	Number	Percent
Poor (D)	14	6.9
Average (C)	106	52.5
Above average (B)	78	38.6
Excellent (A)	<u>4</u>	<u>2.0</u>
Total	202	100.0

Community college grade point average (CCGPA). The grade point average (CCGPA) earned by a transfer student at the time of transfer is reported in Table 5. Among the 202 transfer students studied, 4 (2%) earned below 2.0 GPA, 65.3% earned 2.0-2.99 GPA, and 32.7% earned 3.0 GPA or above. The mean CCGPA for the population was 2.654.

Grade(s) earned in mathematics (MATH). Table 6 summarizes information about grade(s) earned in mathematics. Out of the 202 transfer students included in this study, 26.3% did not meet the mathematics requirement for admission into the upper-division Engineering Technology programs at NIU. This subgroup had poor (D) mathematics grades. Another 38.6% had some mathematics background and received average (C) grades in their lower-division (community) college programs. While 21.8% received above average (B) grades, 5.9% received excellent (A) grades, and 7.4% had no mathematics grade information.

Grade(s) earned in science (SCIENCE). As reported in Table 7, 29.2% transfer students earned poor (D) grades in science in their lower-division (community) college programs. While 29.7% transfer students earned average (C) grades in science, another 24.7% group of transfer students earned above average (B) grades, 4% of the 202 transfer students earned excellent (A) grades, and the remaining 12.4% had no science grade information in their lower-division (community) college programs at the time of transfer.

Descriptive statistics. Table 8 shows the descriptive statistics (number of observations, mean, and standard deviation) for the continuous variables used in this study. The results show that the

Table 5

Overall GPA Earned by Transfer Students from the Lower-Division College Programs (N = 202)

GPA	Number	Percent
Less than 1	0	0.0
1-1.99	4	2.0
2-2.99	132	65.3
3-4.00	<u>66</u>	32.7
Total	202	100.0

Table 6

Grades Earned in Mathematics by Transfer Students from the Lower-Division College Programs (N = 202)

Mathematics grade	Number	Percent
Poor (D)	53	26.3
Average (C)	78	38.6
Above average (B)	44	21.8
Excellent (A)	12	5.9
No grade information	<u>15</u>	<u>7.4</u>
Total	202	100.0

Table 7

Grades Earned in Science by Transfer Students from the Lower-Division  
College Programs (N = 202)

Science grade	Number	Percent
Poor (D)	59	29.2
Average (C)	60	29.7
Above average (B)	50	24.7
Excellent (A)	8	4.0
No grade information	<u>25</u>	<u>12.4</u>
Total	202	100.0



Table 8

Descriptive Statistics for Continuous Variables Used in This Study(N = 202)

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Variable	N	Mean	Standard deviation
MATH	187	2.688	0.662
SCIENCE	177	2.585	0.708
TECSPLTY	202	2.694	0.598
CCGPA	202	2.654	0.470
AGE	202	26.559	4.397

---

average grade earned in mathematics (MATH) course(s) by the students who transferred into the Engineering Technology programs was 2.688 (C+) with a standard deviation of .662. The highest possible score was 4.0 (A). The mean grade earned in science was 2.585 (C+) with a standard deviation of .708. Technical specialty (TECSPLTY) grade had a mean of 2.694 (C+) and a standard deviation of .598. The mean grade point average of transfer students was 2.654 (C+) on a four-point scale. Similarly, the remaining variable (AGE) had a mean of 26.559 years and a standard deviation of 4.397 (Table 8).

Correlation among the variables. The correlations between the dependent variable (GRADUATE) and the independent variables are reported in Table 9. Since a large majority of the students were male and only a few students were included in each of the races other than white, it was thought that the analysis would be more meaningful by excluding the variables of SEX and RACE. All the independent variables included have positive correlations with the dependent variable. These correlation coefficients were used to determine the regression model:

$$\text{GRADUATE} = \text{MATH} + \text{SCIENCE} + \text{TECSPLTY} + \text{CCGPA} + \text{CCLOCATN} + \text{AGE}$$

Multiple regression analysis. To answer the research questions, multiple regression analysis was performed through the use of the stepwise technique. Table 10 presents the results of the stepwise regression analysis as related to the research questions.

Table 9

Correlation Among the Variables (N = 202)

	MATH	SCIENCE	TECSPLTY	CCGPA	CCLOCATN	AGE	GRADUATE
MATH	1.000	.346	.365	.476	-.025	.041	.473
SCIENCE		1.000	.379	.360	.022	.079	.459
TECSPLTY			1.000	.408	-.065	-.101	.572
CCGPA				1.000	-.091	.035	.529
CCLOCATN					1.000	.136	.041
AGE						1.000	.109
GRADUATE							1.000

Table 10

Results of Stepwise Multiple Regression Analysis (N = 202)

Step	Variable entered	Multiple R	R <sup>2</sup>	Standard error	R <sup>2</sup> change
1	TECSPLTY	0.572	0.327	0.375	0.327
2	CCGPA	0.658	0.432	0.345	0.105
3	SCIENCE	0.684	0.468	0.335	0.036
4	MATH	0.699	0.489	0.329	0.021
5	AGE	0.708	0.502	0.326	0.013
	(CONSTANT)	-1.588			

In Table 10, the technical specialty (TECSPLTY) entered the first step of the analysis and the variable AGE entered last. When all predictor variables were considered jointly, 50.2% of the variance in the dependent variable was explained by the linear combination of the five predictor variables. The variable community college location (CCLOCATN) had a weak zero-order correlation (Table 9) and did not meet the statistical criterion for entering the regression equation.

The multiple regression analysis (MRA) results presented in Table 11 were used to determine the relative contributions of each predictor variable in the model. The interpretation of the contribution of each variable comes directly from the regression coefficient (B or Beta). For example, the positive coefficient for community college grade point average (CCGPA) indicates that the ability of those transfer students to graduate was associated with those students who earned higher grade point averages. The results of the MRA revealed that TECSPLTY, CCGPA, SCIENCE, MATH, and AGE all made some contribution to the ability to graduate.

Although the predictor variables have relationships with a transfer student's ability to graduate, the important general question for each predictor variable is how strong is the relationship? To determine the strength of relationship that exists between each of the predictor variables and the criterion variable, partial correlation coefficients reported in Table 11 were used. Cohen (1977) suggested the following criteria for determining the magnitude of the relationship that exists

Table 11

Results of Multiple Regression Analysis (N = 202)

Variable		B	Beta	SE B	Partial r	Controlling for
Dependent	Independent					
GRADUATE	TECSPLTY	0.276	0.363	0.045	0.403	MATH, SCIENCE, CCGPA, AGE
GRADUATE	CCGPA	0.231	0.238	0.059	0.269	MATH, SCIENCE, AGE, TECSPLTY
GRADUATE	SCIENCE	0.116	0.170	0.039	0.208	MATH, AGE, CCGPA, TECSPLTY
GRADUATE	MATH	0.117	0.164	0.033	0.193	AGE, CCGPA, SCIENCE, TECSPLTY
GRADUATE	AGE	0.012	0.117	0.002	0.162	MATH, CCGPA, SCIENCE, TECSPLTY
(Constant)		-1.588				

between the criterion and predictor variables for studies in the behavioral sciences:

Small effect size:  $r^2 = .01$  or  $r = .10$

Medium effect size:  $r^2 = .09$  or  $r = .30$

Large effect size:  $r^2 = .25$  or  $r = .50$  (pp. 79-80)

#### FINDINGS RELATING TO THE RESEARCH QUESTIONS

Five research questions centered around the strength of the relationships between lower-division academic work and the subsequent academic achievement of students who transfer from junior college to the upper-division Engineering Technology curricula. The following findings relate to these questions:

Question 1. What is the strength of the relationship between the grade earned in a lower-division mathematics course(s) and upper-division academic achievement?

This question addressed the extent to which the grade earned in mathematics course(s) in the community college would influence a student's academic achievement (GRADUATE) when such a student transfers to complete a selected major in Engineering Technology curricula, in a selected four-year college. In other words, does ability to earn a degree at the end of the last two years of college in Engineering Technology depend on the grade earned in mathematics in the junior college?

The results presented in Table 11 revealed that the partial correlation coefficient for the grades earned in mathematics course(s) was .193, when other variables were controlled. According to Cohen (1977), this indicates between a small and medium effect size or relationship.

Question 2. What is the strength of the relationship between the grade earned in lower-division science course(s) and upper-division academic achievement?

This question dealt with the effect of the grade(s) earned by transfer students, in the lower-division science course(s), on the students' academic achievement when the students transferred to complete the (last two years) upper-division Engineering Technology programs at NIU.

In Table 11, the result of the partial correlation coefficient was .208. This indicates that the magnitude of the relationship was between small and medium effect size and/or relationship.

Question 3. What is the strength of the relationship between the grade earned in lower-division technical specialty(s) and the upper-division academic achievement?

The effect of the grade earned in lower-division technical specialty (TECSPLTY) on the academic achievement of students who transferred from community college into the upper-division Engineering Technology programs at NIU was the main concern of this question. When the effects of other predictor variables were controlled,



technical specialty (TECSPLTY) had a partial correlation coefficient of .403. According to Cohen (1977), this showed an effect size which is midway between medium and large (Table II).

Question 4. What is the strength of the relationship between the overall grade point average (GPA) earned in the lower-division program and the upper-division academic achievement?

This question addressed the extent to which grade point average (CCGPA) earned in the lower-division (community) college programs influenced the upper-division academic achievement of students who transferred to Engineering Technology programs at NIU. As presented in Table 11, the partial correlation coefficient ( $r = .269$ ) revealed that community college grade point average (CCGPA) had a near medium effect size and/or relationship.

Question 5. What is the strength of the relationship between selected demographic (AGE) factors and upper-division academic achievement?

The only demographic factor included in the analysis was AGE. Thus, this question addressed the extent to which age influenced the academic achievement among students who transferred from the lower-division (community) college programs to the upper-division Engineering Technology programs at NIU.

Table 11 revealed that this variable had a partial correlation coefficient of .162. This result indicates that the correlation coefficient was near Cohen's small effect size.

## SUMMARY

This chapter presented the findings of the analysis and interpretation of the data obtained for this study. The findings described the 202 transfer students identified as the population for this study. These results are reported in Tables 1 through 8.

The results presented in this chapter also cover the five research questions investigated to determine the criteria which will predict the academic achievement of upper-division students who transfer into Engineering Technology curricula from the lower-division (community) college programs. The magnitude of the relationships that exist between the criterion variable and the predictor (intellective and nonintellective) variables were interpreted through the results of the multiple regression statistical analysis summarized in Tables 10 through 11. The information pertaining to the relationships and their strengths were described in terms of the "effect" criteria suggested by Cohen (1977).

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

#### INTRODUCTION

The purpose of this study was to investigate and describe the magnitude of the relationships between selected previous academic work and academic achievement of students who transfer from lower-division (community) colleges to the upper-division Engineering Technology programs at Northern Illinois University, DeKalb. This study is important because it provides information that can be used by policymakers in their efforts to establish rational upper-division college admission criteria. The identification of such criteria would enable educators and administrators to select qualified transfer students (for admission) who have the best chance to succeed in upper-division Engineering Technology undergraduate programs, especially during a time of limited resources. This chapter reports the summary, conclusions, and recommendations of the study.

#### SUMMARY OF THE STUDY

##### Problem

Wolf, in 1987, observed that the number of Engineering Technology programs has grown steadily over the past four decades since ABET first accredited the associate degree programs. This growth pattern

has witnessed dramatic increases in the number and mix of applicants for admission. With the increasing prominence of the community colleges to serve as feeder sources to the growing four-year Engineering Technology programs, there is a concern about such transfer student's ability to earn a degree, especially at this time of limited resources (Ludwig (1987)). The problem of this study was to investigate, determine, and describe the criteria that relate to the academic achievement of students who transferred from lower-division (community) college programs to the upper-division Engineering Technology programs at NIU between 1980-1985 academic years.

### Methodology

This descriptive research study utilized the data obtained from the records of the previous academic work of 202 transfer students who served as the population selected for the study. This population included all the 1980-1985 two-plus-two (articulation) transfer students who were admitted and enrolled in the upper-division of the Engineering Technology programs. It included all those transfer students who graduated, as well as those who did not graduate from the programs at the end of spring semester 1987.

In order to answer the five research questions formulated for this study, the SPSS<sup>X</sup> package was used to perform the statistical analysis and treatment of the data utilizing the Northern Illinois University computer facility.

## Findings

The findings from the statistical analysis of the data provided two types of information. The first type is the descriptive information about the 202 transfer students selected as the available population. The second type of the findings is information for each of the five research questions.

### Descriptive Information About the Population

The data collected for this study revealed that 29.2% of the 202 transfer students included in the study did not graduate, while 70.8% of the same population graduated from the upper-division of the Engineering Technology programs.

Sex. Among the 202 transfer students studied, only 12 (5.9%) were females and 94.1% were males. While males showed a little higher graduation rate (94.7%), females also had a high (91.7%) rate of graduation from the upper-division of the Engineering Technology at NIU.

Age. The average age of all the transfer students included in the study was 26.6 years with a range between 22 and 44 years. Students whose ages were either 25 years or younger formed 57.7% of the 202 transfer students, while those between 26 years and 30 years formed 26.8% of the population.

Race. Transfer students who came from a white ethnic background showed a very high (82.2%) rate of enrollment in Engineering Technology programs. Transfer students from Black, Hispanic, Asian, American Indian, and other ethnic backgrounds showed less than 20% rate of

transfer and enrollment in Engineering Technology programs at NIU during the period covered in the study.

Community college location (CCLOCATN). The data revealed that 43.1% of the students who transferred came from community colleges located in suburban areas and 40.1% came from those located in urban areas. The remaining 16.8% transferred either from out-of-state or came from other countries.

Of the total number of 202 students who transferred to the upper-division Engineering Technology programs at NIU during the period 1980-1985, 75.3% of the 81 students who transferred from community colleges located in urban areas graduated and 74.7% of the 87 students who transferred from suburban community colleges also graduated. It is interesting to note that 97.1% of the 34 students who transferred from either out-of-state of Illinois or came from other countries showed the highest graduation rate.

Grade(s) earned in technical specialty (TECSPLTY). This descriptive information shows that 52.5% of the transfer students received average (C) grade at the time of transfer to NIU. Also, 38.6% earned above average (B) grade. Only 2% earned excellent (A) grade and the remaining 6.9% earned poor (D) grade. Technical specialty (TECSPLTY) had a mean of 2.694 and a standard deviation = .598.

Community college grade point average (CCGPA). While no transfer student earned a 4.0 GPA at the time of transfer, 32.7% earned a 3.0 GPA or above in the lower-division (community) college program before transferring to NIU. Also 65.3% of the transfer students

earned 2.0-2.99 GPA, and 2% earned below a 2.00 GPA at the time of transfer. The overall mean grade point average (CCGPA) earned by all students was 2.654 with a standard deviation of .470.

Grade(s) earned in mathematics (MATH). Only 7.4% transfer students earned an excellent (A) grade in mathematics in their lower-division program before transferring to NIU. While 21.8% of the students received above average (B) grade, the largest percentage of them (i.e., 38.6%) earned an average (C) grade. The remaining 26.3% received a poor (D) grade in mathematics. About 15 (7.4%) transfer students did not provide any information about their previous academic work in mathematics in the lower-division (community) college program. The mean for grades earned in mathematics (MATH) was 2.688 with a standard deviation of .662.

Grade(s) earned in science (SCIENCE). Of the 202 transfer students included in this study, 4% earned an excellent (A) grade in science at the time of transfer to NIU. Another 24.7% received above an average (B) grade, 29.7% earned an average (C) grade, and 29.2% earned a poor (D) grade in science. The overall mean for grades earned in science was 2.585 and a standard deviation of .708.

Correlation among the variables. Since a large majority of the students were male and only a few students were included in each of the races other than white, the variables of SEX and RACE were excluded from the regression analysis. All the independent variables included were positively correlated with the dependent variables. The correlation ranged from a high of .572 for TECSPLTY to .041 for CCLOCATN.

Multiple regression analysis. The variables which entered the stepwise regression and the order they entered are as follows: TECSPLTY, CCGPA, SCIENCE, MATH, AGE. When all predictor variables were considered jointly, 50.2% of the variance in the dependent variable was explained by the linear combination of the predictor variables. The variable CCLOCATN did not meet the criterion for entering the regression equation.

#### Information Relating to the Research Questions

The next section provides information on the research questions raised in the study.

Question 1. What is the strength of the relationship between the grade earned in a lower-division mathematics course(s) and upper-division academic achievement?

The grade(s) earned in a lower-division mathematics course(s) by transfer students was the fourth highest predictor of academic achievement among the transfer students included in the study. The variable had a partial correlation coefficient = .193. While the relationship is positive, it is between a small and medium effect size. Thus, it is a fair predictor to use in admission screening. This finding extends the results reported by ABET (1986), Bell (1984), Coleman et al. (1984), Robertson (1985), and Turner and Gerardo (1983).

Question 2. What is the strength of the relationship between the grade earned in a lower-division science course(s) and upper-division academic achievement?



This variable had a partial correlation coefficient of .208, indicating a small to medium effect size. The grade earned in a lower-division science is a fairly good criterion to consider for admission screening. These findings are in general agreement with the findings in the literature, that the grade earned in previous academic work (SCIENCE) would suffice as a good predictor of academic achievement (Bell, 1984; Crowl, 1983; Johnson & Mottley, 1986; Martin, 1987; Turner & Gerardo, 1983; Zingg, 1983).

Question 3. What is the strength of the relationship between the grade earned in a lower-division technical specialty course(s) and the upper-division academic achievement?

The technical specialty (TECSPLTY) variable exhibited a partial correlation coefficient of .403. This variable was found to be the best predictor of academic achievement of transfer students who graduated in the upper-division of the Engineering Technology programs at NIU. It has an effect size of medium to large relationship. These findings tend to offer support for the studies conducted by ABET (1986), Baird (1985), Brumback (1987), Marsicano (1975), and Robertson (1985).

Question 4. What is the strength of the relationship between the overall grade point average earned in a lower-division program and the upper-division overall academic achievement?

The overall community college grade point average (CCGPA) earned in a lower-division (community) college program had a mean of 2.654 with a standard deviation of .470. This variable had a partial

correlation coefficient of .269 and was considered to have a near medium effect size. This result tends to support the findings reported by Durio, Helmick, and Slover (1982), Gold (1980), Healy and Mourton (1987), McClure, Wells, and Bowerman (1986), Marsicano (1975), Robertson (1985), Ryckman and Rallo (1986), that GPA is a strong predictor of students' academic achievement.

Question 5. What is the strength of the relationship between selected demographic factors and upper-division academic achievement?

The variable (AGE) entered the stepwise regression analysis in the fifth step with a partial correlation coefficient of .162, showing a little more than small effect size. This finding partially supported the findings reported by Healy and Mourton (1987), Healy, O'Shea, and Crook (1985), Marsh, Parker, and Barnes (1985), McClure, Wells, and Bowerman (1986), that age is a useful predictor of successive academic achievement.

#### CONCLUSIONS

The study of academic achievement of transfer students has revealed findings attributable to the intellectual and nonintellectual variables used in the study. The interpretation of these findings to the research questions justified the following conclusions for NIU.

1. The ability of a transfer student to earn or not earn a degree from the upper-division of the Engineering Technology curricula depends upon a number of factors. As highlighted earlier in the discussion of the topic, academic achievement among transfer students in the upper-

division of Engineering Technology is influenced by both intellectual and nonintellectual factors of a diverse nature. The variables used in this study would be considered by many to be among the strongest factors influencing academic achievement of transfer students. Yet they accounted for about 50% of the variance in the dependent variable, leaving much of the variance unexplained.

2. The grade a transfer student earns in a lower-division mathematics course(s) influences a student's ability to earn a degree from the upper-division of the Engineering Technology programs. The strength of the relationship between grades and academic achievement was between a small and medium effect size level of association. Those transfer students who earned higher grades in their lower-division mathematics courses are more likely to earn a degree from the upper-division Engineering Technology than those who earned poor grades or had no mathematical background.

3. Transfer students who earn higher grades in a science course(s) in a lower-division (community) college program are more likely to earn degrees from upper-division Engineering Technology programs than those who earn lower grades in science course(s). The strength of the relationship between the grade earned in a lower-division science course(s) and the academic achievement of a transfer student was small to medium effect size. It is, therefore, meaningful to conclude that the variable is a fairly good predictor of academic achievement among transfer students. The grade earned in a lower-division science course(s) has a considerable potential for use as

an admission tool to screen transfer students. This conclusion adds to the studies reported by Bell (1984), Crowl (1983), Johnson and Mottley (1986), Martin (1987), Turner and Gerardo (1983), and Zingg (1983).

4. The grade earned in a technical specialty by a transfer student, from a lower-division (community) college, affects the student's ability to earn a degree from the upper-division of Engineering Technology program. This observation was made by Baird (1985), Brumback (1987), Marsicano (1975), and Robertson (1985) in their studies. Certainly the grade earned in a lower-division technical specialty course(s) prepares students for advanced work at the upper-level programs. From Cohen's effect criteria, the strength of the relationship between the grade earned in a lower-division technical specialty and academic achievement in the upper-division of Engineering Technology programs was between the criterion level for medium and large effect size. It is, therefore, concluded that the grade earned in technical specialty course(s) is a very good predictor of academic achievement among transfer students. It should be considered as an admission screening criterion, to ensure that opportunity is not denied to those transfer students who have the ability to earn degrees from the upper-division of Engineering Technology curricula.

5. The overall grade point average earned by a transfer student from the junior college influences the student's ability to earn a degree from the upper-division Engineering Technology curricula in a four-year college. As reported in the findings, the magnitude of relationship between GPA and academic achievement is near the medium

effect size. It is, therefore, concluded that GPA is another viable admission device that could be used to screen transfer students for enrollment in the upper-division Engineering Technology programs. At a time of scarce resources and an increase in the number of programs applicants into the upper-division of Engineering Technology programs, it is imperative that the grade earned in a lower-division (community) college program be used as a screening device for admission purposes. This was also suggested in the studies conducted by Bell (1984), Coleman et al. (1984), Robertson (1985), Turner and Gerardo (1983) and required by ABET (1986).

6. Age of a transfer student exerts only a small influence on the student's ability to earn a degree from the upper-division Engineering Technology curricula in a four-year college. Its strength of the relationship with academic achievement was a little more than small effect size. This suggests that it would not be a useful predictor of academic achievement. If older students stay longer in school, they may have the ability to earn degrees for some reasons other than age. For example, they may earn better grades because they are more mature, may worry less about extra curricular activities, and devote more time to studies. In conclusion, age should not be used as a screening device for admission. The findings of this study do not support the findings reported by Healy and Mourton (1987), Healy, O'Shea, and Crook (1985), McClure, Wells, and Bowerman (1986), and Marsh, Parker, and Barnes (1985), who asserted that age is a useful predictor of academic achievement.

The information in Tables 10 and 11 indicate that it is not enough to use the predictor variables individually to screen transfer students for admission, scholarship, and counselling purposes. It is important to consider them jointly as indicated by the regression model. The implications for this information should be clear to educators, policymakers, admission directors, and teachers both in community colleges and four-year colleges that admit transfer students.

#### RECOMMENDATIONS

The interpretation of the findings and the conclusions of the study warranted the following recommendations:

1. Keeping in mind the predictors of academic achievement and their predictive values indicated in this study, policymakers, educators, counselors, and admission officials responsible for Engineering Technology curricula should consider using lower-division intellectual factors to counsel and select transfer students for enrollment in the upper-division of two-plus-two Engineering Technology curricula. Admission criteria should include intellectual factors such as grades earned in mathematics, science, technical specialty courses, and overall GPA.
2. The findings of this study suggest that there is a very low participation by females and transfer students from minority.

backgrounds in Engineering Technology curricula (see Appendix F). The multiple barriers that have inhibited females and minority youths from pursuing Engineering Technology careers should be identified and systematically eliminated.

3. The information in this study and other studies appears to emphasize that additional research remains to be accomplished. Investigation should be conducted using a broader spectrum of two-plus-two Engineering Technology curricula. Multiple measures of academic achievement of transfer students should be used in future studies. Such measures may help to explain the variability of academic achievement not accounted for by the predictor variables in this study.

4. It was difficult to understand the factors that influence a lack of academic achievement among transfer students in upper-division Engineering Technology curricula. A follow-up investigation should be undertaken to determine why transfer students do not earn their BS degrees. Such a study should be longitudinal in nature, should aid in the understanding of students' problems, and assist in determining how to select and retain students to complete their degrees.

5. In light of the findings of this study, it is recommended that this study be replicated to determine the reliability of the results.

6. As suggested in the literature, it is not sufficient to accept transfer credits from one segment of the lower-division (community) college to another, but it is important and necessary to ascertain

that the credit hours transferred carry with them the necessary skills and competencies expected of transfer students. To accomplish this, a College-Level Academic Skill Test (CLAST) should be established and administered to all students transferring into the upper-division Engineering Technology curricula. Such a test should include, but not be limited to, mathematics, science, and technical specialty. If articulation is to enhance the college transfer function, it should be based on student knowledge and skills as well as on the transfer credits evaluation.



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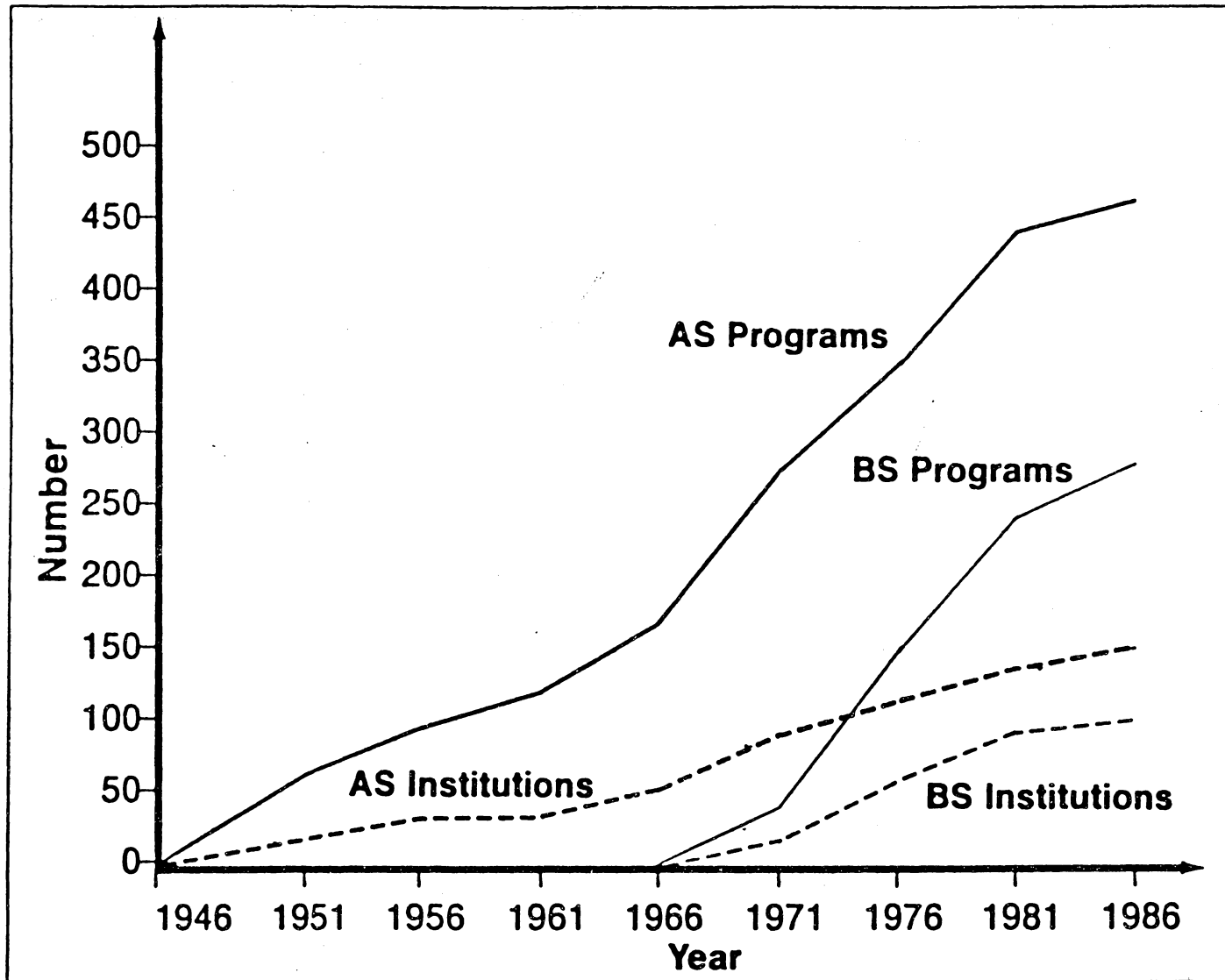
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APPENDIXES

APPENDIX A

HISTORICAL GROWTH OF ACCREDITED ENGINEERING TECHNOLOGY PROGRAMS



*Figure 1. Historical growth of accredited engineering technology programs*

SOURCE: Wolf, L. J.. (1987). The emerging identity of engineering technology. *Engineering Education*, 77(7 & 8), 725-729.



APPENDIX B

DEGREES IN GROWTH FIELDS CONFERRED BY  
U.S. COLLEGES AND UNIVERSITIES, 1982-83

**Table 1. Degrees in Growth Fields Conferred by U.S. Colleges and Universities, 1982-83.**

	<i>Bachelor's Degrees</i>			<i>Master's Degrees</i>
	<i>Total</i>	<i>5-Year Change</i>	<i>10-Year Change</i>	
Architecture, environmental design	9,823	+ 6%	+ 41%	3,357
Business management	226,892	+ 42%	+ 80%	65,319
Communications	36,954	+ 55%	+165%	3,502
Communications technologies	1,648	+ 8%	+360%	102
Computer information sciences	24,506	+240%	+469%	5,321
Engineering	72,248	+ 54%	+ 56%	18,830
Engineering technologies	17,022	+ 94%	+251%	520
Health sciences	61,614	+ 9%	+ 93%	17,068
Law	1,099	+ 68%	+132%	2,091
Multi/indisciplinary studies	17,282	+ 8%	+ 43%	2,930
Physical sciences	23,405	+ 2%	+ 13%	5,290
<b>All fields</b>	<b>969,504</b>	<b>+ 5%</b>	<b>+ 5%</b>	<b>289,921</b>

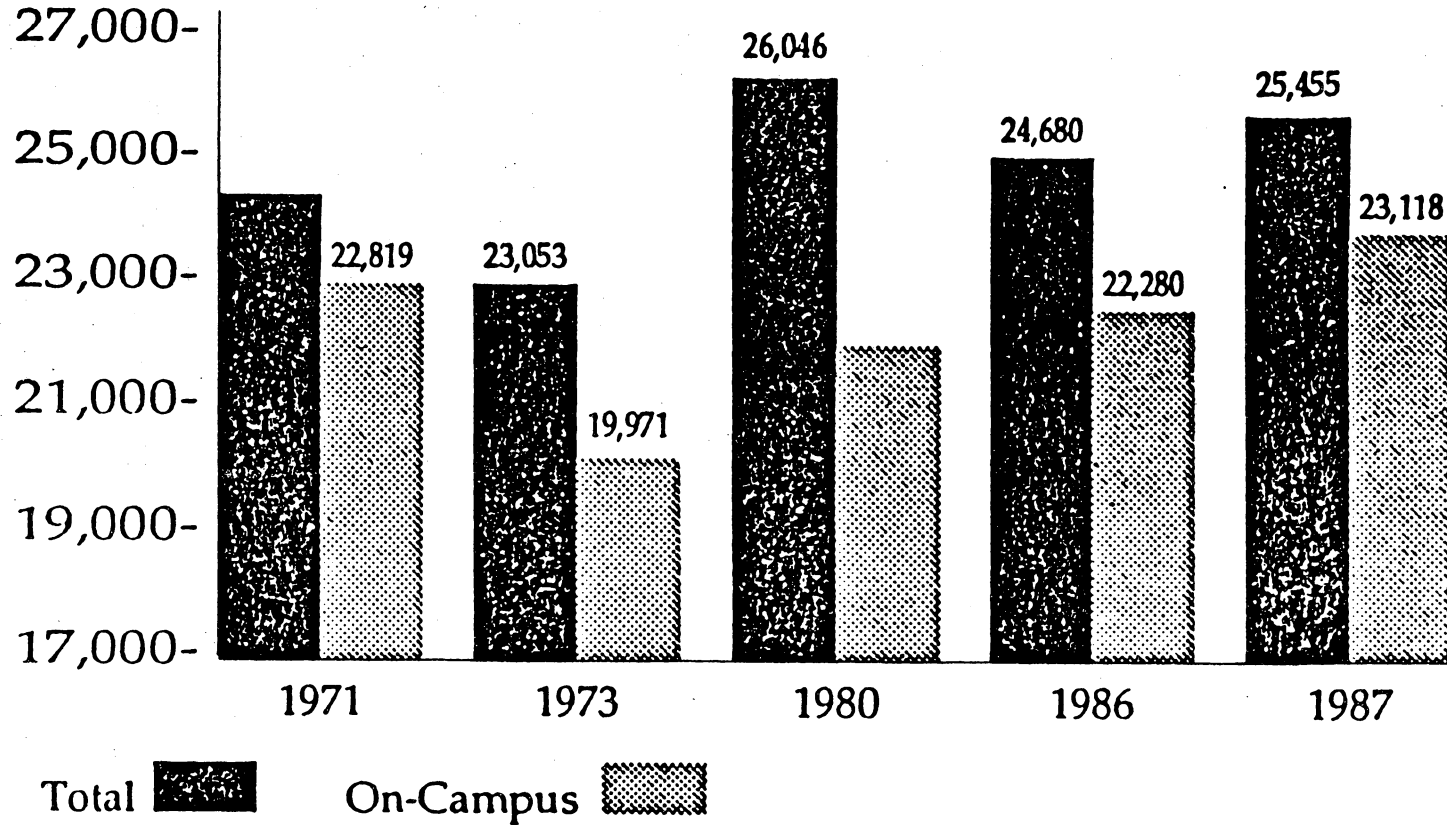
Source: National Center for Education Statistics

APPENDIX C

TOTAL AND ON-CAMPUS ENROLLMENT

FOR UNDERGRADUATE AND GRADUATE STUDENTS FALL 1971 - 1987

## Total and On-Campus Enrollment for Undergraduate and Graduate Students Fall 1971 - 1987

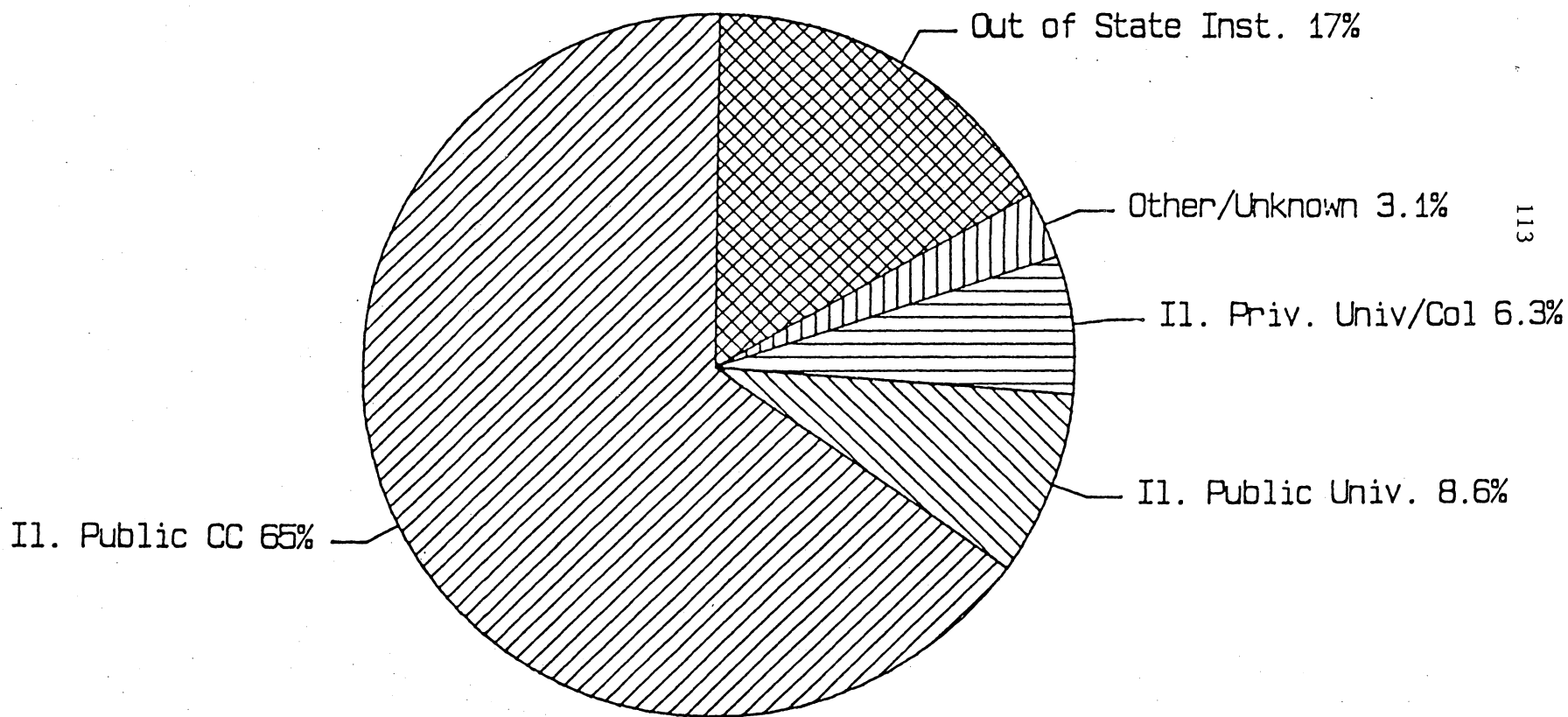


SOURCE: Renner, M. (1987). NIU enrollment at all-time peak. Northern Star, 87(101), 1.

APPENDIX D

NEW UNDERGRADUATE TRANSFERS  
BY INSTITUTION TYPE FALL 1986

# NEW UNDERGRADUATE TRANSFERS BY INSTITUTION TYPE FALL 1986



SOURCE: Office of Institutional Research, NIU. (1986). Student Profile, Fall 1986.

APPENDIX E

NATIVE AND TRANSFER STUDENTS BY CLASS  
ON-CAMPUS UNDERGRADUATES FALL 1985 AND 1986

TABLE III. B. 1.  
NATIVE AND TRANSFER STUDENTS BY CLASS  
ON-CAMPUS UNDERGRADUATES  
FALL 1985 AND 1986

	<u>FALL 1985</u>				<u>FALL 1986</u>			
	<u>NATIVE</u>		<u>TRANSFER</u>		<u>NATIVE</u>		<u>TRANSFER</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
FRESHMEN	5,095	95.2%	255	4.8%	4,775	96.8%	160	3.2%
SOPHOMORE	2,378	70.1%	1,015	29.9%	2,718	72.3%	1,043	27.7%
JUNIOR	2,053	48.3%	2,199	51.7%	2,075	46.7%	2,372	53.3%
SENIOR	2,200	48.2%	2,365	51.8%	2,198	47.4%	2,439	52.6%
POST-GRADUATE AND UNCLASSIFIED	92	26.4%	256	73.6%	96	29.4%	230	70.6%
TOTAL	11,818	66.0%	6,090	34.0%	11,862	65.5%	6,244	34.5%

SOURCE: Office of Institutional Research, NIU. (1986). Student Profile, Fall 1986.



APPENDIX F

NEW UNDERGRADUATE TRANSFERS BY CLASS  
AND INSTITUTION TRANSFERRED FROM FALL 1986

NEW UNDERGRADUATE TRANSFERS BY CLASS & INSTITUTION TRANSFERRED FROM

FALL 1986

<u>INSTITUTION</u>	<u>FRESHMAN</u>	<u>SOPHOMORE</u>	<u>JUNIOR</u>	<u>SENIOR</u>	<u>UNCLASS. UNG.</u>	<u>TOTAL</u>
<u>PUBLIC UNIVERSITIES</u>						
<u>BOARD OF GOVERNORS</u>						
CHICAGO STATE UNIVERSITY	1	0	0	1	0	2
EASTERN ILLINOIS UNIVERSITY	1	8	10	1	4	24
NORTHEASTERN ILLINOIS UNIVERSITY	1	5	3	1	0	10
WESTERN ILLINOIS UNIVERSITY	2	17	8	7	6	40
<u>BOARD OF REGENTS</u>						
ILLINOIS STATE UNIVERSITY	1	7	11	4	5	28
SANGAMON STATE UNIVERSITY	0	0	1	0	0	1
<u>SOUTHERN ILLINOIS UNIVERSITY</u>						
CARBONDALE	0	4	9	3	2	18
EDWARDSVILLE	0	1	2	0	0	3
<u>UNIVERSITY OF ILLINOIS</u>						
CHICAGO CIRCLE	4	8	16	3	2	33
URBANA/CHAMPAIGN	4	16	13	2	5	40
	--	--	--	--	--	--
TOTAL PUBLIC UNIVERSITIES	14	66	73	22	24	199
<u>PUBLIC COMMUNITY COLLEGES</u>						
BLACK HAWK COLLEGE - EAST	0	2	1	0	0	3
BLACK HAWK COLLEGE - QUAD CITIES	2	8	15	1	0	26
BELLEVILLE AREA COLLEGE	0	0	1	0	0	1
CARL SANDBURG COLLEGE	0	0	1	0	0	1
CCC-CITY WIDE COLLEGE	0	2	3	1	0	6
CCC-HARRY S. TRUMAN COLLEGE	0	1	3	1	0	5
CCC-LOOP COLLEGE	1	4	2	0	0	7
CCC-OLIVE HARVEY COLLEGE	0	0	3	0	0	3
CCC-RICHARD DALEY COLLEGE	2	9	8	0	0	19
CCC-WILBUR WRIGHT COLLEGE	2	3	2	1	0	8
COLLEGE OF DUPAGE	9	81	143	5	8	246
COLLEGE OF LAKE COUNTY	6	36	47	1	1	91
DANVILLE AREA COMMUNITY COLLEGE	0	0	1	0	0	1
ELGIN COMMUNITY COLLEGE	3	22	58	1	3	87
FRONTIER COMMUNITY COLLEGE	0	0	1	0	0	1
HIGHLAND COMMUNITY COLLEGE	0	8	24	2	1	35
ILLINOIS CENTRAL COLLEGE	0	5	15	0	0	20

TABLE III. B. 2. B.

NEW UNDERGRADUATE TRANSFERS BY CLASS & INSTITUTION TRANSFERRED FROM (CONT.)

<u>INSTITUTION</u>	<u>FRESHMAN</u>	<u>SOPHOMORE</u>	<u>JUNIOR</u>	<u>SENIOR</u>	<u>UNCLASS. UNG.</u>	<u>TOTAL</u>
<u>PUBLIC COMMUNITY COLLEGES (CONT.)</u>						
ILLINOIS VALLEY COMMUNITY COLLEGE	2	13	31	0	4	50
JOHN A. LOGAN	1	0	1	0	0	2
JOHN WOOD COMMUNITY COLLEGE	0	0	1	0	0	1
JOLIET JUNIOR COLLEGE	8	19	38	1	1	67
KANKAKEE COMMUNITY COLLEGE	0	2	3	0	0	5
KISHWAUKEE COLLEGE	1	18	61	3	5	88
LAKE LAND COMMUNITY COLLEGE	0	1	1	0	0	2
LINCOLN TRAIL COLLEGE	0	0	1	0	0	1
MCHENRY COUNTY JUNIOR COLLEGE	5	22	30	1	0	58
MORAIN VALLEY COMMUNITY COLLEGE	3	42	48	2	1	96
MORTON COLLEGE	0	7	10	0	0	17
OAKTON COMMUNITY COLLEGE	2	29	25	1	0	57
PARKLAND COLLEGE	0	1	1	0	0	2
PRAIRIE STATE COLLEGE	1	3	7	0	0	11
ROCK VALLEY COLLEGE	3	33	79	6	4	125
SAUK VALLEY COLLEGE	2	9	15	2	4	32
SPOON RIVER COLLEGE	0	0	1	0	0	1
THORNTON COMMUNITY COLLEGE	2	8	18	0	0	28
TRITON COLLEGE	1	30	27	1	1	60
WAUBONSEE COMMUNITY COLLEGE	5	18	47	3	1	74
WM. RAINEY HARPER COLLEGE	3	57	106	2	4	172
	--	---	---	--	---	-----
TOTAL PUBLIC COMMUNITY COLLEGES	64	493	879	35	38	1,509
<u>PRIVATE, MULTIPLE PURPOSE INSTITUTIONS</u>						
AUGUSTANA COLLEGE	3	3	2	0	0	8
AURORA UNIVERSITY	1	1	1	1	0	4
BARAT COLLEGE	0	0	1	0	0	1
BLACKBURN COLLEGE	1	0	0	0	0	1
BRADLEY UNIVERSITY	0	4	4	0	1	9
COLLEGE OF ST. FRANCIS	0	2	2	0	2	6
COLUMBIA COLLEGE	1	3	0	0	0	4
CONCORDIA COLLEGE	0	1	0	0	0	1
DEPAUL UNIVERSITY	4	1	1	1	1	8
ELMHURST COLLEGE	0	5	1	0	2	8
EUREKA COLLEGE	1	0	0	0	0	1
GEORGE WILLIAMS COLLEGE	2	1	2	1	0	6
ILLINOIS BENEDICINE	1	4	2	1	0	8
ILLINOIS INSTITUTE OF TECHNOLOGY	1	3	1	0	0	5
ILLINOIS WESLEYAN UNIVERSITY	0	4	0	1	1	6
LAKE FOREST COLLEGE	0	1	0	0	0	1

NEW UNDERGRADUATE TRANSFERS BY CLASS & INSTITUTION TRANSFERRED FROM (CONT.)

<u>INSTITUTION</u>	<u>FRESHMAN</u>	<u>SOPHOMORE</u>	<u>JUNIOR</u>	<u>SENIOR</u>	<u>UNCLASS. UNG.</u>	<u>TOTAL</u>
<u>PRIVATE, MULTIPLE PURPOSE INSTITUTIONS (CONT.)</u>						
LEWIS UNIVERSITY	1	1	2	0	0	4
LINCOLN COLLEGE	0	1	0	0	0	1
LOYOLA UNIVERSITY	2	10	1	0	2	15
MACCORMAC COLLEGE	0	1	1	0	0	2
MACMURRAY COLLEGE	0	1	0	0	0	1
MCKENDREE COLLEGE	0	0	0	0	1	1
MILLIKIN UNIVERSITY	0	0	0	0	1	1
MONMOUTH COLLEGE	0	0	1	0	2	3
MUNDELEIN COLLEGE	0	1	0	0	0	1
NATIONAL COLLEGE OF EDUCATION	0	1	0	0	0	1
NORTH CENTRAL COLLEGE	1	0	1	2	0	4
NORTH PARK COLLEGE & THEOL. SEMINARY	0	0	1	0	0	1
NORTHWESTERN UNIVERSITY	0	2	3	0	0	5
OLIVET NAZARENE COLLEGE						
QUINCY COLLEGE						
ROCKFORD COLLEGE	0	1	6	2	1	10
ROOSEVELT UNIVERSITY	1	0	2	1	1	5
ROSARY COLLEGE	1	2	0	0	0	3
ST. XAVIER COLLEGE	1	2	0	0	0	3
TRINITY COLLEGE	0	3	3	0	0	6
TRINITY CHRISTIAN COLLEGE	0	2	1	0	0	3
	--	--	--	--	--	---
TOTAL PRIVATE, MULTI-PURPOSE	22	60	40	10	15	147
<u>PRIVATE, LIMITED PURPOSE INSTITUTIONS</u>						
ROBERT MORRIS COLLEGE	1	1	0	0	0	2
SCHOOL OF THE ART INSTITUTE	0	1	1	0	0	2
	--	--	--	--	--	---
TOTAL PRIVATE, LIMITED PURPOSE	1	2	1	0	0	4
<u>PROPRIETARY INSTITUTIONS</u>						
DEVRY INSTITUTE OF TECHNOLOGY	0	3	2	0	1	6
	--	--	--	--	--	---
TOTAL PROPRIETARY INSTITUTIONS	0	3	2	0	1	6
TOTAL OUT-OF-STATE TRANSFERS	20	123	114	26	105	388
REMAINING UNKNOWN TRANSFERS	2	0	6	2	54	64
	---	---	-----	--	---	-----
GRAND TOTAL	123	747	1,115	95	237	2,317

NOTE: THESE FIGURES INCLUDE SUMMER AND OFF-CAMPUS TRANSFERS

APPENDIX F

SOURCE: Office of Institutional Research, NIU. (1986). Student Profile, Fall 1986.

APPENDIX G

TRANSFER OF COLLEGE COURSE CREDIT

# **Chapter I**

## **Transfer of College Course Credit**

APPENDIX G

## Acceptance of Transfer Credit

*(This section contains rules governing transferability of credit not only from Illinois public community colleges, but also rules governing transfer credit in general.)*

Northern Illinois University will accept credit in transfer from any regionally accredited college or university if the courses to be transferred are part of a baccalaureate program. Courses which schools consider to be vocational/technical or remedial are accepted as part of NIU's undergraduate degree programs *only* in those cases where departments at NIU have approved particular courses for transfer.

Specifically, the following policies apply:

1. Illinois public community colleges: NIU considers any course baccalaureate-oriented if the Illinois Community College Board has approved and funded the course as baccalaureate-oriented.
2. Private and out-of-state community or junior colleges: Courses are accepted in transfer if, in the judgment of the credit evaluator, the course is consistent with the objectives of a baccalaureate program, *i.e.*, not vocational or remedial in nature. Such decisions are, of course, subject to review on the basis of information received after the initial evaluation has been made.
3. Baccalaureate-granting institutions: All courses are accepted in transfer except where specifically designated as components of vocational, technical, or remedial curricula.

Transfer work earned at any college or university accredited by a regional agency will be accepted, provided that all other standards of acceptance have been met as detailed in this handbook and the university catalog. Work from unaccredited institutions may be accepted insofar as the university judges it applicable to a baccalaureate program.

Applicants who have attempted up to and including 12 semester hours of credit will be treated as freshmen for admission purposes and must meet the requirements for admission as freshmen. The grade point average earned for the attempted 12 hours or less will not affect the admission decision. (This policy has been developed to encourage good students to take advantage of local postsecondary educational opportunities, either during their senior year in high school or during the summer before NIU enrollment, without jeopardizing their admission to Northern.)

Applicants who have attempted more than 12 semester hours but who have earned fewer than 30 semester hours of transferable college level credit at the time of application must:

1. Have an overall "C" average from all colleges attended (as computed by NIU standards).
2. Be in good standing at the last college attended.
3. Meet requirements for admission of freshmen.

Applicants who have earned 30 or more semester hours of transferable college-level credit at the time of application must:

1. Have an overall "C" average or better from all colleges attended (as computed by NIU standards).
2. Be in good standing at the last college attended.
3. Meet Northern's freshman entrance criteria  
**or**  
have completed in their 30 or more hours prior to enrollment, Northern's requirements in English, mathematics, and oral communication.

Provisional admission may be granted to applicants who indicate any courses in progress necessary for completion of these basic skills requirements.

## Transfer Credit and Grades

Eligibility to enter NIU is based in part on a "C" grade-point average for all transferable college work attempted. Thus, a student who has attended two schools prior to NIU may balance a below "C" performance at one school with a higher grade point average at another school to gain admission. However, a student who has been admitted will receive credit only for those courses which average to a "C" at *each* institution. In other words, only those "D" grades will transfer which are balanced by a sufficient number of "A's" and "B's" to bring the student's average at each school up to a "C."

Repeated courses which will not be transferred to NIU are not used in calculating the grade point average to determine which courses will transfer nor are they used in calculating eligibility for admission. (See section on repeated courses below.)

If a continuing NIU student takes course work at another college or university which averages to less than a "C," the work in which a grade of "C" or better was earned will transfer. (Continuing NIU students wishing to take a course at another college or university should consult NIU's concurrent enrollment policy at the end of this chapter.)

Overall and major grade point averages are calculated using only Northern courses. Once a student has been admitted to Northern Illinois University and receives the appropriate amount of transfer credit, no further calculation will be made of the transfer credit and grades. However, calculation of grade point averages for certain limited admission programs may be based on both transfer and Northern course work. Nonetheless, standards governing academic probation and dismissal, graduation, and receipt of degrees with distinction are based on grades of NIU work only.

## "N" Grade

If it appears from the sending college's transcript key or catalog that an "N" (no credit) grading symbol may be equated with academic failure of a course (*i.e.*, no other symbol is provided indicating failure or the "N" may encompass an "F" along with other attendance and grading symbols), it will be counted as an "F" and used in calculating the grade point average for determining admission eligibility. The same holds for any other symbol which is used by a college in a similar manner.

## Repeated Courses

The calculation of the grade point average for admission will not count repeated courses for which the student received a grade of "C" or better in the first attempt, nor will such courses be accepted for transfer credit. In those situations where a student has repeated a course for which she or he earlier earned a "D" or "F" grade, the second attempt only will be utilized for the above purposes.

The evaluation of transfer credit will give the student the benefit of the doubt in identifying repeated courses. Courses will be identified as repeats only if they fall into one of the following categories:

1. The same course (by title or number, or both) has been taken more than once at the same institution.
2. A course taken at NIU was previously credited to the student on the transfer evaluation.
3. Two courses, taken at two different institutions besides NIU, are obviously identical. If a credit evaluator determines that one course is a repeat of another course and the student disagrees, the student is responsible for providing evidence that the courses were different in content. The chair of the appropriate NIU department or a designated representative will be the final judge of any disputed cases.

A student may repeat at NIU a course for which credit was earned elsewhere. However, when the student does, the student forfeits any transfer credit granted for the equivalent or substitute course taken at another college or university.

If a student is transferring to Northern with an A.A. or A.S. degree from an Illinois public community college, courses which were repeated at and accepted by the degree-granting college toward the degree also will transfer to NIU (see Chapter II—The Community College Compact).

A student who receives a grade of "D" in a course which substitutes for NIU's ENGL 103 and repeats the course either at the original institution or NIU with a grade of "C" or better will not be required to pass the qualification examination in written English.

Similarly, an individual who earns a grade of "D" in a course which substitutes for NIU's COMS 100 and repeats the course at the original institution or NIU with a grade of "C" or better will have satisfied the relevant requirement for teacher certification under NIU's entitlement program.

## Limit on Hours Transferable to NIU

Students may transfer up to 66 academic semester hours and 4 semester hours of physical education activity credit (or 99 quarter hours plus 6 quarter hours of physical education activity credit) from a community college. Students transferring to NIU under the compact agreement with Illinois public community colleges also are subject to this limit.

Credit transferred from an approved community college to apply to majors within the College of Engineering and Engineering Technology is limited only by the following provision: the student must earn at least 60 semester hours required for the degree at the university or at any other accredited four-year college or university after attaining junior standing. However, students must meet the residence requirements for a degree from Northern Illinois University that apply to all students.

Possible exceptions to this requirement will be routed through the regular appeals procedure for other university academic regulations. This procedure is initiated in the office of the student's major college.

When a student has earned more than the maximum allowable hours from a community college prior to transferring, the credit evaluator located in the Office of Admissions will select the courses for transfer which seem to be most important to the student's educational program. Any student who disagrees with this selection should consult with the evaluator with regard to selecting other courses for transfer within the stated limit.

After enrollment at Northern a student who has transferred the maximum allowable credit from community colleges may substitute additional community college courses for courses previously transferred (with no increase in total hours), only with the approval of the student's major college office.

## Transfer of Credit Earned on a Non-Semester Basis

**Quarter hours:** Transfer work which is calculated in quarter hours will be converted to semester hours by multiplying the number of quarter hours by 2/3.

**Trimester hours:** Trimester hours have the same value as semester hours.

**Units of Credit:** Units of credit are usually worth 3 or 4 semester hours, with the exact value designated in the explanatory notes accompanying the transcript. Units not defined in the transcript key or in the school's catalog will be credited at 3 1/3 semester hours per unit.

**Old NIU credits:** NIU credit earned when NIU was on the quarter system carries the same value as other quarter hours unless the credit was earned prior to the fall quarter 1930. Credit earned prior to that time was worth 5/8 semester hour for each quarter hour earned.

## Adjustments to Evaluations of Credit

The evaluation of credit is an agreement between the university and the student which is binding on both parties after the student's first semester at NIU. During the first semester errors may be corrected and the chair of the student's major department or a designated representative may make adjustments in the application of transfer credit to the student's major. If an error in the evaluation is discovered after the student's first semester of attendance, it will be corrected only if the student consents to the correction.

The chair of the student's major department is the final authority in questions of the applicability of transfer credit to major field requirements.

## Concurrent Enrollment

Students are considered to be "concurrently enrolled" if:

- a. they are enrolled at NIU and another school, and
- b. their course(s) at the other school meets at any time during the semester they are also enrolled at NIU.

Students enrolled in more than two courses at NIU during a fall or spring semester (more than one during summer session) must obtain written approval from the dean (or a designee) of their major college prior to enrolling concurrently at another school. If they do not do so, they will not receive transfer credit for the course(s) taken at another school.



APPENDIX H

THE COMMUNITY COLLEGE COMPACT AGREEMENT

# **Chapter II**

## **The Community College Compact Agreement**

APPENDIX H

### Terms of the Agreement

Graduates of baccalaureate-oriented associate degree programs from Illinois public community colleges will be admitted to NIU with junior standing. Their general education requirements will be considered complete. Former NIU students who have earned the baccalaureate-oriented associate degree may be readmitted to NIU on the same basis, subject to the limitations detailed later in this chapter.

It must be emphasized that this policy is a basis for admission or readmission only. **No student who earns the associate degree while enrolled at Northern will be eligible for the academic benefits of the compact agreement.**

A student who received either the A.A. or A.S. degree and enrolled at another two- or four-year college or university prior to entering NIU will be granted the same benefits as a student who came to the university directly from the community college, provided admission criteria are met.

Any applicants who have previously been visiting students at Northern from an Illinois public community college must file a petition with their major college for compact benefits. It is expected that the students who petition will have met the basic minimum grade point average and other requirements for the associate degree from their community college, considering all course work taken prior to receipt of the degree.

### Additional Benefits

Any course which is not baccalaureate-oriented as defined in Chapter I will transfer to NIU if it was counted toward the baccalaureate-oriented associate degree by the granting community college. NIU considers a course to be part of the baccalaureate-oriented degree program if it meets at least one of the following criteria:

1. The course is needed to give the student the minimum number of hours required for the associate degree.
2. The course is necessary for completion of the general education requirements of the associate degree program.
3. The course is necessary for completion of some other requirement of the associate degree program.

Any courses in which a grade of "D" was earned which would not ordinarily transfer to NIU will transfer for the graduate of such a program if they were included in the courses required for the A.A. or A.S. degree.

Courses which were repeated at and accepted by the degree-granting community college required for the degree also will transfer to NIU.

The compact agreement applies only to students who are in one of the following categories:

1. New transfer students who first enrolled at NIU in the fall semester 1972 or later.
2. Reentering students who earned the associate degree after leaving NIU and before reentering and who reentered in the spring semester 1973 or later.

### The Compact Agreement for Readmitted Students—Additional Benefits

A former student who left NIU in good standing, has been away from NIU for at least a fall or spring semester, and reenters with the baccalaureate-oriented associate degree from an Illinois public community college will be granted the same academic benefits as community college graduates new to NIU if:

1. The student left Northern with fewer than 60 semester hours of credit.
2. The student has completed no more than 80 semester hours (including NIU work and all transfer work) at the time of reentry.

In addition to receiving the benefits listed above such a student reentering Northern will also begin a new NIU grade point average. A student not wishing to have the benefits granted to Illinois public community college graduates, which include a new grade point average, must inform the Office of Admissions of this at the time of reentry. **Note:** Students leaving Northern Illinois University on academic probation are not in good standing.

A former NIU student who was academically dismissed and who has since graduated from an Illinois public community college with a baccalaureate-oriented associate degree will be granted the same academic benefits as a community college graduate new to NIU, if the following conditions are satisfied:

1. The student had completed fewer than 60 semester hours prior to being dismissed from NIU,
2. The student has completed no more than 80 semester hours (including NIU work and all transfer work) at the time of reentry, and
3. The student has been away from Northern for a fall or spring semester.

The student will return to NIU on final academic probation.

### Applicants for Teacher Certification

All undergraduate students who wish to enroll in any of the NIU teacher education programs will be required to qualify by passing the College of Education Pre-Professional Skills Tests prior to entry to teacher education. These tests will include reading, writing, and mathematics. Information about the tests is available in the Office of Clinical Education and Student Services, 146 Gabel Hall. Students must register for the College of Education Pre-Professional Skills Tests in the Office of Testing Services, Altgeld Hall 125.

Illinois public community college graduates who plan to seek teacher certification in the state of Illinois through NIU's entitlement program should be aware that, while the baccalaureate-oriented associate degree satisfies the university's general education requirements for graduation, additional general education courses may be required for teacher certification. Specific general education requirements for teacher certification are outlined in Chapter VII of this handbook.

APPENDIX I  
TRANSFER CREDIT AND GENERAL EDUCATION

# **Chapter III**

## **Transfer Credit and General Education**

APPENDIX I

### Guidelines

Students entering or reentering NIU without the benefits of the community college compact agreement must meet NIU's general education requirements.

The following guidelines were developed as a method of selecting the transfer courses for general education which are most consistent with the concept of general education upon which the NIU course selections are based:

#### 1. University requirements:

- a. **English 103 and 104:** Any legitimate two-semester sequence of freshman English courses will transfer to meet these requirements. Transfers from schools on the quarter system must have (a) a three-quarter sequence of freshman English or (b) a two-quarter sequence for which each course carries four-quarter hours of credit.
- b. **Communication Studies 100** (formerly Speech-Communication 100): Any introductory speech course similar to Northern's COMS 100 (formerly Speech 100) covering theory and performance in public speaking, discussion, and interpersonal communication will satisfy this requirement.
- c. **Mathematics:** Only a course which has been evaluated as an acceptable substitute for one of the approved NIU courses in this area will satisfy the requirement. These NIU courses are MATH 110, MATH 120, MATH 155, MATH 201, MATH 210, or MATH 229 (MATH 229 may *not* be counted as meeting both the university and science area requirements).
- d. **Senate Bill 195 Requirements:** Chapter 122, Section 27-3 of the Illinois School Code requires evidence of knowledge of the Declaration of Independence, the constitutions of the United States and the state of Illinois, balloting procedures, and the proper use and display of the flag.

#### 2. Humanities (9 semester hours):

The courses in this area must be distributed among the following schools/departments:

- a. **Art:** Art appreciation and art history survey courses will be accepted for general education credit; studio art courses and specialized art history courses will *not* count in general education.
- b. **Communication Studies:** Any lower-division course in speech which is historically or theoretically oriented rather than skill-oriented will count in the humanities area of general education.
- c. **English:** Introductory, lower division genre courses and surveys of English or American literature will count in general education, as will general "introduction to literature" or "world literature" courses. Courses in individual authors, specific periods of literature, advanced composition, creative writing, or linguistics will *not* count in humanities.
- d. **Foreign language:** Only courses in classical mythology, in Russian culture, or in the Italian Renaissance count for general education humanities credit.
- e. **History:** Western civilization survey, American history survey, Asian history, or world history will count in general education; upper division specialized history courses will *not* count.

f. **Music:** Music appreciation will count in general education. Music history, theory, or performance courses will *not* count.

g. **Philosophy:** Introductory courses in philosophy and basic logic, introduction to ethics, "contemporary issues" courses, and history of philosophy survey courses will count in general education. Specialized courses such as metaphysics, epistemology, or courses in particular philosophical movements or periods in the history of philosophy will *not* count.

h. **Theatre:** Any introductory course to theatre or theatre arts will count in general education; acting, directing, costume, makeup, or other "skills" courses in theatre will *not* count.

i. **General humanities:** A course offered by a general humanities department or division will count as a one-department course under the humanities area of general education. However, if a student has taken 6 or more semester hours of course work in a general humanities department or division, this will be considered a two-department distribution relative to Northern's three-department distribution requirement in humanities.

#### 3. Science (7 semester hours):

a. Any transfer course in chemistry, geology, or physics which is freshman or sophomore level and of an introductory or survey nature (as opposed to technical or skill-oriented) will count in the science area. Physical geography courses meeting these two criteria will also count in the science area.

b. **Biological Sciences:** Introductory college level courses that are of a general nature and therefore include a broad coverage of the field of biology will ordinarily transfer as science electives. If a student is transferring a two-semester or three-quarter sequence of "general biology," science elective credit will ordinarily be assigned to the entire sequence. General botany and/or general zoology courses will transfer as science electives. Specifically *excluded* as science electives are courses in anatomy and physiology, microbiology, genetics, heredity and evolution, morphology, embryology, natural history, field biology, and other specialized courses.

c. **Mathematics:** Mathematics courses which have been evaluated as acceptable substitutes for the NIU courses: MATH 110, MATH 120, MATH 155, MATH 201, MATH 210, and MATH 229, are acceptable for meeting the NIU general university mathematics requirement. Mathematics courses which have been evaluated as acceptable substitutes for the NIU courses: MATH 130, STAT 208, CSCI 205, and MATH 229 can be counted toward the fulfillment of the science area requirement. However, MATH 229, Calculus I, may not be counted as meeting both science area and university requirements.

**4. Social Sciences** (6 semester hours):

The courses in this area must be distributed between two departments. Any introductory or general course in anthropology, economics, political science, psychology, sociology, or social science at the freshman or sophomore level will count in general education. Cultural or regional geography courses will also count in this area.

A course offered by a general social sciences department or division will count as a one-department course under the social sciences area of general education. However, if a student has taken 6 or more semester hours of course work in a general social sciences department or division, this will be considered a two-department distribution relative to Northern's two-department distribution requirement in social sciences.

**5. Special** (3 semester hours):

The only transfer courses which will count in this area are those evaluated as acceptable substitutes of NIU courses approved in the special area. The most common acceptable substitutes will be courses in Humanistic Botany (BIOS 101), Consumer Economics (BEAS 215), Nutrition and Food Selection (HFR 100), Personal Development and the Family (HFR 180), Scientific Basis of Human Activity (PHED 100), Mass Communication (COMS 151), Persuasive Campaigns (COMS 204), and Education as an Agent for Change (LEFE 201).

**General Education Requirements**

The following general education requirements will become effective in the fall of 1986. Any transfer students who enrolled in a community college prior to the fall of 1986 will come in under the old general education requirements (see "Choice of Catalog" in Chapter V).

**1. Core Competency Requirements** (0-12 semester hours):

- The sequence ENGL 103 and ENGL 104, or, if exempt from this sequence, ENGL 105.
- COMS 100 (unless exempted).
- MATH 101 (Students admitted prior to the fall of 1988 will be allowed to fulfill the mathematics competency by satisfactorily completing MATH 120) or obtain at least a C in MATH 155, MATH 201, MATH 210, MATH 211, or MATH 229.

**Core Competency Course Titles**

- COMS 100, Fundamentals of Oral Communication (3)
- ENGL 103, Rhetoric and Composition I (3)
- ENGL 104, Rhetoric and Composition II (3)
- ENGL 105, Rhetoric and Composition (3)
- MATH 101, Core Competency in Mathematics (3)
- MATH 155, Trigonometry and Elementary Functions (3)
- MATH 201, Foundations of Elementary School Mathematics I (3)
- MATH 210, Finite Mathematics (3)
- MATH 211, Calculus for Business and Social Science (3)
- MATH 229, Calculus I (4)

**2. Distributive Studies Area Requirements**

(29 semester hours):

All students must satisfactorily complete the following semester hour requirements in the distributive studies areas for a total of 29 semester hours.

- Humanities and the arts, 9-12 semester hours
- Sciences and mathematics, 7-11 semester hours
- Social sciences, 6-9 semester hours
- Interdisciplinary studies, 3-6 semester hours

**a. Humanities and the Arts** (9-12 semester hours):

Students must earn from 9 to 12 semester hours in at least three departments and in more than one college.

Courses in the College of Liberal Arts and Sciences are designated as ANTH, COMS, ENGL, FLCL, FLIT, FLRU, HIST, and PHIL. Courses in the College of Visual and Performing Arts are designated as ART, MUSC, THEA, and TH-D.

- ANTH 102, The Rise of Civilization (3)
- ART 282, Introduction to the Visual Arts (3)
- ART 283, Visual Arts Experiences (3)
- ART 291, Art History Survey I: To 1150 (3)
- ART 292, Art History Survey II: 1150-1700 (3)
- ART 293, Art History Survey III: From 1700 (3)
- ART 294, Art History Survey IV: Arts of the East (3)
- ART 378, Indian and Southeast Asian Art (3)
- ART 385, Pre-Columbian Art (3)
- ART 388B, Ancient Art II: Classical Art (3)
- ART 395, 19th Century Art (3)
- ART 396, Italian High Renaissance Art (3)
- COMS 220, Rhetoric and Public Issues (3)
- COMS 230, Rhetoric and the Media (3)
- COMS 240, Rhetoric of Interpersonal Communication (3)
- COMS 356, Critical Interpretation of Film/Television (3)
- COMS 410, Communication and the Sexes (3)
- ENGL 110, Experience of Fiction (3)
- ENGL 115, Masterpieces of British Literature (3)
- ENGL 116, Masterpieces of American Literature (3)
- ENGL 310, Literary Classics (3)
- ENGL 315, Shakespeare (3)
- FLCL 271, Classical Mythology (3)
- FLIT 272, The Italian Renaissance (3)
- FLRU 261, Russian Culture and Literature (3)
- HIST 110, Western Civilization to 1500 (3)
- HIST 111, Western Civilization: 1500-1815 (3)
- HIST 112, Western Civilization since 1815 (3)
- HIST 140, Asia to 1500 (3)
- HIST 141, Asia since 1500 (3)
- HIST 260, American History to 1865 (3)
- HIST 261, American History since 1865 (3)
- MUSC 220, Introduction to Music (3)
- MUSC 221, Experiencing World Cultures through Music (3)
- MUSC 222, Music in Contemporary Culture (3)
- PHIL 101, Introduction to Philosophy (3)
- PHIL 103, Introduction to Logic (3)
- PHIL 231, Contemporary Moral Issues (3)
- PHIL 342, Philosophy of the Arts (3)
- PHIL 363, Communism, Fascism, and Democracy (3)
- PHIL 364, Philosophical Ideas in Literature (3)
- PHIL 370, Philosophy of Religion (3)
- THEA 203, Introduction to Theatre (3)
- THEA 217, Interpretive Studies (3)
- TH-D 203, Dance and the Fine Arts (3)

**b. Sciences and Mathematics** (7–11 semester hours):

Students must earn from 7 to 11 semester hours in courses taken in at least two but no more than three departments.

ANTH 240, General Physical Anthropology (3)  
 BIOS 103, General Biology (3)  
 BIOS 106, Environmental Biology (3)  
 BIOS 109, Human Biology (3)  
 BIOS 200, Principles of Biology (4)  
 CHEM 110, Chemistry (3)  
 CHEM 110A, Chemistry (4)  
 CHEM 210, General Chemistry (4)  
 CHEM 211, General Chemistry (4)  
 CSCI 205, Introduction to Computing (3)  
 GEOG 101, Survey of Physical Geography (3)  
 GEOG 101A, Survey of Physical Geography (4)  
 GEOG 105, Introduction to the Atmosphere (3)  
 GEOG 105A, Introduction to the Atmosphere (4)  
 GEOL 103, Planetary and Space Science (3)  
 GEOL 104, Introduction to Oceanography (3)  
 GEOL 105, Environmental Geology (3)  
 GEOL 120, Introductory Geology (3)  
 GEOL 120A, Introductory Geology (4)  
 GEOL 121T, Earth History (4)  
 HFR 201, Human Nutrition (3)  
 MATH 130, Excursions into Mathematics (3)  
 MATH 229, Calculus I (4)  
 PHYS 150, Physics (3)  
 PHYS 150A, Physics (4)  
 PHYS 250, General Physics (4)  
 PHYS 250A, General Physics (4)  
 PHYS 251, General Physics (4)  
 PHYS 251A, General Physics (4)  
 STAT 208, Basic Statistics (3)

**c. Social Sciences** (6–9 semester hours):

Students must earn from 6 to 9 semester hours in courses taken in at least two departments.

ANTH 120, Introduction to Anthropology (3)  
 ANTH 210, General Prehistoric Archaeology (3)  
 ANTH 220, General Cultural Anthropology (3)  
 ANTH 230, Anthropology of Language (3)  
 ECON 160, Contemporary Economic Issues (3)  
 ECON 180, World Economic Systems (3)  
 ECON 260, Principles and Problems of Macroeconomics (3)  
 ECON 261, Principles and Problems of Microeconomics (3)  
 GEOG 202, World Regional Geography (3)  
 GEOG 253, Natural Resources and Environmental Quality (3)  
 HFR 230, Child Development (3)  
 POLS 100, American Government and Politics (3)  
 POLS 181, American Foreign Policy (3)  
 POLS 260, Foreign and Comparative Politics (3)  
 POLS 350, Classical and Medieval Political Theory (3)  
 PSYC 102, Introduction to Psychology (3)  
 SOCI 170, Introduction to Sociology (3)  
 SOCI 250, Contemporary Social Institutions (3)  
 SOCI 260, Introduction to Social Psychology (3)

**d. Interdisciplinary Studies** (3–6 semester hours):

Students must earn from 3 to 6 semester hours from the following courses. (Students may not receive general education credit for both AHP 201 and PHED 206.)

AHP 201, Social and Individual Patterns of Alcohol Use (3)  
 ANTH 101, Human Origins (3)  
 ART 288, Modern Art and Film (3)  
 BIOS 101T, Plant Products and Human Affairs (3)  
 HFR 207, The Consumer (3)  
 HFR 280, Human Development, the Family, and Society (3)  
 HFR 406, Global Food and Nutrition Issues (3)  
 HIST 323, History of Science to Newton (3)  
 IDSP 200, Racism in American Culture and Society (3)  
 IDSP 211, Educating for Cultural Sensitivity (3)  
 IDSP 219, Introduction to African Studies (3)  
 IDSP 225, Introduction to Medieval Society and Culture (3)  
 IDSP 290, Drama Into Film (3)  
 IDSP 291, Art and Literature in the Ancient World (3)  
 IDSP 294, Literature and Music (3)  
 ILAS 123, Cultural Pluralism in the United States (3)  
 ILAS 225, Southeast Asia: Crossroads of the World (3)  
 ILAS 230, Women in Contemporary America (3)  
 ILAS 235, Women Across Cultures and Centuries (3)  
 ILAS 325, Introduction to International Relations (3)  
 LDSE 200, Exceptional Persons in Society (3)  
 LEFE 201, Education as an Agent for Change (3)  
 PHED 100, Scientific Basis of Human Activity (3)  
 PHED 111, Sport: Culture and Society (3)  
 PHED 206, Contemporary Health Concepts (3)  
 PHIL 170, World Religions (3)  
 PHIL 353, Philosophical Problems of Social Science (3)  
 PHIL 354, Philosophical Problems of Natural Science (3)  
 PHYS 335, Biophysics (3)

**Applicants for Teacher Certification**

Illinois public community college graduates who plan to seek teacher certification in the state of Illinois through NIU's entitlement program should be aware that, while the baccalaureate-oriented associate degree satisfies the university's general education requirements for graduation, additional general education courses may be required for teacher certification. Specific general education requirements for teacher certification are outlined in Chapter VII of this handbook.



APPENDIX J

TRANSFER OF SPECIAL TYPES OF CREDIT

# **Chapter IV**

## **Transfer of Special Types of Credit**

APPENDIX J

### Proficiency Examinations

Proficiency credit (*including CLEP*) earned at each institution at which the student completed 12 or more semester hours of transferable credit through regular classroom work may be accepted as recorded on the transcript. Entering students who have completed some, but fewer than 12, semester hours of transferable college credit in classroom work in another institution may have any potential transfer credit earned by proficiency reevaluated on the basis of NIU's standards for the awarding of proficiency credit.

In both circumstances, however, such credit is reviewed to determine if it fulfills any specific graduation requirements.

### College Level Examination Program (CLEP)

If another school has accepted CLEP examinations, granted baccalaureate credit in a specific course or subject area, and indicated this credit on a transcript of the student's academic record, the credit will be accepted in transfer provided the regulations under proficiency credit (above) are met. If the school which grants the credit is a community college, the CLEP credit will count toward the 66-semester-hour limit of community college transfer credit.

Further, if 6 semester hours of CLEP credit are accepted in transfer to be applied toward either Northern's humanities and the arts or social sciences general education requirements, such will be considered as a two-department distribution.

Once enrolled at NIU, a student may not have CLEP general exam scores sent to a transferring institution for the purpose of getting credit to transfer to the university.

### Correspondence Courses

Correspondence courses from accredited institutions will be accepted subject to the policies governing other types of transfer credit, with the limitation that only 30 semester hours of correspondence credit will be accepted toward a baccalaureate degree from NIU. (NIU does not offer correspondence courses.)

### Credit for Military Experience

A student admitted to NIU who can provide a Form DD214 documenting one full year of active duty in the armed forces of the United States and discharged under honorable conditions will be granted 6 semester hours of credit on entrance. This is evaluated as 4 semester hours of physical education activity courses and 2 semester hours of health. Because of this arrangement, no physical education or health credit granted by another school for military service will be accepted as transfer credit.

Physical education credit earned through military service satisfies the physical education requirement for teacher certification in Illinois.

Credit for military educational experiences may also be granted to veterans entering NIU. The university follows the recommendations of *A Guide to the Evaluation of Educational Experiences in the Armed Services*, published by the American Council on Education. Test scores must be submitted for evaluation of the Military Occupational Speciality. Submission of the form DD225 may facilitate evaluation of military course work.

### Community College Data Processing Courses

Unlimited credit will be granted for those data processing courses which are demonstrably equivalent to or accepted as substitutes for NIU course offerings, or when a student passes an appropriate proficiency examination. In addition, up to a maximum of 6 semester hours will be granted for courses which have been evaluated as elective credit. Alternatively, departments teaching computer science or data processing courses may determine that certain courses provide sufficient background to justify exempting transfer students who have taken them from extradepartmental or prerequisite requirements in certain areas of their curricula. No transfer credit will be granted for courses evaluated "N/C."

### Off-Campus Courses (Extension)

Off-campus courses offered by NIU constitute part of the student's academic load and are counted in the NIU grade point average. They may be used to meet the undergraduate residency requirement for graduation.

### Military Science Courses

Credit from another school in military science will be accepted in transfer to a maximum of 10 semester hours, as elective credit.

### Religion Courses

Religion courses will be accepted in transfer to a maximum of 10 semester hours, as elective credit. Additional credit may be transferred for courses which are evaluated as acceptable substitutes.

### Technical Mathematics and Physics

Specific course credit for technical mathematics and physics courses will be granted only by passing the appropriate proficiency examinations. However, the College of Engineering and Engineering Technology has determined that some of these courses may provide adequate background in mathematics and physics to justify exempting transfer students who have taken these courses from the extradepartmental requirements of Mathematical Sciences (MATH 229) and Physics (PHYS 250-251) in certain areas of their curricula. Majors should contact the College of Engineering and Engineering Technology for specific information.

### United States Armed Forces Institute (USAFI)

Three types of credit are available through USAFI. Each type is treated in a different way by NIU:

1. USAFI credit granted by the self-study method will be accepted by NIU if the student scores at the 50th percentile or above.
2. USAFI correspondence credit will be accepted with a score at the 50th percentile or above, subject to the regulations governing other types of correspondence credit, as detailed earlier in this chapter.
3. USAFI credit by examination is administered by the College Level Examination Program (CLEP) and is transferable only under the regulations governing CLEP credit, as set forth earlier in this chapter.

APPENDIX K  
GRADUATION REQUIREMENTS

# **Chapter V**

# **Graduation Requirements**

APPENDIX K

### Second Bachelor's Degree for Transfer Students

A student with a bachelor's degree from an accredited institution will be eligible to enter NIU to pursue a second bachelor's degree in another major department. All credit counted toward the student's first degree will be transferred to NIU and general education requirements will be considered satisfied. Specific courses will be evaluated only in reference to the student's major or in reference to teacher certification requirements, if applicable.

Such a student will be admitted as a postgraduate through the Office of Admissions. The following requirements must be met for graduation:

1. Being admitted to NIU.
2. Earning 30 semester hours of undergraduate credit in residence at NIU.
3. Fulfilling all requirements for a major other than the first major and all degree requirements.
4. Earning 12 semester hours of major departmental requirements in courses numbered at the 300 and 400 level taken at NIU.
5. Fulfilling the state law requirement.

A student may not apply any credit in physical education activity courses toward the 30 semester hours required for a second bachelor's degree.

### Junior- and Senior-Level (Upper Division) Credit

Students are required to have a minimum of 40 semester hours of credit at the upper-division level in order to receive a bachelor's degree from NIU. These must include at least 12 semester hours of *major departmental courses* taken at Northern. A course accepted in transfer may be used to meet this requirement if it falls under one of the following guidelines:

1. The course has been evaluated as an acceptable substitute for an NIU course numbered 300 or higher.
2. The course is an upper-division course at the previous institution (four-year college or university only).
3. If more than one lower-division transfer course is used to award substitute credit for an NIU course, the upper division credit awarded will be limited to the credit hours of the NIU course.

### Exemptions

Exemptions from required courses at other schools are recognized by NIU if the exemptions are noted on the transcript and if they are relevant to NIU requirements. No course credit is conferred for exemptions.

### Choice of Catalog

The rules governing catalog choice for different categories of students are given below. However, no student may graduate under a catalog more than five years old, unless specific permission is obtained from the major college in a case where the major program in question is still available as an approved program of study.

The "catalog year" is defined as the year in which the regulations and requirements stated in a particular catalog are first in force. The catalog year begins with the fall semester and extends through the spring semester and summer session. No student may graduate under the requirements of a particular catalog prior to the beginning of the year in which it becomes effective.

#### Transfer Students

Students may choose the NIU catalog which was in effect when they became freshmen at their original school or any later NIU catalog, providing they were enrolled during the catalog year of their choice. (However, they cannot choose an NIU catalog which was in effect more than three years before their admission to NIU.) They may also elect to satisfy all graduation requirements from a single catalog or major and minor requirements from one and general education requirements from a second.

#### Reentering Students

Students reentering NIU after an interruption of more than three years are subject to catalog provisions in effect at the time they reenter. (However, every effort will be made to count earlier courses in the way most beneficial to fulfilling current requirements.)

Students reentering NIU after an interruption of fewer than three years can use the catalog in effect at the time of their original admission to NIU or any later catalog.

Reentering students who have attended other colleges or universities while away from NIU may select a catalog in effect up to three years prior to the term they reenter, providing they were enrolled during the catalog year of their choice.

A student may elect to satisfy all graduation requirements from a single catalog or major and minor requirements from one and general education requirements from a second.

### English Qualification Exam

All students must complete the sequence ENGL 103 and ENGL 104 or, if exempt from this sequence, ENGL 105. Students who earn a "D" in ENGL 103 at NIU or who have earned a "D" in a course evaluated as an acceptable substitute at another institution must either (1) pass a qualification examination in written English, (2) repeat ENGL 103 at NIU earning a grade of "C" or better (see Repeat Courses, NIU *Undergraduate Catalog*), or (3) repeat ENGL 103 (with no gain of credit) at the institution where the "D" was originally earned. Students who earn a grade of "D" in the first quarter of a three-quarter sequence in freshman English will be required to take the exam, regardless of the grades earned in the final two quarters of the sequence. The qualification examination is administered by the Department of English three times each academic year on the second Tuesday of November, April and July. Students may take the examination as many as three times and should complete it successfully before they complete 90 semester hours of course work. If they do not, they may not be allowed to register for further courses at NIU.

### Senate Bill 195 Requirements

Chapter 122, Section 27-3, of the Illinois School Code requires evidence of knowledge of the Declaration of Independence, the constitutions of the United States and the state of Illinois, balloting procedures and the proper use and display of the flag by passing a university test (known as the Senate Bill 195 or constitution test).

This requirement may be fulfilled in the following ways:

1. By presenting a transcript from another Illinois institution of higher education in which the student has been previously enrolled specifically noting that the requirements of Senate Bill 195 have been met.
2. By having passed prior to fall 1977 POLS 100 (The American Political Order), or a course evaluated as an acceptable substitute at another Illinois college or university, or the proficiency examination for POLS 100.

3. By passing the test for Senate Bill 195 offered by the university's Office of Testing Services. (No academic credit is awarded for passage of the test. A study guide and reference to study materials are available from the Office of Testing Services, Altgeld 125.) The Senate Bill 195 test will automatically be given to all students who enroll in POLS 100. Students who earn a passing grade on the test when administered in POLS 100 will be certified by the Office of Testing Services as having fulfilled the Senate Bill 195 requirements for graduation from Northern Illinois University.

A transfer student who has not satisfied this requirement at the time of entrance to Northern should do so by the end of the first year in residence. No charge is made for the first registration for the test; subsequent registrations carry a fee of \$7.00.

### Residence Requirement

Candidates for degrees from Northern must earn their last 30 hours of credit in course work offered by Northern Illinois University. Exceptions to this requirement can be granted, for substantial reasons, by the dean (or a designee) of the student's major college. Approval must be obtained prior to enrollment. Exceptions, however, will still require that at least 30 hours of credit be earned at Northern Illinois University after a minimum of 80 semester hours is earned. Students should check for other residency requirements in their majors under the appropriate departmental listings.

APPENDIX L

COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY



# **Chapter VIII**

## **College of Engineering and Engineering Technology**

**Electrical Engineering  
Industrial Engineering  
Mechanical Engineering  
Technology**

APPENDIX L

### Admission to Engineering and Engineering Technology

The College of Engineering and Engineering Technology limits the total number of students admitted to a major, depending upon the resources available. This limitation applies to all applicants seeking admission to the College of Engineering and Engineering Technology in the engineering majors and technology majors, whether enrolled at Northern Illinois University at the time of application or transferring from another institution. The College of Engineering and Engineering Technology attempts to fulfill societal needs by admitting students from a variety of socioeconomic backgrounds. The admission criteria are applied, however, to ensure that all of the students admitted will have achieved above a predetermined level.

Admission is competitive and is based primarily on GPA in the tool courses and secondarily on overall GPA earned in course work taken at NIU or transferred from other institutions. Transfer students compete with other transfer students for admission to the majors in the College of Engineering and Engineering Technology, and nontransfer students compete with other non-transfer students. Transfer students admitted to the university who have not satisfied the requirements for consideration for admission will be classified as pre-engineering or pre-technology students until they meet the requirements and can apply to the College of Engineering and Engineering Technology to be considered for admission to a specific major or emphasis.

Applicants must meet the following deadlines for completed application to be considered for admission:

Semester	Deadline
Spring 1987	October 1, 1986
Summer 1987	February 15, 1987
Fall 1987	February 15, 1987

Applicants will be notified within four weeks after the deadline for application as to their admission status.

**Note:** Students are advised to review requirements of a specific degree emphasis before making course selections. Students may take courses required in the degree emphasis to be considered for admission to the emphasis.

### Admission Requirements for Technology Majors

All students who have indicated an interest in technology, but have not met all admission criteria, will be classified as pre-technology students. They will be considered for acceptance into departmental programs according to the procedures set forth below, depending on their status as entering transfer or continuing students.

Entering transfer students who indicate on the application for admission to the university that they intend to enroll in a specific emphasis in the Department of Technology need not apply separately to the department. After such students are accepted into the university, their applications will be transmitted to the department for consideration for admission into a particular emphasis. Students should seek departmental advisement at orientation or as soon as they arrive on campus.

Continuing NIU students apply directly to the department for admission into a departmental emphasis. Students who have not met the requirements for admission to one of the departmental emphases will remain classified as pre-technology and may make application when they meet the criteria. To change from one emphasis to another, the student must apply to the department for admission into the new emphasis.

**To be retained as a major in the Department of Technology and the College of Engineering and Engineering Technology, a student must maintain an NIU grade point average of at least 2.00 on a 4.00 scale.**

#### **The Comprehensive Major in Industry and Technology (B.S.Ed.)**

Requirements for the B.S.Ed. degree in this major include the completion of 15 semester hours of course work as indicated in the "Professional Education Requirements for Teacher Certification" section of the Northern Illinois University *Undergraduate Catalog*. A grade of "C" or better must be earned in each of the courses.

#### **The Comprehensive Major in Industry and Technology (B.S.)**

Requirements for the B.S. degree in this major include the completion of five courses to be selected from groups 1 through 4, with at least one course from each group. A grade of "C" or better must be earned in each of these courses.

GROUP 1: MATH 155, MATH 210, MATH 229, MATH 230

GROUP 2: CHEM 110 or CHEM 110A, CHEM 210, PHYS 150A, PHYS 250 or PHYS 250A, PHYS 251 or PHYS 251A

GROUP 3: General education courses in the humanities and the arts and social sciences areas of distributive studies.

GROUP 4: TECH 111, TECH 230, TECH 267, TECH 270 and TECH 270A, TECH 360

**Graphic Arts Technology Emphasis:** To be retained in this emphasis, students must maintain a minimum GPA of 2.20 overall and a minimum of 2.60 in all graphic arts courses at Northern.

## Admission Requirements for Engineering Majors

Pre-engineering students may apply formally to be considered for admission to an engineering major when they have satisfied the following requirements:

1. Completion of a minimum of 41 semester hours of course work with a minimum of 2.00 cumulative gradepoint average (GPA) on a 4.00 scale.
2. Completion of the following courses with a minimum 2.00 GPA.  
 ENGL 103, Rhetoric and Composition I (3), **and**  
 ENGL 104, Rhetoric and Composition II (3), **or**,  
 if the student is exempt from this sequence  
 ENGL 105, Rhetoric and Composition (3).  
 MATH 229, Calculus I (4)  
 MATH 230, Calculus I (4)  
 PHYS 250A, General Physics (4)  
 MEE 210, Engineering Mechanics I (3).

Students who have not yet met the application requirements to a major in engineering will remain classified as pre-engineering and may apply when they meet application criteria.

Prior to their final admission to the College of Engineering and Engineering Technology and entrance into 300- and 400-level engineering courses, students must complete:

1. 65 semester hours with a minimum 2.00 overall grade point average.
2. The following additional courses with a minimum 2.00 gradepoint average:  
 MATH 232, Calculus III (4)  
 CHEM 210, General Chemistry (4)  
 CHEM 211, General Chemistry (4)  
 PHYS 251A, General Physics II (4)  
 CSCI 260A, Computer Programming in FORTRAN (4)  
 MEE 211, Engineering Mechanics II (3)  
 MEE 270, Engineering Graphics (3)  
 ELE 210, Engineering Circuit Analysis I (3)  
 ELE 211, Engineering Circuit Analysis II (3)

Students who fail to meet these final requirements will be returned to a pre-engineering status and must apply for admission to the college for a later semester.

Students may enter sophomore standing as pre-engineering majors only if they have a minimum overall GPA of 2.00; such students must maintain a GPA of 2.00 subsequently in order to remain pre-engineering majors.

APPENDIX M

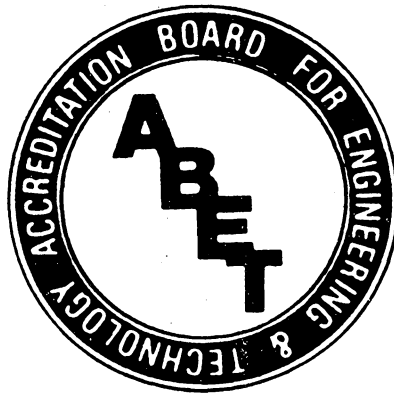
CRITERIA FOR ACCREDITING PROGRAMS  
IN ENGINEERING TECHNOLOGY

# **CRITERIA FOR ACCREDITING PROGRAMS IN ENGINEERING TECHNOLOGY\***

(\*Incorporates all changes approved by the ABET Board of Directors as of November 23, 1986)

*Effective for Evaluations  
During the 1987-1988 Academic Year*

## APPENDIX M



**Accreditation Board for Engineering and Technology, Inc.  
345 East 47th Street  
New York, New York 10017-2397**

# Criteria for Accrediting Programs in Engineering Technology\*

## I. INTRODUCTION

### A. Purposes

The purposes of the Accreditation Board for Engineering and Technology (hereafter referred to as ABET) as related to accreditation are stated in the Constitution as follows:

1. Organize and carry out a comprehensive program of accreditation of pertinent curricula leading to degrees, and assist academic institutions in planning their educational programs.
2. Promote the intellectual development of those interested in engineering and engineering-related professions, and provide technical assistance to agencies having engineering-related regulatory authority applicable to accreditation.

### B. Responsibilities

1. ABET accomplishes its purposes through standing committees or commissions, one of which is the Technology Accreditation Commission (hereafter referred to as TAC or TAC/ABET). The accreditation commissions are charged with the following responsibilities.

- a. The accreditation commissions shall propose policies, procedures, and criteria to the ABET Board of Directors for approval. The Board of Directors shall review policies, procedures, and accreditation criteria and may specify changes to be made in them to the appropriate accreditation commissions.
  - b. The accreditation commissions shall administer the accreditation process based on policies, procedures, and criteria approved in advance by the Board of Directors. The accreditation commissions shall make final decisions, except for appeals, on accreditation actions.
2. Procedures and decisions on all appeals to accreditation actions shall be the responsibility of the Board of Directors.

### C. Objectives of Accreditation

The purposes stated above are basic to accreditation efforts in engineering technology education. Accreditation seeks to attain the following specific objectives:

1. To serve the public, industry, and the engineering profession generally by stimulating the development of improved engineering technology education.
2. To identify for prospective students, student counselors, parents, potential employers, public bodies, and officials, engineering technology programs which meet the minimum ABET criteria in engineering technology.
3. To provide stimulation leading to curricular improvement in existing programs and to assist in the devel-

opment of educational models for establishing new engineering technology programs as increased service to the public interest.

### D. Development

ABET is recognized by the U.S. Department of Education and the Council on Postsecondary Accreditation (COPA) as the sole agency responsible for accreditation of educational programs leading to associate and baccalaureate degrees in engineering technology. In 1944 the Engineers' Council for Professional Development (now ABET) appointed a Subcommittee on Technical Institutes. On October 5, 1964, this subcommittee became a standing committee of ECPD and established a basis for accrediting programs of the technical institute type, now designated as programs in engineering technology. Amendments and additions have from time to time been adopted. The original statement and its amendments and additions are combined here into a unified statement of the policies, methods of evaluation, criteria, and procedures which pertain to the accreditation of engineering technology programs.

### E. Description of Programs

1. Programs to be considered are technological in nature and are in the field of higher education. Instruction is in the broad area of technical education between engineering and vocational education/Industrial technology.

2. The definitions that follow clarify terms used by TAC/ABET.

- a. Engineering Technology is that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. The term "engineering technician" is applied to the graduates of associate degree programs. Graduates of baccalaureate programs are called "engineering technologists."
- b. An engineering technology program is a planned sequence of college-level courses designed to prepare students to work in the field of engineering

*The shaded sections are published for review and comment. Comments will be considered up to May 15, 1987, after which the ABET Board of Directors will determine, with the advice of the TAC and based on comments received, whether the proposed change will be adopted. Comments should be addressed to the Accreditation Director, TAC/ABET, 345 East 47th Street, New York, NY 10017-2397.*

\*Incorporates all changes as of November 23, 1986.

technology. The term "college-level" indicates the rigor and degree of achievement required.

3. Engineering problems require solutions of varying degrees of complexity and are constrained by both technical and non-technical considerations. As the technical leader, the engineer determines the policy basic to technical solutions and exercises responsibility to society in the non-technical dimensions. The technician and the technologist work in many functional and responsive ways to execute the applications indicated by the engineer.

4. Briefly, the differences between educational programs in engineering technology and industrial technology include type of faculty, use of facilities, mathematics and science sequence content, and degree of specialization. More faculty members with professional educational backgrounds appear to staff the present industrial technology programs, whereas a larger number with engineering or technological backgrounds staff the engineering technology programs.

## II. POLICIES

### A. Accreditation Policies

Accreditation of programs in engineering technology is accomplished under the following general policies.

1. TAC/ABET will consider for accreditation programs offered in an institution of higher learning in one of the following categories:

- a. Institutions currently accredited by a regional or national institutional accrediting agency or formally approved by a State authority recognized by the Council on Postsecondary Accreditation (COPA) and/or the U.S. Department of Education.
- b. Institutions holding appropriate approval by a State authority to offer only engineering, engineering technology, or engineering-related programs, or a combination thereof, and not offering programs in any other field or discipline; or other institutions offering programs in engineering technology whose accreditation would further the objectives of ABET.

2. Programs are considered for accreditation action only at the written request of the institution.

3. Only individual programs are accredited, rather than institutions, for it is recognized that programs of different standards and objectives may be found at the same institution. When a multi-campus institution presents programs for accreditation, each campus will be considered as a separate institution in the evaluation process. In order for a program to be accredited, all options, concentrations, or other routes to completion of the program must be accreditable.

#### a. Options

Alternative curricula within a major engineering technology program (commonly called options) leading to a degree in a subfield of the major discipline may be accredited and listed as separate programs at the request of the institution. In such case the option must have been formally designated by

the institution prior to the request for evaluation. It must conform to the criteria and to any program criteria applicable to independent programs in the same curricular area as the option. The accreditation status of the option must be clearly identified and distinguished from any non-accredited options within the same major program, and from any other programs.

#### b. Evening Programs

Evening programs will be accredited separately from regular day programs at the same institution unless the day and evening programs follow the same curriculum, use the same or equivalent laboratory equipment and facilities, are under the supervision and control of the full-time program faculty, and include equal rigor of student work and grading.

4. Accreditation by TAC/ABET is based on meeting differential criteria applicable to programs which lead to the associate degree or to the baccalaureate degree.

5. An evaluation visit for accreditation will be carried out only if students have been graduated from the program prior to the on-site visit. If granted, such accreditation will extend to the graduates of the program in the academic year prior to the visit.

6. Qualitative factors, as well as quantitative factors, are given careful consideration through a visit by an evaluation team of competent personnel appropriately constituted for the curriculum under consideration.

7. Although rigid quantitative standards are not considered sacrosanct, programs are expected to meet the minimum standards delineated in the criteria. Well-planned experimentation and development in engineering technology education are encouraged. Experimental or nontraditional programs will be evaluated against the intent of the minimums established.

8. Such matters of broad institutional function as administration, student personnel services, library, arts and sciences, etc., are considered only with respect to services rendered to engineering technology and are reviewed with different emphasis within institutions with regional accreditation versus those without such accreditation. When an institution not holding regional accreditation is visited, these areas are examined in depth within ABET policy.

9. Accreditation is denied to programs which omit instruction in a significant portion of a subject in which technicians and/or technologists in a particular field may reasonably be expected to have competence. This policy is intended to be a safeguard to the public and should not entail the setting of rigid standards.

10. The institution presents complete data pertinent to a comprehensive evaluation. Information supplied by the institution is for the confidential use of ABET and will not be disclosed without the written authorization of the chief administrative officer of the institution or his/her designee.

11. a. Caution and discretion must be exercised by institutions in all publications and references to avoid ambiguity or confusion among engineer-

ing technology, engineering and engineering-related specialties. TAC/ABET will not accredit a program in engineering technology if the administration and/or faculty improperly use the term engineer or engineering or make claim that the program graduates are qualified as engineers. In any promotional media or institutional bulletin, the institution should not use job entry titles which are normally held by graduates from programs in engineering or engineering-related specialties.

b. Although the selection of program titles is the prerogative of educational institutions, ABET discourages the proliferation of engineering technology program titles, because different titles for essentially the same program are confusing or misleading to the public, including students, prospective students, and employers. Preferred curriculum titles for accredited programs would include the words "engineering technology." No program will be approved for accreditation or reaccreditation unless the word "technology" is used as the final noun in the title.

c. For accreditation to be granted, a program must have a title that is consistent with the curriculum content, and the content must satisfy the ABET criteria and Participating Body criteria applicable in accordance with section IV, as appropriate to that content.

12. A draft visitation report is submitted to the dean or appropriate academic administrator of the institution for comment on the factual elements of the report before accreditation action is taken.

13. The findings and recommendations of the visiting team are submitted for review by the appropriate officers of TAC/ABET and then by the full membership of the Commission. The final decision on accreditation rests with TAC/ABET, except in cases of appeal of not-to-accredit actions, which are the responsibility of the ABET Board of Directors.

14. A list of currently accredited programs is published annually. The accredited status of a program listed in the *ABET Annual Report* applies to all graduates who completed the program during the academic year indicated therein.

## B. Revocation of Accreditation

Questions regarding the continued compliance of such programs during the period of accreditation may be directed to ABET. If it appears that an accredited program is not in compliance with ABET criteria, the institution is so notified. If the response from the institution is not adequate, ABET may institute revocation for cause procedures. The institution is notified of the reasons why revocation is to be instituted. An on-site visit is scheduled to

determine the facts. A comprehensive document showing the reasons for revocation is provided to the institution for its analysis and its response. If the institution's response is not adequate, revocation for cause is implemented. The institution is promptly notified by the President of ABET of such action together with a supporting statement showing cause. A revocation constitutes a "not to accredit" action and is appealable. Accreditation is continued until the appeal procedure has terminated.

## C. Appeal Policy and Procedure

In the event an institution wishes to appeal an action of "not to accredit" taken by TAC/ABET, written notice of intent to appeal must be given to the Executive Director of ABET within 30 days of the date of notification of the action. Upon receipt of such notice, the President of ABET will appoint a special committee of the Board of Directors having a minimum of three members. This special committee will schedule a meeting at the ABET headquarters or other location as soon as practical and convenient for all parties concerned. Appropriate administrative officers of the institution and representatives of TAC/ABET shall be present at this meeting to consider the importance and relevance of statements submitted in support of the appeal. The findings of the special committee will be reported to the next scheduled meeting of the Board of Directors and final action will then be taken.

## D. Public Release Policy

1. Accreditation by TAC/ABET is based on satisfying minimum educational criteria. As a measure of quality, it assures only that an accredited program satisfies the minimum standards. The various periods or terms of accreditation do not represent a relative ranking of programs in terms of quality. At no point is an institution allowed to publish or imply the term or period of accreditation. Public announcement of the accreditation action should only relate to the attainment of accredited status. Because accreditation is specific to a program, all statements on accreditation status must refer only to those programs that are accredited. No implication should be made by an announcement or release that accreditation by TAC/ABET applies to any programs other than the accredited ones.

2. College catalogs and similar publications must clearly indicate the programs accredited by TAC/ABET as separate and distinct from any other programs or kinds of accreditation. No implication should be made in any listing that all programs are accredited because of an institution's regional or institutional accreditation. Accredited engineering technology programs should be specifically identified as "accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology."

3. Direct quotation in whole or in part from any statement by TAC/ABET to the institution is unauthorized. Correspondence and reports between the accrediting agency and the institution are confidential documents and should only be released to authorized personnel at the in-



stitution. Any document so released must clearly state that it is confidential. Wherever institution policy or state or federal laws require the release of any confidential documents, the entire document must be released.

4. If accreditation is withdrawn or discontinued, the institution shall no longer refer to the program as accredited.

### III. METHOD OF EVALUATION

#### A. Questionnaire

One of the first steps in the accreditation process for a program is the submission by the institution of information and data in the form of a self-study questionnaire and its review by TAC/ABET prior to an on-site visit.

#### B. On-Site Visit

1. The questionnaire will be supplemented by a report of an on-site visit by a carefully selected team drawn from the official engineering technology list of program evaluators. The purpose of the on-site visit is three-fold.

a. The visiting team will assess factors that cannot be adequately described in the questionnaire. The intellectual atmosphere, the morale of the faculty and the students, the caliber of the staff and student body, and the character of the work performed are examples of intangible qualitative factors that are difficult to describe in a written statement.

b. The visiting team will help the institution assess its weak points as well as its strong points.

c. The team will examine in further detail material compiled by the institution relating to but not limited to the following:

(1) Auspices, control, and organization of the institution and of the engineering technology division.

(2) Educational programs offered and degrees conferred.

(3) Maturity and stability of the institution and of the individual educational programs.

(4) Basis of and requirements for admission of students.

(5) Number of students enrolled:

(a) in the technology college or division as a whole, and

(b) in the individual educational programs.

(6) Teaching staff, teaching loads, and faculty salaries.

(7) Physical facilities—adequacy of the educational plant devoted to engineering technology education.

(8) Finances—investments, expenditures, sources of income.

(9) Curricular content of the program and items of student coursework. In order to make a qualitative evaluation of a program, it is necessary that the institution exhibit teaching materials such as course outlines and textbooks for all

courses required for graduation. Sufficient examples of student work in technical, mathematics and science courses must be available to the visiting team for the entire campus visit. The examples should show a range of grades for assignments including homework, quizzes, examinations, drawings, laboratory reports, projects, and samples of computer usage in technical courses. Examples must also be presented to demonstrate compliance with the requirement for student competency in written and oral communications as specified in section V.C. 5.a.

(10) Provisions for keeping the program current.

2. Additional evaluation activities by the on-site visiting team include the following.

a. The team will review records of the employment of graduates to evaluate placement and performance in terms of goals stated for each program.

b. The team's factual findings are presented orally to the institution's chief executive officer or designee and such faculty personnel as he or she wishes to assemble. The opportunity is presented at this time for the correction of factual errors in the team's observations.

#### C. Review

Following these activities, the report of the on-site visiting team and the institution's response are reviewed by TAC/ABET prior to taking final accreditation action.

### IV. PROGRAM CRITERIA

Program criteria relative to the accreditation of engineering technology programs in particular disciplines are developed by the cognizant Participating Bodies of ABET or, at the request of TAC/ABET, by other societies or groups having appropriate expertise. The program criteria provide the specificity needed for interpretation of the general criteria as applicable to a given discipline. Program criteria must be accepted by the TAC and ABET before they can have effect in the accreditation process. When approved, program criteria are published as an integral part of this document, following the general criteria. A program in a curricular area covered by approved program criteria must be in compliance with both the general criteria and the program criteria in order to be accredited. Provisions of the program criteria may be more restrictive than related provisions of the general criteria. Engineering technology programs in areas not covered by program criteria must meet the general criteria.

### V. GENERAL CRITERIA

*The shaded sections below are published for review and comment. Comments will be considered up to May 15, 1987 after which the ABET Board of Directors will determine, with the advice of the TAC and based on comments received, whether the proposed changes will be adopted. Comments should be addressed to the Accreditation Office.*

ector, TAC/ABET, 345 East 47th Street, New York, NY  
10017-2397

## A. Program Level and Course Requirements

Engineering technology programs may be accredited at the associate degree level or at the baccalaureate level. Differential criteria are specified as the minimum course requirements for each level. This section of the criteria relates to the program performance in producing graduates from programs meeting minimum course criteria.

1. Accreditable associate degree programs must be characterized by the following minimums in course requirements:

- A minimum of 64 semester hour credits or 96 quarter hour credits for a two-year associate degree.
- 32 semester hour or 48 quarter hour credits of technical courses including technical sciences, technical specialties, and technical electives.
- 16 semester hour or 24 quarter hour credits of basic sciences and mathematics, of which at least 8 semester hour or 12 quarter hour credits are the study of appropriate mathematics. Courses in computer programming may not be included in the category of basic sciences and mathematics in satisfying the minimum quantitative requirements. (See section C.4.c. below.)

*(It is proposed to change this paragraph to read as follows in the next edition of these criteria:*

- 16 semester hour or 24 quarter hour credits of an appropriate combination of basic sciences and mathematics of the type, level, and subject coverage specified in these criteria and applicable program criteria. The basic sciences component must include at least 4 semester hour or 6 quarter hour credits in areas specified in section V.C.4.b. below. The mathematics component must include at least 8 semester hour or 12 quarter hour credits in areas specified in section V.C.4.c. below. The remainder of the requirement may be met by appropriate coursework in either basic sciences or mathematics. Coursework in computer programming may not be included in the category of basic sciences and mathematics in satisfying the minimum quantitative requirements.)

- 9 semester hour or 13 quarter hour credits consisting of social sciences and/or humanities and instruction in written and oral communications appropriate to the program, of which at least 6 semester hour or 9 quarter hour credits are the study of communications. Some study in social sciences and/or humanities must also be included in the total requirement.

- The balance of the program should be designed to achieve an integrated and well-rounded engineering technology program. The additional time is available for the implementation of the educational objectives of the institution and/or individual as they relate to ensuring adequate educational preparation for the graduate to function as an engineer-

ing technician. This includes the ability to use the computer in solving technical problems. Additional coursework in engineering technology or related areas will be needed to fulfill such an objective. The institution must address such needs and objectives in developing the program and its contents. A maximum of 4 semester hours or 6 quarter hours of cooperative work-study/experience to enhance the skills of the technician may be included in this portion of the curriculum toward meeting the minimum number of credit hours specified in section V.A.1.a. above, provided it meets the requirements of section V.C.7. below.

2. Accreditable baccalaureate programs must be characterized by the following minimums in course requirements:

- A minimum of 124 semester hour credits or 186 quarter hour credits for a baccalaureate degree.
- 48 semester hour or 72 quarter hour credits of technical courses including technical sciences, technical specialties, and technical electives.
- 24 semester hour or 36 quarter hour credits of basic sciences and mathematics of which at least 12 semester hour or 18 quarter hour credits are the study of appropriate mathematics. Courses in computer programming may not be included in the category of basic sciences and mathematics in satisfying the minimum quantitative requirements. (See section C.4.c. below.)

*(It is proposed to change this paragraph to read as follows in the next edition of these criteria:*

- 24 semester hour or 36 quarter hour credits of an appropriate combination of basic sciences and mathematics of the type, level, and subject coverage specified in these criteria and applicable program criteria. The basic sciences component must include at least 8 semester hour or 12 quarter hour credits in areas specified in section V.C.4.b. below. The mathematics component must include at least 12 semester hour or 18 quarter hour credits in areas specified in section V.C.4.c. below. The remainder of the requirement may be met by appropriate coursework in either basic sciences or mathematics. Coursework in computer programming may not be included in the category of basic sciences and mathematics in satisfying the minimum quantitative requirements.)

- 24 semester hour or 36 quarter hour credits consisting of social sciences and/or humanities and instruction in written and oral communications appropriate to the program, of which at least 9 semester hour or 13 quarter hour credits are the study of communications and at least 8 semester hour or 12 quarter hour credits are in social sciences and/or humanities. The remainder of the requirement may be met by appropriate coursework in either area.

- The balance of the program should be designed to achieve an integrated and well-rounded engineering technology program. The additional time is

available for the implementation of the educational objectives of the institution and/or the individual as they relate to ensuring adequate educational preparation for the graduate to function as an engineering technologist. This includes the ability to use the computer in solving technical problems. Additional coursework in engineering technology or related areas will be needed to fulfill such an objective. The institution must address such needs and objectives in developing the program and its contents. A maximum of 8 semester hours or 12 quarter hours of cooperative work-study experience to enhance the professional development of the technologist may be included in this portion of the curriculum toward meeting the minimum number of credit hours specified in section V.A.2.a above, provided it meets the requirements of section V.C.7. below. However, no more than half of such credit may be earned in either the lower division (freshman/sophomore years) or upper division (junior/senior years) of the program.

3. ABET encourages innovative or novel program arrangements. Non-traditional programs will be evaluated against the above criteria to ascertain that the programs satisfy the intent of the minimums established.

## B. Program Content and Orientation

1. The program content should provide an integrated educational experience directed toward development of the ability to apply pertinent knowledge to the solution of practical problems in the graduate's engineering technology specialty.

2. ABET requires a high degree of specialization for engineering technology programs, but with field orientation rather than task orientation. The engineering orientation of the technical specialization should be manifested by faculty qualifications and course content.

## C. Curriculum Elements

The quantitative criteria listed in A.1. and 2. above are now discussed as providing a minimum foundation for the preparation of an engineering technician or engineering technologist.

1. Technical Sciences—Subject matter in an engineering technology program has its roots in mathematics and basic science and carries knowledge further toward application. Courses are designated to supply the core of technological knowledge students need in their chosen profession. The same subject areas are included, with more emphasis on application than the "engineering science" of an engineering program.

### 2. Technical Specialties

a. Technical Skills and Techniques—These are courses in which the student would acquire the necessary skills and knowledge of appropriate methods, procedures, and techniques—such as graphics, problem solving, processes, construction techniques, instrumentation techniques, pro-

duction methods, field operations, plant operations, safety, and maintenance. Technology laboratory manuals, experiments, projects, and activities should clearly reflect the orientation of the program towards the education of the student in the modern techniques of applied design, construction, operation, maintenance, testing, and some production processes. Among courses requiring laboratory work, sufficient written documentation of that work (such as formal reports, technical briefs, and engineering logbooks) is required to ensure that students become competent in communications. The documentation should be graded with respect to both technical content and writing skills.

b. Technical Design Courses—These are courses in practice-oriented standard design applied to work in the field—such as construction—in which students acquire experience in carrying out established design procedures in their own areas of specialization. The key to this type of technical design lies in the fact that the courses would follow established design concepts developed by engineering and that there would be prime emphasis on standard design procedures and practices. Many of these design methods have already been included in handbooks or standard computer methods for various branches of engineering. These courses would require an understanding of the application of mathematics and science, for example to such activities as air conditioning systems design, duct design, piping design, amplifier design, computer component and circuit design, plant layout, materials handling operations, and/or civil engineering technology applications such as road design.

3. Technical Electives—Technical electives include any related technical courses which support the student's career interest (e.g., electronic circuits for a student in mechanical engineering technology).

### 4. Basic Sciences and Mathematics

a. Allocations within this group between basic sciences and mathematics will depend partly upon the specific program needs. For example, electronics might require a higher fraction of the total in mathematics than environmental engineering technology, which may have a greater basic sciences requirement. Courses in computer programming may *not* be included in the category of basic sciences and mathematics in satisfying the minimum quantitative requirements.

b. Basic Sciences—In a study of science, the objective is to acquire fundamental knowledge about nature and its phenomena. Toward this end, the courses should emphasize the understanding, measurement, and quantitative expression of the phenomena of nature. Laboratory work, including experimentation, observation, and accurate measurement, is a required part of the study of physical science. The basic sciences component of an engineering technology program may include physics,

chemistry, and the life and earth sciences in accordance with specific program needs.

c. Mathematics

(1) College algebra is the normal beginning point for the study of mathematics in engineering technology programs, and is the basis for the specified minimum mathematics credit and competency requirements. (See sections V.A.1.c. and V.A.2.c. above.) Program requirements should include carefully selected topics, suited to the individual program, from algebra through trigonometric functions to higher levels of mathematics.

(2) In baccalaureate programs, particularly, the study of the concepts and applications of calculus must be included in the program to ensure that students are professionally literate and to permit use of this mathematical tool in technological courses.

(3) Study of the concepts of calculus shall also be included in associate degree programs unless alternative subjects in mathematics beyond algebra and trigonometric functions are specified in the applicable specific program criteria as developed by the professional societies and approved by ABET. (See section IV. above.)

5. Communications, Humanities, and Social Sciences

a. Communications—Good oral and written communications are considered by ABET to be a necessary achievement of a college graduate. Technically trained individuals should not be considered educated regardless of the depth of their technical capability if they cannot communicate, both orally and in writing, their technical findings, thoughts, and philosophy to others around them. Since it is by practice that the real importance of a specific aspect of educational endeavor is demonstrated to the student, a good technical educator will insist that reports be neat, grammatically correct, and lucid. It must be evident to the visiting team that graduates are proficient in the use of the English language and have developed the ability to communicate ideas and understand those of others. Coursework in English composition, including both written and oral presentation, literature, and especially technical writing, is appropriate for meeting the quantitative requirement. Moreover, the visiting team will be looking for evidence that both oral and written communications have been taken into account in the review and evaluation of student technical work.

b. Social Sciences/Humanities—It is important that the student acquire an appreciation and understanding of our rich cultural heritage, the complexities of interpersonal relationships, an understanding of the interrelationship between technology and society, and a system of values essential for intelligent and discerning judgments. There will be

variation in the specific courses offered in this general area from institution to institution. This by no means minimizes the importance of these courses to broaden the student in the general education area. Skill courses such as physical education or military drill do not qualify as social-humanistic studies.

6. Computer Literacy—The computer is one of the most important and versatile tools in the practice of engineering and engineering technology. Engineering technicians/technologists are dependent on it to effectively discharge their job functions. It is therefore essential that students acquire a working knowledge of computer usage in the engineering technology field. Instruction must be included in one or more of the computer languages commonly used in the practice of engineering technology. Assignments should concentrate on using the computer in technical problem solving applications as contrasted to traditional data processing problems. Following formal instruction or demonstrated proficiency in programming, students should gain experience using the computer in appropriate technical courses.

7. Cooperative Work-Study Experience—TAC/ABET does not separately identify cooperative programs. However, flexibility in the development of appropriate work experiences, such as a formal cooperative program, as part of an engineering technology program is encouraged. Work experience components will be evaluated as part of the evaluation of an entire engineering technology program, but credit for work experience may not be counted toward the minimum credit hour requirements in the categories prescribed in sections V.A.1.b. through d. or V.A.2.b. through d. Cooperative course credit may be included in the balance of the program as specified in sections V.A.1.e. and V.A.2.e. Where cooperative work experience is counted toward meeting the minimum total number of credit hours specified in V.A.1.a. or V.A.2.a. above, the cooperative work-study must include an appropriate academic component such as a seminar or written formal report addressing the experience and the educational benefits derived therefrom. This academic component must be graded by the faculty of the department responsible for the program's technical content. Material relating to the academic component must be provided for the visiting team's review. (See section III.B.1.c.(9).)

8. Remedial Work—Remedial courses, designed to remove deficiencies in the background of entering students, are inherently at a level lower than expected in college credit work. Such courses, particularly in the areas of mathematics and communications, are not to be used to meet the minimums in curricular content requirements.

## D. Technical Currency

In engineering technology programs, technical currency is important and must be assured by such means as a competent and inquisitive faculty, an active industrial

advisory committee, an adequately funded budget which encourages continuing faculty development, and a modern library collection with an adequately funded program for continuous renewal. Positive procedures must be established and closely monitored to safeguard against technical obsolescence. These procedures should be described in the self-study questionnaire and demonstrated to the evaluation team during the visit.

### E. Arrangement of Baccalaureate Programs

1. Some baccalaureate engineering technology programs have been developed using a single continuous four year curriculum structure; others are organized on a "two plus two" or a "three plus one" plan wherein upper level studies are added to associate degree level work to form a baccalaureate degree program. The latter arrangement provides a specific associate degree exit with a concomitant job opportunity and also allows students the possibility of continuing their education toward a baccalaureate degree. The post-associate degree portions of the baccalaureate programs, hereinafter referred to as upper division programs, vary considerably depending upon objectives. Some focus on continuation of the associate degree technical specialty whereas others are deliberately broader and may be considered interdisciplinary engineering technology programs. Considering the variety of legitimate local circumstances that may apply, these plans as well as others are acceptable if the total baccalaureate program reflects adequate work beginning at the freshman level and extending through the senior level courses.

2. Upper division programs generally accept students from accredited associate degree programs. Students from nonaccredited associate degree programs should have appropriate validation of their work. It is expected that those students with deficiencies in their background preparation for the upper division programs will be required to remove those deficiencies. In all cases, the accreditation process is intended to ensure that the graduate has achieved a level of competency expected in a baccalaureate program.

3. For those upper division programs that continue the technical specialty, the courses should be structured on a "building block" basis: i.e., the advanced courses in the technical specialty should have as prerequisites the technical courses including mathematics from the associate degree program. These courses should obviously demonstrate a greater degree of sophistication and theory than those in the associate degree program.

4. For the "interdisciplinary" upper division program, the technical courses must be designed with the student's academic background in mind. That is, it would be expected that a technical course at the junior level would cover more material and utilize greater mathematics content than a similar course at the freshman level in a specialty area. The "interdisciplinary" program must be clearly identified with an appropriate title.

5. Under no circumstances should an upper division program that is predominantly management oriented be considered an engineering technology program, nor

should two associate degree programs back-to-back be considered for baccalaureate accreditation.

### F. Faculty

This section of the criteria relates to faculty adequacy in numbers, competence, and the standards of instruction that the institution maintains in all subject areas that supply instruction to engineering technology students.

1. Each program must have an appropriately qualified faculty. The faculty determines the adequacy of any engineering technology program. It is axiomatic that instructional goals will be achieved only to the level of faculty competence and vision.

2. The technology faculty members should have earned baccalaureate degrees in a discipline appropriate to the program. While a baccalaureate degree in engineering or engineering technology is considered typical and desirable for most programs in engineering technology, relevancy and appropriateness of the faculty member's education and experience to the engineering technology program being evaluated are considered paramount. A majority of the program faculty should have an earned master's degree in the same field or a field complementary to the subject being taught, and appropriate industrial experience. For accreditation purposes registration as a Professional Engineer, Architect or Surveyor is acceptable in lieu of a master's degree. Criteria for employment, promotion, and financial recognition of faculty members should reflect emphasis on competence as a teacher, relevant industrial experience, and the master's degree as the appropriate terminal degree.

3. The number of faculty members will naturally depend upon the number of students, whether they are day students or night students, and on other duties assigned to the faculty. It is further recognized that no single faculty member can represent the diversity of knowledge and opinion necessary to teach the entire spectrum of technical specialty courses required within any program. The number of faculty members must be great enough to insure continuity and viability of the program and proper sequencing and frequency of course offerings. One of the following conditions must be satisfied before TAC/ABET will consider a program to be creditable. (In order not to stifle innovative programs and administrative structures, TAC/ABET will consider variations from any of the three following requirements provided the institution demonstrates that its plan for stability and continuity is an acceptable alternative.)

- a. Associate degree program—a minimum of two full-time-equivalent (FTE) faculty members, of which at least one person must be a full-time employee of the institution.
- b. Four year baccalaureate degree program or both associate and bachelor's degree programs in the same discipline—a minimum of three FTE faculty members of which at least two persons must be full-time employees of the institution.

c. Upper division only baccalaureate degree program—a minimum of two FTE faculty members, of which at least one person must be a full-time employee of the institution.

4. The overall competence of the faculty may be judged by such factors as the level of academic achievement of its members; the diversity of their backgrounds; the extent to which they further their own education in relevant areas; their non-academic engineering and engineering technology experience; their experience in teaching; their technical currency; their interest in and enthusiasm for developing more effective teaching methods; their level of scholarship; the degree of their participation in professional, technical, and scientific societies; recognition by students of their technical acumen; their ability to communicate in English; and their personal interest in the students' curricular and extracurricular activities.

5. Faculty members teaching the technical skills courses are not required to have advanced degrees but are expected to be artisans or masters of their crafts. However, they should represent only a small fraction of the total technology faculty.

6. Baccalaureate engineering technology education with its emphasis on problem-solving courses, participation in laboratories, and technical skills, requires a sufficient number of faculty members to provide adequate attention to each student. The student-faculty ratio for technical courses will vary, depending on the nature of the programs and courses, but should not exceed the institutional ratio for science-related areas. Student-faculty ratios for non-technical studies should follow normal institutional patterns.

## G. Student Body

This section of the criteria relates to the admission of students, school policy on scholastic work, and the adequacy of operations for student advising, selective retention, and application of graduation requirements.

1. Entrance requirements should include high school graduation or the equivalent. A high school transcript indicating graduation, or satisfactory evidence and/or certification of equivalency, must be available for each student.

2. Institutional policies and procedures on credit for scholastic work, retention, probation and graduation must ensure that all graduates of a program accredited by TAC/ABET meet these criteria in addition to satisfying all program and institutional requirements.

3. Proper academic advisement must be provided to ensure that students are adequately prepared to meet the requirements of the program.

4. The institution must maintain up-to-date academic records for all students and graduates.

5. Adequate placement services must be available to assist graduates in seeking employment.

## H. Administration

The administration should demonstrate effective leadership and satisfactory support for engineering technology. The following factors relate to this provision.

1. A capable faculty can perform its function best in an atmosphere of good relations with the administration. This requires good communication between faculty members and administrators, and a mutual concern with policies that affect the faculty.

2. The college administration should have four basic roles: selection, supervision, and support of the faculty; selection and supervision of the students; operation of the facilities for the benefit of the faculty and students; and interpretation of the college to members of the profession and to the public.

3. In performing many of these functions, the administrators should not operate alone, but should seek advice from individual faculty members, faculty committees, and special consultants.

4. Each program in engineering technology is expected to have an identifiable, qualified person who has direct responsibility for program coordination and curriculum development. Such a person shall be a full-time employee of the institution.

### I. Satisfactory Employment

One of the distinguishing features of engineering technology programs is the desire to provide their graduates with enough acumen that there will be a minimum training period required in industry. An accreditable program must demonstrate employer satisfaction with recent graduates, graduate satisfaction with employment, career mobility opportunities, appropriate starting salaries, and appropriate job titles. Evidence of the above must be made available to the evaluation team during the visit.

### J. Industrial Advisory Committee

1. Industrial advisory committees can contribute significantly to the growth and development of engineering technology programs as a means of assuring technical currency of the program and maintaining close liaison with the supporting and employing industries.

a. An effective industrial advisory committee should:

(1) Be broad-based and composed primarily of practicing engineers and senior engineering technicians with active interests in the institution and the program it offers and with intimate knowledge of the current work of engineering technicians and the work they are likely to do in the near future.

(2) Meet regularly with the administration and the faculty to discuss program needs, progress and problems and to recommend solutions.

(3) Review program offerings and course content periodically to ensure that the current and future needs of engineering technicians in industry are being met.

b. Industrial advisory committees should also be encouraged to:



- (1) Assist in the recruitment of a competent faculty and of potentially capable students.
  - (2) Assist in the placement of graduates.
  - (3) Assist in obtaining financial aid and part-time employment for needy students.
  - (4) Assist in obtaining financial and material resources for the institution and in assuring a high level of community awareness and support of the program offerings.
2. To be effective, advisory committees must be properly supported, logistically and administratively. They should be given meaningful assignments that are properly within their areas of expertise and their advice must be given serious consideration. Whenever their advice cannot be taken, such decision must be supported by good reasons.

## K. Financial Support and Facilities

The institution must demonstrate that adequate facilities and financial support for each program are available. The following factors delineate the nature and degree of the support required.

1. ABET is concerned that financial and facility provisions are adequate as predictors of continuing quality in education and evidence of program stability. Faculty salaries sufficient to attract desirable candidates for open positions and to provide a reasonably stable staff at the institution and within technology departments are a major factor.

2. Adequate facilities in classrooms and laboratories are central to effective achievement of educational goals. Provision for updating equipment in response to changing practices in technology is important. The availability of sufficient expendable materials to give students proper learning experiences is another essential to achieving goals. Laboratory manuals, experiments, and projects should clearly indicate that the facilities are being used to educate the student in modern techniques of applied design, construction, operation, maintenance, testing, production processes, etc.

3. It is particularly important that instruction in engineering technology be conducted in an atmosphere of realism. Theory courses should stress problem identification and solution, with emphasis on the quantitative, analytical approach, including the making of "order of magnitude" estimates quickly. They should be accompanied by coordinated laboratory experiences, including measurement, collection, analysis, interpretation, and presentation of data.

4. Laboratory equipment and computers should be of the type that would be encountered in industry and practice. Since one of the objectives of engineering technology programs is the development of technical skills, all students should be thoroughly familiar with the use and operation of analytical or measurement equipment common to their major field of study. Experience in the operation of standard or basic shop equipment such as lathes,

welders, and engines does not, in itself, meet this requirement.

5. Equipment catalogs, professional magazines, journals and manuals of industrial processes and practices should be readily accessible and used by technology students in addition to the usual library resources. Students should be familiar with the literature of their technology and encouraged to use it as a principal means of staying abreast of the state of the art in their technological field. Library usage is one indication of faculty interest in developing student skills in locating and utilizing information. Library holdings must include a sufficient number of appropriate books, periodicals, reference books, and standards documents to support the engineering technology programs.

6. Satisfactory secretarial/clerical support must be provided for the engineering technology faculty and administration.

7. Satisfactory procedures and/or qualified support personnel for repair and maintenance of laboratory and other instructional equipment and for general laboratory assistance must be provided.

## VI. PROCEDURE

### A. Application and Preparation for Visit

1. Consideration of engineering technology programs for accreditation is done at the invitation of the institution. TAC/ABET is prepared to examine associate and baccalaureate programs that appear likely to satisfy the respective criteria. Programs offered by institutions in the United States are eligible for review.

2. An institution desiring the accreditation of any or all of its programs leading to degrees in engineering technology may communicate directly with ABET headquarters. This will activate established arrangements for TAC/ABET to secure advance information by questionnaire, and to conduct an evaluation by a team constituted for that particular visit.

### B. Visit and Report

1. Each visiting team is selected, on the basis of the programs to be considered, from lists provided by the professional societies. The visiting team reports its preliminary findings and recommendations in writing to the officers of TAC/ABET for editing and transmission to the institution visited.

2. Between the time of the visit and the annual meeting of TAC/ABET, the responsible administrative officer of the institution may submit to the Commission any supplemental information which he or she believes may be useful to the Commission in its consideration and appraisal of the visiting team's report. The operating policy of TAC/ABET has been to base its accreditation actions on the status of the respective program at the time of the on-site visit. However, the Commission has maintained a flexible attitude toward the addition or modification of discrete items, based on conditions altered after the team visit but

prior to the Commission's accreditation deliberations. Weaknesses existing at the time of the visit are considered to have been corrected only when the correction or revision has been made effective, is substantiated by official documents signed by the responsible administrative officers, or other evidence required by TAC/ABET is provided. Where action to correct a problem has been initiated but not completed to the satisfaction of TAC/ABET, or where only indications of good intent are given, the action will not be considered in current accreditation deliberations.

### C. Accreditation Action

1. Final decision on accreditation rests with TAC/ABET, which acts on the recommendations made to it by the visiting team and on consideration of the institution's response to the preliminary report of findings or, in the case of actions based on progress reports, on the institution's report.

2. Accreditation of a program is granted for a limited period, not to exceed six years, with reappraisal stipulated at the end of this period. The term of accreditation is subject to review for cause at any time during the period of accreditation. Accreditation is granted only when conditions are considered to meet minimum criteria.

3. A "not to reaccredit" action under "show cause" is effective as of the beginning of the academic year closest to September 30 of the calendar year following the year of the "not to reaccredit" decision by an accreditation commission or by the Board of Directors in appeal cases. The notification to the institution shall indicate (a) that the termination supersedes the accredited status listing of the program in the current annual report and (b) that ABET expects the institution to formally notify students and faculty affected by the termination of the program's accredited status, not later than September 30 of the calendar year of the "not to reaccredit" action.

4. When reaccreditation of a program has been denied by the TAC and not reversed by the ABET Board of Directors on appeal, or when a program is being discontinued by the educational institution within the period for which accreditation has been granted, ABET will include a note in its next annual listing of accredited programs indicating the expected date for discontinuation of the program or expiration of accreditation. Accreditation of a program in the process of being discontinued may be extended on a year-by-year basis subject to acceptance by the TAC of a satisfactory continuation report by the institution.

5. A comprehensive evaluation of the total engineering technology activity under TAC/ABET purview at an institution, including all engineering technology programs and the related supporting offerings, will be conducted at intervals not exceeding six years. Interim accreditation of individual programs may be requested by an institution at a time other than the established comprehensive evaluation date. The institution will be required to submit an abbreviated questionnaire which would address only the program or programs to be evaluated.

6. If, for any reason, the future appears precarious, or definite weaknesses exist which should be strengthened,

accreditation may be denied or withdrawn, or may be granted for a shorter period, usually two or three years. Such precarious conditions include uncertainty as to financial status, uncertainty due to nature of administrative organization, need for additions to or improvements in staff or equipment, a new or changing program, undue dependence upon a single individual, etc.

7. ABET is authorized by its constituent organizations to publish a list of accredited engineering technology programs for use as desired by those agencies which require such a list. The list of programs which have been accredited by TAC/ABET is revised annually.

### D. Changes During Periods of Accreditation

1. It is the obligation of the administration officer responsible for the engineering technology program at the institution to notify ABET of any changes in content and/or title of curriculum during the period of accreditation and to submit catalog revisions of accredited programs to ABET when the catalog revisions are published.

2. TAC/ABET shall be kept informed of program terminations and other significant changes in programs, staff, facilities, organization, enrollment, and other pertinent factors in institutions where engineering technology programs currently are accredited. If an accredited program is terminated by an institution, accreditation by TAC/ABET is automatically terminated at the same time.

3. TAC/ABET will re-examine an accredited program should a finding of possible need be made during the normal term. The purpose is to protect the public interest by ensuring that the institution observes common canons of professional conduct in its operations. Upon receipt of information showing a possible cause for complaint, TAC/ABET will institute procedures that include one or more of the following steps:

- a. Advise the chief executive officer of the institution of the complaint and request information on the matter.
- b. Develop understandings with institutional officials as to the situation, its problems, and alternatives for relief.
- c. Present the matter to the Executive Committee of TAC/ABET for procedural advice and direction.
- d. Develop a plan of operation for response by the institution concerned, with an objective of providing mutually acceptable and equitable processes.
- e. Submit the cases as resolved or as needing decision to the Executive Committee or to the full Commission.
- f. If a complaint is considered serious enough to warrant revocation of accreditation, the provisions of paragraph II.B. under POLICIES will be invoked.

### E. Further Information

Requests for further information relative to ABET and the engineering technology accrediting program may be addressed to the Executive Director, Accreditation Board for Engineering and Technology, 345 East 47th Street, New York, N.Y. 10017.



## Program Criteria

Program Criteria, addressed in section IV. of the general criteria, amplify or interpret specific sections of the general criteria for programs in particular engineering technology disciplines.

The Program Criteria which follow have been developed by the appropriate Participating Body of ABET, reviewed by the Technology Accreditation Commission (TAC), and approved by the Board of Directors of ABET. Before being adopted for implementation in the accreditation process they were published for review and comment. They will be applied by the TAC for accreditation actions during the 1987-88 academic year and following years.

Attention is invited to the Proposed Program Criteria for other curricular areas. These are published after the Program Criteria for review and comment. If approved by the ABET Board of Directors, they will be implemented during the 1988-89 academic year.

Participating Bodies of ABET having responsibility for assigned curricular areas periodically propose non-substantive or editorial changes to the program criteria. Upon approval by the ABET Board of Directors, such changes will be published and placed in effect without advance publication for comment.

### PROGRAM CRITERIA FOR CHEMICAL ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by the American Institute of  
Chemical Engineers

#### 1. Applicability.

These program criteria apply to chemical engineering technology programs, and those with similar modifiers in their titles, leading to an associate degree.

#### 2. Curriculum.

a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

The curriculum must include courses in chemistry, including but not limited to, inorganic, organic, and analytical chemistry. All chemistry courses must include laboratory exercises. Chemistry courses may be counted as technical sciences or as basic sciences. Thermodynamics, process control and instrumentation, computer science and materials should also be included. The selection of course topics and credits in the curriculum will depend on the primary thrust of the program and some topics may be covered superficially.

b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Technical specialty courses should include process stoichiometry and unit operations such as mass transfer, heat transfer, distillation/fractionation, and evaporation.

(2) A typical unit operations laboratory facility where students receive actual practice in the opera-

tion, maintenance, repair, testing, and checkout of process equipment is required. Such laboratory exercises must include analyses made during the laboratory operations and preparation of detailed formal written reports. Oral reporting is also recommended.

c. **Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) A physics course, with laboratory, must be included in the program.

(2) College algebra, trigonometry, analytical geometry and calculus should be treated as separate mathematics subjects and not as part of a technical science or technical specialty course. Additional mathematics subjects may be appropriate.

d. **Communications.** (Amplifies criteria section V.C.5.a.)

It must be demonstrated that graduates are adequately prepared in both oral and written communications.

3. **Industrial Advisory Committee.** (Amplifies criteria section V.J.)

An advisory committee composed of industrial representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

### PROGRAM CRITERIA FOR CIVIL AND CONSTRUCTION ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by the American Society of Civil Engineers

#### 1. Applicability.

These program criteria apply to engineering technology programs including "civil," "construction," or closely related modifiers in their titles, leading to either an associate or a bachelor's degree.

#### 2. Curriculum.

a. **Mathematics.** (Amplifies criteria section V.C.4.c.)

(1) Associate degree programs in civil engineering technology must ensure that a student understands and is able to use algebra, trigonometry and analytic geometry with facility. In addition, depending upon the educational objectives of the program, the basic concepts of applied statistics, advanced trigonometry, or calculus should be included.

(2) Baccalaureate degree programs in civil engineering technology must ensure that a student understands and is able to use algebra, trigonometry, analytic geometry, and applied differential and integral calculus with facility. In addition, depending upon the educational objectives of the program, topics in applied statistics, advanced trigonometry or differential equations might be necessary. The

topics covered in mathematics should actually be used in the technical courses.

### PROGRAM CRITERIA FOR COMPUTER ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by The Institute of Electrical and Electronics Engineers, Inc. (Lead Society, in cooperation with the American Institute of Chemical Engineers and the American Institute of Industrial Engineers)

#### 1. Applicability.

These program criteria apply to engineering technology programs including "computer" or similar modifiers in their titles, leading to either an associate or a bachelor's degree.

#### 2. Curriculum.

##### a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

Technical science courses must be applications-oriented with a majority having an accompanying laboratory with emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Coursework must include the fundamentals of electricity/electronics and digital principles.

##### b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Technical skills and techniques courses must include instruction in computer programming (high-level and assembly languages), logic digital devices (including microprocessors) and computer organization/architecture/systems. There must be a balanced treatment of computer software and hardware. Courses at the associate degree level must prepare the student for immediate employment but must include sufficient depth to enable the student to continue in upper-division studies without penalty. Upper-division coursework must complement and expand lower-division work.

(2) Technical design courses must emphasize flow charting, documentation and the use of manuals, handbooks, language/equipment specifications, and computers where applicable.

##### c. **Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) The basic sciences must include physics (with laboratory) presented in a rigorous algebra/trigonometry environment (as a minimum).

(2) A minimum coverage in mathematics includes beginning college-level algebra, linear algebra/matrices and trigonometry. Baccalaureate programs must include differential/integral calculus, and instruction in numerical methods is strongly encouraged. Applied differential equations, transform methods, linear programming and probability/

statistics are appropriate electives. Application-oriented textbooks are preferred.

#### 3. Industrial Advisory Committee. (Amplifies criteria section V.J.)

An advisory committee composed of industrial representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

### PROGRAM CRITERIA FOR DRAFTING/DESIGN ENGINEERING TECHNOLOGY (MECHANICAL) AND SIMILARLY NAMED PROGRAMS

Submitted by The American Society of Mechanical Engineers.

#### 1. Applicability.

These program criteria apply to drafting/design engineering technology programs with an emphasis on mechanical components and systems, and those with similar modifiers in their titles, leading to either an associate or bachelor's degree.

#### 2. Curriculum.

##### a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

(1) Associate degree curricula shall include topics in materials or applied mechanics.

(2) Bachelor's degree curricula shall include topics in materials, statics, strength of materials, and at least one of the following: dynamics, fluid mechanics, thermodynamics and electrical power or electronics.

(3) Where appropriate, the courses must depend on prerequisite science and mathematics, including calculus.

##### b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Associate degree curricula shall include sufficient instruction in applied drafting practice emphasizing mechanical components and systems including the fundamentals of descriptive geometry, orthographic projection, sectioning, tolerancing and dimensioning, an introduction to computer-aided graphics and design, and a course in manufacturing methods.

(2) Bachelor's degree curricula shall extend the above courses in both drafting and manufacturing, and must include a course in the design of machine elements. Technical design courses will also include open-ended design experience which integrates materials, manufacturing, design analysis and design graphics.

(3) Use of ASME Codes & Standards or other appro-

appropriate standards, and current industrial practices should be emphasized. A familiarity with the International System of Units (SI) is required.

c. **Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

Physics and chemistry are recommended basic sciences. Mathematics must include topics in algebra and trigonometry and at least an introduction to calculus for the associate degree. A second course in calculus is required for a bachelor's degree.

### PROGRAM CRITERIA FOR ELECTRICAL/ELECTRONIC(S) ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by The Institute of Electrical and  
Electronics Engineers, Inc.

#### 1. Applicability.

These program criteria apply to engineering technology programs including "electrical," "electronic(s)," and similar modifiers in their titles, leading to either an associate or a bachelor's degree.

#### 2. Curriculum.

a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

Technical science courses must be applications-oriented with a majority having an accompanying laboratory with emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Coursework must include the fundamentals of electricity/electronics and principles of circuit analysis.

b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Technical skills and techniques courses must include, as appropriate to the program emphasis, instruction in electrical/electronic devices, electrical machinery, digital fundamentals and microprocessors. Courses at the associate degree level must prepare the student for immediate employment but must include sufficient foundation to enable the student to continue in upper-division studies without penalty. Upper-division coursework must complement and expand on lower-division work.

(2) Technical design courses must stress the use of manuals, handbooks and material/equipment specifications, and computers where applicable.

c. **Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) The basic sciences must include physics (with laboratory) presented in a rigorous algebra/trigonometry environment (as a minimum).

(2) A minimum sequence in mathematics is college-level algebra, trigonometry, and an introduction to calculus. Baccalaureate programs must in-

clude differential/integral calculus, and instruction in applied differential equations is strongly encouraged. Linear programming, numerical methods and probability/statistics are other appropriate electives.

3. **Industrial Advisory Committee.** (Amplifies criteria section V.J.)

An advisory committee composed of industrial representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

### PROGRAM CRITERIA FOR INDUSTRIAL ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by the Institute of  
Industrial Engineers

#### 1. Applicability.

These program criteria apply to industrial engineering technology programs, and those with similar modifiers in their titles, leading to either an associate or a bachelor's degree. (Note: programs in *industrial technology*, as distinct from industrial *engineering* technology, are not accredited by TAC/ABET.)

#### 2. Curriculum.

a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

A student must have knowledge of probability, statistics, engineering economic analysis and cost control. Other essential technical sciences of which some topics must be included are material science, computer science, mechanics of solids/fluids, thermodynamics or heat power, metrology, and electricity/electronics.

b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) There should be a core of courses in industrial engineering technology covering skills and techniques in time/motion study, plant layout, materials handling, production control, statistical quality control, wage/salary administration, CPM/PERT, organization/management, and work simplification. Instruction in tool engineering technology, manufacturing processes, inventory control, simulation, robotics, numerical control, CAD/CAM, system/procedure analysis, optimization techniques, and software design would be helpful and appropriate. Courses at the associate degree level must prepare the student for immediate employment but must include sufficient depth to enable the student to continue in upper-division studies without penalty. Upper-division coursework must complement and expand on lower-division work.

(2) The last year of the program should include a project or capstone course to integrate the knowledge learned in the technical specialties and gain experience in the art of practicing industrial engineering technology.

## PROGRAM CRITERIA FOR MANUFACTURING ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by the Society of Manufacturing Engineers

### 1. Applicability.

These program criteria apply to engineering technology programs including "manufacturing" and similar modifiers in their titles, leading to either an associate or a bachelor's degree.

### 2. Curriculum.

a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

The baccalaureate degree program should include statics, dynamics, strength of materials, mechanisms, thermodynamics or heat transfer, electricity and electronics, fluid power, computer programming, and metallurgy/materials. An associate degree program should include some of the above topics. The amount of credit earned and the breadth and depth of coverage in the subject areas depend upon the thrust of the curriculum.

b. **Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) **Specialties, Techniques and Skills.** Technical areas within manufacturing include assembly, casting, forming, material removal, welding, tooling, industrial materials, finishing, quality assurance, and automation. An associate degree program must have a planned sequence of courses in at least one of these areas. A baccalaureate program must include at least three planned sequences of courses in these areas. Computer techniques should be utilized in all appropriate problem-solving courses. The concepts of computer-aided manufacturing must be included in the baccalaureate program. Skills should be developed through laboratory experience.

(2) **Technical Design Courses.** These courses should stress the use of manuals, handbooks, charts, and other appropriate reference materials used in designing tools, products, facilities, processes, and equipment. The concepts of computer-aided design must be included.

(3) **Integrating Experience.** The baccalaureate degree program requires a "capstone" experience in the final year which draws together major elements of the design and manufacturing process. The experience might be provided by such activity as a course, appropriate internship/cooperative

education assignment, or an individual or group project. Credit for work experience, however, may not be counted toward the prescribed categories of minimum course requirements.

c. **Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) The basic sciences must include physics with laboratory experiences. Chemistry is a desirable science where appropriate.

(2) Algebra, trigonometry, analytical geometry, and calculus should be treated as separate mathematical subjects and not only as part of a technical specialty course. Additional mathematical subjects may be appropriate, depending upon the objectives of the curriculum.

3. **Technical Currency.** (Amplifies criteria section V.E.)

Effective liaison with industry is required. The means by which the communication is sustained is open to selection by the institution. Examples of how this might occur would be the use of advisory committees, as well as regular contact with knowledgeable individuals representing manufacturing engineering and/or its supporting professions.

## PROGRAM CRITERIA FOR MECHANICAL ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by The American Society of  
Mechanical Engineers

### 1. Applicability.

These program criteria apply to mechanical engineering technology programs and those with similar modifiers in their titles, leading to either an associate or a bachelor's degree.

### 2. Curriculum.

a. **Technical Sciences.** (Amplifies criteria section V.C.1.)

(1) Technical science courses must be applications-oriented with a majority having an accompanying laboratory with emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Technical science courses should provide the science foundation for the technical specialties and may be included in the sequences required below. (See section 2.b.)

(2) Technical sciences must include topics in most of the following for the associate degree: applied materials science, applied mechanics, and applied thermal sciences. For the bachelor's degree, topics in materials science, statics, dynamics, strength of materials, fluid mechanics, thermodynamics, and

electrical power or electronics must be included. Where appropriate, at both degree levels, the courses shall depend on prerequisite science and mathematics.

**b. Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Associate degree curricula shall include a sequence of courses in at least one of the following areas: manufacturing processes, drafting and mechanical design, engineering materials, solid mechanics, fluid mechanics and thermosciences, or electromechanical devices and controls.

(2) Bachelor's degree curricula shall include a sequence of courses in at least three of the following areas: manufacturing processes, mechanical design, engineering materials, solid mechanics, fluid mechanics, thermosciences, electromechanical devices and controls, or industrial operations.

(3) Instruction provided in a series of sequential courses shall provide a progressively increasing level of sophistication. Courses at the associate degree level must prepare the student for immediate employment but must include sufficient depth to enable the student to continue in upper-division studies without penalty. Upper-division coursework must complement and expand on lower-division work.

(4) Technical design courses must stress the use of manuals, handbooks, material/equipment specifications, and computers where applicable.

**c. Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) Basic sciences must include a minimum of one course in physics for the associate degree, plus another course in a laboratory science, preferably chemistry or a second physics course. For the bachelor's degree programs two physics courses and a chemistry course are required.

(2) Mathematics should include topics in algebra and trigonometry and at least an introduction to calculus for the associate degree, and the calculus must be used in some appropriate technical coursework. A minimum of two courses in calculus is required for the bachelor's degree, and upper-level technical courses must include applications of the calculus where appropriate.

**PROGRAM CRITERIA FOR  
MINING ENGINEERING TECHNOLOGY  
AND SIMILARLY NAMED PROGRAMS**

Submitted by the Society of Mining Engineers  
of AIME

**1. Applicability.**

These program criteria apply to engineering technology programs including "mining" and similar modifiers in their titles, leading to either an associate or bachelor's degree.

**2. Curriculum.**

**a. Technical Sciences.** (Amplifies criteria section V.C.1.)

(1) Associate degree curricula must include instruction in the basic concepts of mechanics and computer science.

(2) Bachelor's degree curricula must include instruction in the basic concepts and fundamentals in rock mechanics, dynamics, electrical power and transmission, and fluid dynamics.

**b. Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Associate degree curricula must include instruction in surface or underground mine planning, exploitation methods, and elements of mine surveying.

(2) Bachelor's degree curricula must meet the requirements for an associate degree and provide additional instruction in surface and underground mine planning and exploitation methods, and must include instruction in materials handling, mine environmental controls, mineral or coal processing, mine safety, and mine economics.

**c. Basic Sciences.** (Amplifies criteria section V.C.4.b.)  
Instruction must include basic concepts in physics, chemistry, and physical geology.

**d. Communications.** (Amplifies criteria section V.C.5.a.)

Oral and written communications coursework must be followed by evaluation of these skills as used in mining applications presentations in laboratory reports and in special projects coursework.

**e. Industrial Advisory Committee.** (Amplifies criteria section V.J.)

An industrial advisory committee is required and must meet at least annually. Records and minutes of the committee should be maintained and kept available. Mining professionals with intimate knowledge of the full spectrum of employment in the mining industry in the institution's regional area should be encouraged to participate in the activities of the industrial advisory committee.

**PROGRAM CRITERIA FOR  
NUCLEAR ENGINEERING TECHNOLOGY  
AND SIMILARLY NAMED PROGRAMS**

Submitted by the American Nuclear Society

**1. Applicability.**

These program criteria apply to nuclear engineering technology programs and those with similar modifiers in their titles, leading to either an associate or a bachelor's degree.

**2. Curriculum.**

**a. Technical Sciences.** (Amplifies criteria section V.C.1.)

**PROGRAM CRITERIA FOR  
SURVEYING ENGINEERING TECHNOLOGY  
AND SIMILARLY NAMED PROGRAMS**

Submitted by the American Congress on Surveying  
and Mapping

**1. Applicability.**

These program criteria apply to surveying engineering technology programs and those with similar modifiers in their titles, leading to either an associate or a bachelor's degree.

**2. Curriculum.**

**a. Technical Sciences and Technical Specialties.** (Amplifies criteria sections V.C.1. and V.C.2.)

"Hands on" applications-oriented courses are required. Coursework for associate degree programs must include basic plane surveying, boundary location and relocation, surveying law, photogrammetry, control surveys, instrument use and field practice. Additional topics such as error theory, data adjustments, remote sensing, subdivision design, and land information systems must be found in baccalaureate programs. Site planning, urban planning, construction surveying, and route surveying should be found to some extent in all programs.

**b. Technical Electives.** (Amplifies criteria section V.C.3.)

To meet the needs of many state laws and to broaden the individual's background, coursework from other engineering technology areas should be included in the curriculum. Coursework such as hydraulics, road design, construction estimating, construction management, engineering economics and fundamentals of electronics would be appropriate.

**c. Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) The basic sciences must include coverage in mechanics and basic electricity in a lecture laboratory format.

(2) Coverage in mathematics must include college-level algebra/trigonometry and statistics. Analytic geometry and calculus would be helpful to associate degree programs. Baccalaureate programs must have coverage in differential/integral calculus, statistics and matrix algebra.

**3. Industrial Advisory Committee.** (Amplifies criteria section V.J.)

An advisory committee composed of industrial representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

Technical science courses must be applications-oriented with a majority having an accompanying laboratory experience. Topics in the physical sciences must include fundamental principles, conservation laws, mass and heat transfer, and rate processes. Studies in nuclear systems and radiological safety should begin early enough in the program to allow development in subsequent studies. Problem solving must be a major element in most nuclear engineering technology courses.

**b. Technical Specialties.** (Amplifies criteria section V.C.2.)

(1) Technical skills and techniques courses should emphasize those areas of study that are consistent with the institution's philosophy and the needs of the nuclear industry served by the program. Courses should emphasize nuclear processes and operations, the relation between design and operation, the human interface in operations, maintenance of nuclear systems, and the translation of engineering ideas and concepts into functioning nuclear devices, machines, structures and systems.

(2) Technical design courses must stress the use of manuals, handbooks, material/equipment specifications, and computers where applicable. Problems should be related to current technology and should include considerations of balancing effort and accuracy as well as confidence limit estimates. Studies of nuclear plant operation must include topics in radiation protection procedures, current applicable rules and regulations, maintenance and control of nuclear systems, and quality assurance.

**c. Basic Sciences and Mathematics.** (Amplifies criteria section V.C.4.)

(1) The basic sciences must include physics (with laboratory) presented in rigorous algebra/trigonometry environment (as a minimum).

(2) A minimum sequence in mathematics is college-level algebra, trigonometry, and an introduction to calculus. Baccalaureate programs must include differential/integral calculus, and instruction in applied differential equations is strongly encouraged. Applied probability/statistics and numerical methods are other appropriate electives.

**3. Industrial Advisory Committee.** (Amplifies criteria section V.J.)

An advisory committee composed of industry representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

# Proposed Engineering Technology Program Criteria

The proposed Program Criteria which follow have been developed by appropriate Participating Bodies of ABET, reviewed by the Technology Accreditation Commission (TAC), and approved in principle by the Board of Directors of ABET. Before being adopted for implementation in the accreditation process, they are to be circulated among the institutions with accredited programs, and other interested parties, for review and comment.

Comments will be considered up to May 15, 1987. The ABET Board of Directors will determine, with the advice of the TAC and based on comments received, the content of the adopted Program Criteria, which will become effective following the ABET Annual Meeting in the fall of 1987 and will first be applied by the TAC for accreditation actions during the 1988-89 academic year and the following years.

Comments relative to the proposed Program Criteria should be addressed to the Accreditation Director, Accreditation Board for Engineering and Technology, 345 East 47th Street, New York, NY 10017.

## PROPOSED PROGRAM CRITERIA FOR BIO-ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Submitted by The Institute of Electrical and  
Electronics Engineers, Inc.

### 1. Applicability.

These program criteria apply to engineering technology programs including "biomedical," "medical electronics," "biomedical equipment," and similar modifiers in their titles, leading to either an associate or a bachelor's degree.

### 2. Curriculum.

#### a. Technical Sciences. (Amplifies criteria section V.C.1.)

Technical science courses must be applications-oriented with a majority having an accompanying laboratory with

emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Coursework must include the fundamentals of electricity/electronics and principles of circuit analysis.

#### b. Technical Specialties. (Amplifies criteria section V.C.2.)

(1) Technical skills and techniques course must include, as appropriate to the program emphasis, instruction in electrical/electronic devices, digital fundamentals, linear integrated circuits, microprocessors, anatomy, physiology and biomedical instrumentation. Courses at the associate degree level must prepare the student for immediate employment but must include sufficient foundation to enable the student to continue in upper-division studies without penalty. Upper-division coursework must complement and expand on lower-division work. All upper-division programs must include at least one 3-semester credit course in hospital internship.

(2) Technical design courses must stress the use of manuals, handbooks, and material/equipment specifications, and computers where applicable.

#### c. Basic Sciences and Mathematics. (Amplifies criteria section V.C.4.)

(1) The basic sciences must include physics and chemistry (with laboratory) presented in a rigorous algebra/trigonometry environment (as a minimum).

(2) A minimum sequence in mathematics is college-level algebra, trigonometry, and an introduction to calculus. Baccalaureate programs must include differential/integral calculus, and instruction in applied differential equations is strongly encouraged. Linear programming, numerical methods, and probability/statistics are other appropriate electives.

### 3. Industrial Advisory Committee. (Amplifies criteria section V.J.)

An advisory committee composed of hospital and biomedical industry representatives is required and should meet at least annually. Records and minutes of the committee should be maintained and kept available.

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