

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

PRELIMINARY REPORT  
OF THE COMMITTEE ON  
EVALUATION OF ENGINEERING EDUCATION

OCTOBER 10, 1953

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

PRELIMINARY REPORT  
OF THE COMMITTEE ON  
EVALUATION OF ENGINEERING EDUCATION

TABLE OF CONTENTS

PAGE

OBJECTIVES OF THE 1952-54 STUDY OF EVALUATION OF ENGINEERING EDUCATION . .	1
SELECTION AND DEVELOPMENT OF AN ENGINEERING FACULTY . . . . .	2
INTRODUCTION . . . . .	2
UNIVERSITY AND COLLEGE ENVIRONMENT . . . . .	2
QUALIFICATION OF TEACHERS . . . . .	3
RECRUITMENT OF A FACULTY . . . . .	3
DEVELOPMENT OF A FACULTY . . . . .	4
EVALUATION OF A FACULTY . . . . .	5
CURRICULAR CONTENT AS RELATED TO THE OBJECTIVES OF ENGINEERING EDUCATION .	6
HISTORICAL BACKGROUND . . . . .	6
OBJECTIVES OF ENGINEERING EDUCATION . . . . .	8
INSTRUCTIONAL GOALS . . . . .	8
CURRICULAR AREAS AND CONTENT . . . . .	10
METHODS OF INTRODUCING REQUIRED NEW MATERIAL . . . . .	13
PROVIDING OPPORTUNITIES FOR GIFTED STUDENTS . . . . .	14
FUTURE DEMANDS ON ENGINEERING EDUCATION . . . . .	15
GENERAL FACTORS AND BROAD CURRICULAR DIVISIONS RELATED TO ACCREDITATION .	16
INTRODUCTION . . . . .	16
RESOLUTION ON ACCREDITATION ADOPTED BY ECPD . . . . .	16
FACULTY REQUIREMENTS FOR ACCREDITATION . . . . .	16
STUDENT SELECTION AND ADVANCED STANDING . . . . .	17
ENVIRONMENT AS A FACTOR INFLUENCING EDUCATION . . . . .	18
MEASURING STUDENT ACCOMPLISHMENT . . . . .	18
FACTORS INFLUENCING FUNCTIONAL DIVERGENCE OF CURRICULA . . . . .	18
DEFINITIONS OF PROFESSIONAL-GENERAL AND PROFESSIONAL- SCIENTIFIC CURRICULA . . . . .	20
CURRICULA CONTENT RECOMMENDED FOR PROFESSIONAL- SCIENTIFIC ACCREDITATION . . . . .	20
CURRICULA CONTENT RECOMMENDED FOR PROFESSIONAL- GENERAL ACCREDITATION . . . . .	22
LENGTH OF ENGINEERING CURRICULA . . . . .	23
POSSIBLE CURRICULAR ADJUSTMENTS INVOLVING BIFURCATION . . . . .	24
SPECIAL DESIGNATION OF ACCREDITED CURRICULA . . . . .	25
CONCLUSIONS . . . . .	25

## P R E L I M I N A R Y   R E P O R T

### OBJECTIVES OF THE 1952-54 STUDY OF EVALUATION OF ENGINEERING EDUCATION

THE ASEE COMMITTEE ON EVALUATION OF ENGINEERING EDUCATION WAS APPOINTED IN MAY, 1952 BY PRESIDENT S. C. HOLLISTER. THE CHARGE TO THE COMMITTEE WAS TO DETERMINE THE PATTERN OR PATTERNS THAT ENGINEERING EDUCATION SHOULD TAKE TO KEEP PACE WITH THE RAPID DEVELOPMENTS IN SCIENCE AND TECHNOLOGY.

THE EXTENSION OF OUR KNOWLEDGE OF BASIC SCIENCE HAS OPENED DOORS TO VAST NEW AREAS OF ENGINEERING ENDEAVOR AND HAS EXPANDED THE FOUNDATION UNDERLYING MANY OF OUR EXISTING ENGINEERING FIELDS. SOME OF THE NEWER FIELDS OF ENGINEERING HAVE BEEN REASONABLY ALERT TO ASSIMILATE NEW SCIENTIFIC ADVANCES INTO THEIR TEACHING PROGRAMS. IN MANY OF THE OLDER FIELDS OF ENGINEERING, HOWEVER, IT SEEMS DESIRABLE TO STRENGTHEN THE UNDERLYING SCIENTIFIC FOUNDATIONS. IT IS THE RESPONSIBILITY OF ENGINEERING EDUCATION TO PROVIDE THAT KIND OF EDUCATIONAL PREPARATION WHICH WILL ASSURE MAXIMUM RATE OF PROGRESS OF THE ENGINEERING PROFESSION. THE RESPONSE OF ENGINEERING EDUCATORS TO THE CHALLENGING DEVELOPMENTS OF MODERN SCIENCE WILL HAVE A VITAL INFLUENCE UPON THE COURSE OF ENGINEERING PROGRESS IN THIS COUNTRY.

THE COMMITTEE ON EVALUATION BEGAN ITS WORK IN JUNE, 1952 AT THE DARTMOUTH MEETING OF ASEE. ECPD IMMEDIATELY REQUESTED THE COMMITTEE TO GIVE CONSIDERATION TO THE DEVELOPMENT OF STANDARDS FOR BRINGING ENGINEERING ACCREDITATION IN LINE WITH THE FUTURE RESPONSIBILITIES OF ENGINEERS FOR APPLYING NEW CONCEPTS IN SCIENCE. THE COMMITTEE ON EVALUATION WAS ALSO ASKED TO CLARIFY THE CURRICULUM CONTENT THAT DIFFERENTIATES ENGINEERING EDUCATION FROM THAT IN SCIENCE OR IN TECHNOLOGY.

THIS REPORT WHICH IS INTENDED TO SERVE THE JOINT PURPOSES OF ASEE AND ECPD IN THE PROMOTION OF ENGINEERING EDUCATION ATTEMPTS TO ESTABLISH A PHILOSOPHY OF EDUCATION APPROPRIATE TO THE TRAINING OF ENGINEERS FOR LEADERSHIP A GENERATION HENCE AND TO CLARIFY THE SIGNIFICANT FACTORS THAT CONTRIBUTE TO HIGH STANDARDS OF ENGINEERING EDUCATION. THE COMMITTEE HAS ALSO STUDIED THE INFLUENCE UPON THE COLLEGES OF ENGINEERING OF ADVANCING THE STANDARDS OF ACCREDITATION AND HAS

CONSIDERED WAYS IN WHICH INSTITUTIONS MAY APPROPRIATELY JUSTIFY ACCREDITATION BASED UPON PERFORMANCE OF DIFFERENT FUNCTIONS IN ENGINEERING EDUCATION.

ALTHOUGH WE ACCREDIT CURRICULA IT IS THE TEACHER THAT COUNTS MOST, WE CANNOT DEVELOP SUPERIOR STUDENTS IN AN INSTITUTION OF HIGHER EDUCATION WITHOUT DEVELOPING SUPERIOR TEACHERS. AND, SUPERIOR TEACHERS WILL INEVITABLY BE LEADERS IN THE FIELDS THEY TEACH.

## THE SELECTION AND DEVELOPMENT OF AN ENGINEERING FACULTY

### INTRODUCTION

THE EXISTENCE OF OUTSTANDING FACULTIES IS MORE IMPORTANT TO THE ADVANCEMENT OF ENGINEERING EDUCATION THAN DETAILS OF CURRICULA OR THE MAGNIFICENCE OF FACILITIES. IMPROVEMENTS IN CURRICULA AND COURSES, ACQUISITION AND UTILIZATION OF FACILITIES, DEVELOPMENT OF EDUCATIONAL PRESTIGE, AND ATTRACTION OF OUTSTANDING STUDENTS TO THE PROFESSION ALL REQUIRE EXCELLENT TEACHERS IF SUCH OBJECTIVES ARE TO BE REALIZED MOST EFFECTIVELY.

A COMPETENT FACULTY CAN BE ACQUIRED AND MAINTAINED ONLY IF THE COLLEGE ADMINISTRATION GIVES CAREFUL AND DISCRIMINATING ATTENTION TO THE IMPORTANT PROBLEMS OF RECRUITMENT, SELECTION, TRAINING, ADVANCEMENT AND TERMINATION OF EMPLOYMENT.

### UNIVERSITY AND COLLEGE ENVIRONMENT

THE SATISFACTORY DEVELOPMENT OF A FACULTY CAN PROCEED ONLY IN A FAVORABLE ENVIRONMENT. ALTHOUGH THE ENVIRONMENT INCLUDES THE PHYSICAL SURROUNDINGS, THE MORE IMPORTANT PART IS THE ACADEMIC ATMOSPHERE; I.E., THE ATTITUDES AND IDEAS OF THE PEOPLE WHO COMPRISE THE UNIVERSITY. IN SUCH AN ATMOSPHERE THERE SHOULD FIRST BE UNITY OF PURPOSE, THE MUTUAL SELECTION OF COMMON GOALS AND THE COLLABORATION OF EFFORT TOWARD THEIR ACHIEVEMENTS. OPPORTUNITY AND ENCOURAGEMENT FOR INTELLECTUAL GROWTH AND PROFESSIONAL DEVELOPMENT MUST ALSO EXIST. TEACHING LOADS MUST BE KEPT AT REASONABLE LEVELS IF TIME FOR SCHOLARLY AND CREATIVE ACTIVITIES IS TO BE AVAILABLE. THE DEVELOPMENT OF A FAVORABLE ACADEMIC ATMOSPHERE SHOULD BE THE CONCERN OF ALL FACULTY MEMBERS. THOSE IN SENIOR ADMINISTRATIVE POSTS HAVE A PARTICULARLY IMPORTANT OBLIGATION FOR ITS CREATION.

PHYSICAL SURROUNDINGS ALSO CONTRIBUTE TO A FAVORABLE ENVIRONMENT. ALTHOUGH FACILITIES MAY BE MODEST OR EXTENSIVE, THEY MUST BE RELATED TO THE OBJECTIVES OF THE INSTITUTION. THE INDIVIDUAL TEACHER NEEDS OFFICE SPACE, RESEARCH FACILITIES, TECHNICAL SERVICES, SECRETARIAL HELP, AND ACCESS TO AN ADEQUATE LIBRARY. THE LIBRARY SHOULD BE AN EFFICIENT WORKSHOP RATHER THAN A MUSEUM.

THE CLIMATE IN WHICH STUDENTS DEVELOP IS AN INTEGRAL PART OF UNIVERSITY MORALE. STUDENTS NEED A CLOSE BOND OF MUTUAL INTEREST AND FRIENDSHIP WITH MEMBERS OF THE FACULTY. THEY NEED OBJECTIVE GUIDANCE AND ENCOURAGEMENT IN THEIR INTELLECTUAL GROWTH, THEY NEED SYMPATHETIC UNDERSTANDING OF THEIR PERSONAL PROBLEMS, BUT ABOVE ALL, THEY NEED THE REALIZATION THAT THEY ARE BEING TREATED AS INDIVIDUALS AND NOT AS PART OF A HERD. A FACULTY WHICH IS ENGROSSED IN SELF-DEVELOPMENT AND SELF-INTERESTS IS NOT LIKELY TO CREATE A FAVORABLE STUDENT ENVIRONMENT.

### QUALIFICATIONS OF TEACHERS

THE ENGINEERING TEACHER MUST HAVE A FULL APPRECIATION OF THE GOALS TO BE ACHIEVED. HE SHOULD INSPIRE HIS STUDENTS TOWARD CREATIVE ENDEAVOR, INTELLECTUAL DEVELOPMENT, AND RECOGNITION OF THE IMPORTANCE OF INTEGRITY, INTELLECTUAL HONESTY, AND PROFESSIONAL ETHICS. TO ACHIEVE THESE GOALS HE SHOULD BE ENDOWED WITH ENERGY, ENTHUSIASM, AND A SINCERE INTEREST IN THE DEVELOPMENT OF YOUNG PEOPLE. TO BE FULLY SUCCESSFUL HE MUST EXERCISE JUDGEMENT AND TACT, AND HAVE THE ABILITY TO MEET THE MINDS OF HIS STUDENTS. AS AN EXAMPLE TO HIS STUDENTS, HE MUST POSSESS ORIGINALITY, AND SHOULD PERFORM CREATIVE WORK WHETHER IT BE IN TEACHING, WRITING, RESEARCH OR PROFESSIONAL ACTIVITIES.

THE SELECTION OF INDIVIDUALS FOR SPECIFIC FACULTY APPOINTMENTS IN A COLLEGE OF ENGINEERING IMPLIES THE NEED FOR EVALUATION OF PROFESSIONAL TRAINING AND FOR CRITERIA FOR MEASURING POTENTIALITY FOR ACCOMPLISHMENT. LONG TIME TRENDS IN ENGINEERING SEEM TO INDICATE THAT THE IMPORTANCE OF SCIENCE IS INCREASING AND THAT THAT OF ART IS DECREASING. SIMULTANEOUSLY, IT MUST BE RECOGNIZED THAT UNIVERSITIES ARE BEST EQUIPPED TO TEACH THE MORE THEORETICAL CONCEPTS OF PROFESSIONAL PRACTICE, WHEREAS INDUSTRY IS BETTER ADAPTED TO PROVIDE EXPERIENCE IN THE PRACTICAL APPLICATIONS. SYNTHESIS CANNOT, HOWEVER, BE IGNORED IN PROFESSIONAL EDUCATION. WITHIN A FACULTY THERE SHOULD EXIST A BALANCE OF EXPERIENCE IN BOTH THE SCIENCE AND ART OF ENGINEERING.

AN EDUCATIONAL BACKGROUND WHICH INCLUDES THE PH.D. DEGREE IS THE STRONGEST EVIDENCE USUALLY AVAILABLE TO MEASURE THE PROBABLE USEFULNESS IN TEACHING AND RESEARCH OF A RELATIVELY YOUNG CANDIDATE FOR A FACULTY POSITION. FOR OLDER PERSONS EVIDENCE OF THE PRODUCTIVITY OF THE INDIVIDUAL IN CREATIVE TEACHING AND RESEARCH MAY BE GAGED BY OTHER CRITERIA, AND THE FORMAL EDUCATIONAL BACKGROUND IS OF LESS SIGNIFICANCE. YOUNG ENGINEERS WHO HOLD JUST THE BACHELOR'S DEGREE SHOULD BE EMPLOYED ONLY IN A TEMPORARY POSITION THAT PRESUPPOSES REQUIRED CONTINUATION OF EDUCATION FOR ADVANCED DEGREES. LACK OF PROGRESS TOWARD AN ADVANCED DEGREE SHOULD BE SUFFICIENT REASON FOR TERMINATION OF SUCH AN APPOINTMENT.

APPROPRIATE INDUSTRIAL EXPERIENCE IS IMPORTANT IN A WELL-BALANCED FACULTY. THIS EXPERIENCE MAY BE CONSIDERED IN THE SELECTION AND ADVANCEMENT OF INDIVIDUALS, BUT IT SHOULD NOT BE A REQUIREMENT FOR FACULTY MEMBERS WITH SPECIAL EDUCATIONAL BACKGROUND OR WITH DEMONSTRATED CREATIVE ABILITY IN RESEARCH OR TEACHING. EVERY TEACHER SHOULD BECOME A RECOGNIZED EXPERT IN HIS FIELD REGARDLESS OF HIS BACKGROUND. FOR EVERY TEACHER THERE IS NO SUBSTITUTE FOR KNOWLEDGE OF SUBJECT MATTER FAR BEYOND THE LIMITATIONS OF THAT TO BE TAUGHT.

### RECRUITMENT OF A FACULTY

RECRUITMENT OF A FACULTY EMBRACES THE CONTACTING OF PERSONS WHOSE APTITUDES, ABILITIES, AND PERSONALITIES ARE OF THE DESIRED TYPE; TELLING THEM OF OPPORTUNITIES, ENVIRONMENT, OBLIGATIONS, AND LIMITATIONS OF THE PROFESSION; ASCERTAINING WHETHER THEIR IDEALS AND AMBITIONS ARE CONSONANT WITH THOSE OF THE PROFESSION AND THE SCHOOL; AND FINALLY ARRANGING SUITABLE COMPENSATION FOR EMPLOYMENT. OF PARAMOUNT IMPORTANCE TO ANY PROFESSION IS THE PERSONNEL OF THAT PROFESSION; TOO MUCH ATTENTION CAN NEVER BE GIVEN TO THE RECRUITMENT OF TEACHERS; NO TIME CAN BE MORE PROFITABLY SPENT THAN THAT REQUIRED TO FIND AND DEVELOP PEOPLE FOR COLLEGE FACULTIES.

NEW TEACHERS ARE OFTEN THOSE WHO HAVE JUST FINISHED STUDY OF A PART OF THE WIDE FIELD OF ENGINEERING AND SCIENCE. IT IS RECOMMENDED THAT PROMISING UNDERGRADUATE AND GRADUATE STUDENTS BE SOUGHT OUT AND THEIR APTITUDES APPRAISED AS POTENTIAL TEACHERS EARLY IN THEIR SCHOOLING. IF A STUDENT'S INTEREST IS AROUSED IN A TEACHING CAREER, HIS STUDY MAY BE GUIDED TO EMBRACE BREADTH OF VIEW AND SCHOLARLY ATTITUDE. SUCH A PROGRAM SHOULD HELP TO RECRUIT AND DEVELOP TEACHERS WHO WILL CARRY THE RESPONSIBILITY FOR IMPROVEMENT OF ENGINEERING EDUCATION TO MEET THE NEEDS OF THE FUTURE. CARE SHOULD BE EXERCISED TO AVOID INBREEDING; A HETEROGENEITY OF FACULTY BACKGROUNDS IS OF UTMOST IMPORTANCE.

TEACHERS RECRUITED FROM INDUSTRIAL PRACTICE MAY BRING MATURITY, BREADTH OF VISION, AND A PRACTICAL VIEWPOINT TO GIVE BALANCE TO A STAFF. SUCH PERSONS SHOULD ALSO ACCEPT THE IDEALS, OPPORTUNITIES, AND OBLIGATIONS OF A SCHOLARLY EDUCATIONAL CAREER BEFORE EMBARKING ON THEIR ACADEMIC EMPLOYMENT.

THE EFFECTIVE RECRUITMENT AND RETENTION OF A QUALIFIED FACULTY CAN BE ENSURED BY THE ESTABLISHMENT OF A SALARY SCALE IN COLLEGES OF ENGINEERING COMPARABLE TO THAT EARNED BY OUTSTANDING PRACTICING PROFESSIONAL ENGINEERS, AS INDICATED BY THE PUBLISHED SURVEYS OF NATIONAL SOCIETIES. THE EXAMPLE OF ACCEPTED PRACTICES IN ESTABLISHING ADEQUATE FACULTY SALARY SCALES IN THE PROFESSIONS OF MEDICINE AND LAW IS OFFERED AS EVIDENCE THAT COMPETITIVE SITUATIONS MUST BE MET IF PROFESSIONAL EDUCATION IS NOT TO STAGNATE.

#### DEVELOPMENT OF A FACULTY

EVEN THOUGH THE ENVIRONMENT AND SALARY SCALE OF AN ENGINEERING COLLEGE MAY BE SUCH AS TO ATTRACT AND RETAIN AN OUTSTANDING FACULTY, THE NEWER MEMBERS OF SUCH A GROUP WILL USUALLY NEED GUIDANCE IN THE TECHNIQUES OF TEACHING. THE PRIMARY PURPOSE OF AN ENGINEERING COLLEGE IS TO PROVIDE EFFECTIVE INSTRUCTION IN PROFESSIONAL SUBJECT MATTER AS WELL AS TO STIMULATE AND MOTIVATE STUDENTS, AND IT IS ESSENTIAL THAT THOSE SELECTED TO TEACH BE PROPERLY TRAINED FOR THIS DUAL FUNCTION. THEIR OWN USE OF AND INSISTENCE ON GOOD ENGLISH, BOTH ORAL AND WRITTEN, SHOULD BE CONSIDERED AN ESSENTIAL PART OF THEIR TEACHING OF ANY SUBJECT.

ALTHOUGH EXPERIENCED TEACHERS WILL GENERALLY PERFORM MORE EFFECTIVELY THAN YOUNG INSTRUCTORS OR GRADUATE ASSISTANTS, IT IS POSSIBLE TO ACHIEVE EXCELLENT RESULTS WITH THE LATTER PROVIDED THEY ARE PROPERLY SUPERVISED. FURTHERMORE, TEACHING IS A BENEFICIAL PART OF THE EDUCATIONAL EXPERIENCE EVEN FOR THOSE WHO LATER ELECT INDUSTRIAL PURSUITS. SEMINARS, DISCUSSION GROUPS, FORMAL AND INFORMAL CONFERENCES BETWEEN EXPERIENCED AND INEXPERIENCED TEACHERS CAN ALL BE USED EFFECTIVELY FOR THE DEVELOPMENT AND GROWTH OF A FACULTY. INFORMALITY IN SUCH ARRANGED PROGRAMS HAS MERIT AS LONG AS IT DOES NOT ENCOURAGE THE DEVELOPMENT OF IRREGULARITY OF PARTICIPATION. SUCH PROGRAMS SHOULD BE VARIED IN FORM TO MAINTAIN INTEREST.

IT IS IMPORTANT THAT FACULTY MEMBERS SET AN EXAMPLE FOR THEIR STUDENTS BY THEIR MEMBERSHIP IN PROFESSIONAL AND TECHNICAL SOCIETIES, ATTENDANCE AND ACTIVE PARTICIPATION IN SOCIETY MEETINGS, STUDY OF CURRENT LITERATURE, AND INTEREST IN NEW DEVELOPMENTS OR RESEARCH. SUCH FACULTY LEADERSHIP IS PARTICULARLY NECESSARY IN INSTITUTIONS THAT ARE ABLE TO PROVIDE ONLY LIMITED

OPPORTUNITIES FOR RESEARCH, FOR IT CONTRIBUTES AN IMPORTANT ELEMENT OF VITALITY TO UNDERGRADUATE TEACHING. THE SPIRIT OF LEADERSHIP THAT INSPIRES THE STUDENT TO WANT TO LEAD IS OF GREAT IMPORTANCE. IT CAN BE DEVELOPED BY TEACHERS WHO ARE MEN OF STATURE, JUDGMENT, WISDOM AND TACT. THE AMBITION FOR LEADERSHIP SHOULD INVOLVE NOT ONLY ASCENDENCY IN A MAN'S TECHNICAL FIELD, BUT SHOULD INCLUDE SERVICE TO SOCIETY AS WELL.

IN ENGINEERING TEACHING CONTINUAL CONTACT WITH THE FOREFRONT OF ENGINEERING AND SCIENTIFIC PROGRESS IS ESSENTIAL. IT IS ALSO CLEAR THAT LEADERSHIP IN SUCH PROGRESS HAS FREQUENTLY STEMMED FROM UNIVERSITY RESEARCH ACTIVITY. IN HIS FULLEST DEVELOPMENT THE ENGINEERING TEACHER CARRIES A RESPONSIBILITY TO CONTRIBUTE TO SUCH LEADERSHIP IN ENGINEERING RESEARCH. THE UNIVERSITY MUST PROVIDE THE OPPORTUNITY IN TERMS OF TIME, FACILITIES AND ASSISTANCE TO REALIZE THIS OBJECTIVE.

IT IS ONLY WHEN TEACHERS OF PROFESSIONAL SUBJECTS ARE RECOGNIZED AS EXPERTS THAT THEY HAVE AN OPPORTUNITY FOR CONSULTING WORK. HENCE, THE PRIVILEGE OF SUCH CONSULTATION IS NOT CONSIDERED TO BE A MAJOR FACTOR IN RECRUITMENT OF YOUNG TEACHERS. CONSULTING PRACTICE SHOULD BE CONSIDERED AS A MEANS OF DEVELOPING AND FURTHER STRENGTHENING AN ENGINEERING FACULTY. CLOSE ASSOCIATION WITH ENGINEERING WORK OR RESEARCH IN INDUSTRY SHOULD STIMULATE THE TEACHER AND IMPROVE HIS TEACHING. CONSULTING IS ALSO A SOURCE OF IDEAS FOR RESEARCH. THE LIMIT UPON THE USEFUL EXTENT OF THIS ACTIVITY HAS NOT BEEN DETERMINED. HOWEVER, THE BELIEF IS WIDELY ACCEPTED THAT AN AVERAGE OF ONE DAY PER WEEK OF THE INDIVIDUAL'S TIME DEVOTED TO CONSULTING ACTIVITIES WILL REFLECT TO THE OVERALL ADVANTAGE OF THE INSTITUTION.

FACULTY MEMBERS ENGAGED AS PRINCIPALS IN CONSULTING ENGINEERING WORK MUST BE REGISTERED PROFESSIONAL ENGINEERS OR THE RANGE OF THEIR PRACTICE WILL BE RESTRICTED. SOME YOUNGER STAFF MEMBERS SHOULD BE ENCOURAGED TO BECOME LICENSED SO THAT THEY WILL ULTIMATELY BE LEGALLY QUALIFIED TO ENGAGE IN SUCH ACTIVITY. THIS STATEMENT SHOULD NOT BE INTERPRETED AS APPLYING TO THOSE FACULTY MEMBERS ENGAGED IN SCIENTIFIC RESEARCH OR SIMILAR ACTIVITIES.

#### EVALUATION OF A FACULTY

EVALUATION OF THE POTENTIAL OF PROSPECTIVE FACULTY MEMBERS, AND OF THE ACHIEVEMENT OF EXISTING STAFF, RANKS WITH THE DEVELOPMENT OF A PROPER ATMOSPHERE AS A MOST IMPORTANT FUNCTION OF A UNIVERSITY ADMINISTRATOR. SYSTEMATIC RATHER THAN HAPHAZARD METHODS ARE ESSENTIAL AS A GUIDE FOR RECRUITMENT AND FOR MAKING SALARY ADJUSTMENTS AND PROMOTIONS. DEFINITE POLICIES ON TERMINATION OF EMPLOYMENT FOR THOSE WHO DO NOT LIVE UP TO THEIR EXPECTED PERFORMANCE ARE ALSO NECESSARY FOR PROPER DEVELOPMENT OF A GOOD FACULTY.

IT WOULD BE MOST DESIRABLE IF THIS EVALUATION COULD BE DONE ON A QUANTITATIVE BASIS, BUT THE COMMITTEE IS NOT AWARE OF ANY SYSTEMS WHICH WARRANT RECOMMENDATION FOR GENERAL ADOPTION. IT SUGGESTS THAT THERE BE MORE EXPERIMENTATION BY INDIVIDUAL INSTITUTIONS IN THE DEVELOPMENT OF QUANTITATIVE SYSTEMS. ANY EVALUATION SYSTEM MUST SERVE AS ONLY A PARTIAL GUIDE, AND PERSONAL JUDGMENTS MUST REMAIN THE MOST IMPORTANT FACTOR. THE COMMITTEE RECOMMENDS THAT SUCH QUANTITATIVE SYSTEMS AS ARE DEVELOPED BE REPORTED AT MEETINGS OF THE SOCIETY AND IN THE JOURNAL. THE SUCCESS OF SOME INDUSTRY EVALUATION SYSTEMS INDICATES THAT THERE IS HOPE FOR REAL PROGRESS IN THIS AREA.

THE FACT THAT EVALUATION OF THE PROGRESS OF A FACULTY MEMBER MUST BE BASED ON JUDGMENT INVOLVING MANY FACTORS, INDICATES THAT ADMINISTRATORS AT EACH LEVEL SHOULD ALSO MAKE USE OF THE ADVICE OF THEIR FACULTY IN REACHING THESE JUDGMENTS, REALIZING ALSO THAT THERE ARE DANGERS IN JUDGMENTS MADE BY ASSOCIATES OF THE INDIVIDUAL CONCERNED.

THE FACULTY SHOULD BE AS COMPLETELY INFORMED AS IS POSSIBLE ON BOTH THE BASES AND METHODS USED IN EVALUATION, TO WHAT EXTENT QUANTITATIVE ASSESSMENTS ARE MADE, AND THE METHODS BY WHICH THE JUDGMENTS OF THE ADMINISTRATORS AT EACH LEVEL ARE SUPPLEMENTED OR GUIDED BY FACULTY GROUPS.

EVALUATION, TO BE EFFECTIVE, SHOULD BE AS OBJECTIVE AS POSSIBLE, AND IT SHOULD INCLUDE ALONG WITH OTHER FACTORS ALL THE ITEMS MENTIONED IN THE SECTION ON THE QUALIFICATIONS OF A TEACHER WITH EMPHASIS ON:

- A. THE EFFECTIVENESS OF THE INDIVIDUAL'S TEACHING.
- B. HIS PRODUCTIVITY IN RESEARCH AND OTHER CREATIVE AREAS INCLUDING NEW METHODS OF PRESENTATION OF SUBJECT MATTER.
- C. HIS ACTIVITY IN PROFESSIONAL SOCIETIES, GOVERNMENT AND COMMUNITY ACTIVITIES.
- D. THE NATURE AND RESPONSIBILITY OF CONSULTING SERVICES TO OTHER AREAS OF THE UNIVERSITY AND TO OUTSIDE ORGANIZATIONS.
- E. HIS PUBLICATIONS.
- F. HIS PROFESSIONAL DEVELOPMENT AS EVIDENCED EITHER BY PROGRESS IN EARLY YEARS TOWARDS ADVANCED DEGREES, OR LATER BY HIS ATTAINMENTS AND RECOGNITION AS A SCHOLAR IN HIS FIELD.

IT IS IMPORTANT THAT ADMINISTRATORS ADVISE MEMBERS OF THE STAFF PERIODICALLY REGARDING THEIR STANDING, PARTICULARLY THOSE WHO SHOULD BE ENCOURAGED AT AN EARLY DATE TO ABANDON A TEACHING CAREER. MERE LACK OF PROMOTION OR SALARY ADVANCES SHOULD NOT BE ASSUMED AS A SUFFICIENT METHOD OF CRITICISM FOR INDIVIDUALS WHO ARE NOT DEVELOPING ACCORDING TO THE STANDARDS EXPECTED.

IT IS EQUALLY IMPORTANT TO STIMULATE THE GOOD TEACHER BY VERBAL OR WRITTEN APPROBATION EITHER FOR GENERAL PROGRESS OR SPECIAL ACCOMPLISHMENTS. IT IS ALSO ABSOLUTELY ESSENTIAL THAT THOSE STAFF MEMBERS ENDOWED WITH ENERGY AND ENTHUSIASM COMBINED WITH HIGH TECHNICAL ABILITY THAT IS APPLIED IN A CREATIVE MANNER BE COMPENSATED TO THE FULLEST MEASURE.

#### CURRICULAR CONTENT AS RELATED TO THE OBJECTIVES OF ENGINEERING EDUCATION

##### HISTORICAL BACKGROUND

SINCE THE ORGANIZATION OF THE SOCIETY IN 1893 THERE HAVE BEEN MANY STUDIES OF ENGINEERING CURRICULA WHICH REVIEWED CONTENT OF THE SEVERAL PROGRAMS AND GAVE A DISTRIBUTION OF TIME TO THE MAJOR DIVISIONS OF THE WORK. OUT OF THE STUDY BEGUN AS THE MANN REPORT, PUBLISHED AS CARNEGIE BULLETIN NO. 11, CAME THE WICKENDEN REPORT OF 1923-29, THE MONUMENTAL EFFORT OF THE SOCIETY. IT WAS FOLLOWED BY "AIMS AND SCOPE OF ENGINEERING CURRICULA" IN 1940 AND "ENGINEERING EDUCATION AFTER THE WAR" IN 1944. DR. D. C. JACKSON'S "PRESENT STATUS AND TRENDS OF ENGINEERING EDUCATION IN THE UNITED STATES"



WAS PUBLISHED IN 1939, AND ITS STUDY OF CURRICULA MAY BE CONSIDERED AS A SUPPLEMENT TO THE WICKENDEN REPORT.

SINCE THE WICKENDEN REPORT IS SO BASIC AND FUNDAMENTAL IT MAY BE DESIRABLE TO QUOTE A FEW SENTENCES:

"THE MULTIPLICATION OF TRUNK AND BRANCH CURRICULA BASED ON TECHNICAL SPECIALIZATION HAS GONE FULLY AS FAR AS CAN BE JUSTIFIED. FURTHER DIFFERENTIATION IN COURSES FOR UNDERGRADUATES IS MUCH MORE LIKELY TO PROCEED ON FUNCTIONAL LINES."

THE COLLEGES DID NOT HEED THE SUGGESTION THAT MULTIPLICATION OF CURRICULA HAD GONE FAR ENOUGH, BUT HAVE CONTINUED TRUNK AND BRANCH DIVISIONS THROUGHOUT THE LAST TWENTY-FIVE YEARS.

THE WICKENDEN REPORT ALSO EMPHASIZES THE NECESSITY FOR CONTINUING STUDY AFTER GRADUATION:

"THE MOST SERIOUS DEFICIENCY IN ENGINEERING EDUCATION IS NOT SO MUCH IN MATTER TAUGHT OR MATTER OMITTED IN COLLEGE AS IN ALLOWING THE ORDERLY PROCESS OF EDUCATION TO STOP, WHERE IT SO OFTEN DOES, AT GRADUATION."

IT IS DIFFICULT TO OVER-EMPHASIZE THE NECESSITY OF LEARNING HOW TO STUDY AND OF CONTINUING STUDY THROUGHOUT A WHOLE PROFESSIONAL CAREER.

THE 1940 AND 1944 REPORTS, REFERRED TO ABOVE, EMPHASIZED THE DIVISION OF EACH CURRICULUM INTO TWO MAJOR AREAS, TITLED THE SCIENTIFIC-TECHNOLOGICAL STEM AND THE HUMANISTIC-SOCIAL STEM. THESE TWO STUDIES RENEWED INTEREST IN THE "GENERAL ACADEMIC SUBJECTS" LISTED BY WICKENDEN. THE WORDING DESCRIBING THE HUMANISTIC-SOCIAL STEM USED IS PRACTICALLY IDENTICAL IN BOTH REPORTS AND THE TIME SUGGESTED FOR THIS AREA WAS TWENTY PER CENT OF THE TOTAL. THE PROGRAM WAS TO BE AN INTEGRATED SEQUENCE RUNNING THROUGH THE FOUR YEARS. DURING THE LAST DECADE MUCH THOUGHT AND MUCH STUDY HAVE BEEN GIVEN TO THIS PHASE OF ENGINEERING EDUCATION.

BOTH REPORTS RECOMMEND THE FOUR-YEAR UNDERGRADUATE PROGRAM AS THE DESIRABLE NORM. HOWEVER, IT WAS RECOGNIZED THAT ENGINEERING GRADUATES ENTER INTO MANY KINDS OF ACTIVITY AND THAT THERE SHOULD BE COMPARABLE DIFFERENTIATION IN THE EDUCATIONAL PROGRAMS. IN SUMMARIZING THE 1944 REPORT, DEAN H. P. HAMMOND OUTLINED THE NEEDED PREPARATION FOR WIDELY VARYING ENGINEERING ACTIVITIES AS FOLLOWS:

"IN ORDER TO PROVIDE FOR THE SATISFACTION OF THE NEEDS INCIDENT TO THESE TRENDS, THE (1944) COMMITTEE SUGGESTS, FOR CONSIDERATION, A PLAN OF CURRICULA DIFFERENTIATION IN THE FOURTH YEAR, THROUGH WHICH THREE OPTIONS WOULD BE OFFERED WITHIN EACH MAJOR PROFESSIONAL CURRICULUM:

(1) CONTINUATION OF THE PRESENT TYPE OF 4 YEAR PROGRAM ESSENTIALLY AS A TERMINAL CURRICULUM, BUT WITH MODIFICATIONS ADVOCATED BY THE COMMITTEE, FOR A MAJORITY OF STUDENTS.

(2) AN ALTERNATIVE FOURTH YEAR EMPHASIZING SUBJECTS DEALING WITH THE MANAGEMENT OF CONSTRUCTION AND PRODUCTION ENTERPRISES.

(3) A FOURTH YEAR INTENDED TO PREPARE FOR ADDITIONAL YEARS OF ADVANCED STUDY BY STRENGTHENING THE STUDENT'S COMMAND AND EXTENDING HIS KNOWLEDGE OF BASIC SCIENCES AND MATHEMATICS, AND BY INTRODUCING HIM TO THE METHODS OF ADVANCED STUDY. THIS FOURTH YEAR AND THE YEAR OR YEARS OF GRADUATE STUDY TO FOLLOW WOULD BE PLANNED AS A UNIT RATHER THAN AS TWO STAGES MARKED BY THE USUAL DIFFERENCES OF UNDERGRADUATE AND POSTGRADUATE PROGRAMS."

#### OBJECTIVES OF ENGINEERING EDUCATION

ANY ATTEMPT TO SPECIFY THE CONTENT OF AN ENGINEERING CURRICULUM MUST BE PRECEDED BY THE DEVELOPMENT OF A CLEAR UNDERSTANDING OF THE OBJECTIVES OF SUCH PROFESSIONAL EDUCATION. THESE OBJECTIVES ARE TWOFOLD AND ARE BASED ON THE TECHNICAL AND SOCIAL RESPONSIBILITIES THAT MUST BE ASSUMED BY GRADUATES ELECTING TO ENTER THE PROFESSION. THE ENTIRE PROFESSIONAL EDUCATIONAL PROCESS IS MORE INCLUSIVE IN ITS SCOPE THAN A FOUR YEAR ENGINEERING COURSE, FOR IT INCLUDES TRAINING IN HIGH SCHOOL, GRADUATE SCHOOL AND/OR INDUSTRY, AND ENGINEERING PRACTICE BEFORE FULL PROFESSIONAL STATUS CAN BE ACHIEVED. THE TECHNICAL GOAL OF ENGINEERING EDUCATION IS PREPARATION FOR PERFORMANCE OF THE FUNCTIONS OF ANALYSIS AND DESIGN OR OF THE FUNCTIONS OF CONSTRUCTION, PRODUCTION OR OPERATION WITH FULL KNOWLEDGE OF ANALYSIS AND DESIGN OF THE STRUCTURE, MACHINE OR PROCESS INVOLVED. THE BROAD OBJECTIVE OF ENGINEERING EDUCATION SHOULD ALSO INCLUDE THE DEVELOPMENT OF LEADERSHIP AND INCULCATION OF A DEEP SENSE OF PROFESSIONAL ETHICS AND THE GENERAL EDUCATION OF THE INDIVIDUAL.

THERE IS A TENDENCY TODAY FOR THE PUBLIC TO CONFUSE THE FUNCTIONS OF ENGINEERS, TECHNICIANS AND SCIENTISTS IN INDUSTRIAL WORK. THE ENGINEER IS ENGAGED PRIMARILY WITH CREATIVE ECONOMIC DESIGN, DEVELOPMENT, RESEARCH AND PRODUCTION, THE TECHNICIAN WITH ROUTINE OPERATION, AND THE SCIENTIST WITH RESEARCH. FURTHERMORE, THE PROFESSIONAL ENGINEER IS LEGALLY RESPONSIBLE FOR THE PROTECTION OF LIFE, HEALTH AND PROPERTY, WHEREAS THE TECHNICIAN AND SCIENTIST ARE NOT. HENCE, THE ENGINEER'S EDUCATION SHOULD BE POINTED TOWARD CREATION, ACTION AND RESPONSIBILITY.

#### INSTRUCTIONAL GOALS

THE INSTRUCTIONAL GOALS OF ENGINEERING INCLUDE HELPING THE STUDENT TO LEARN TO DEAL WITH NEW SITUATIONS IN TERMS OF FUNDAMENTAL PRINCIPLES AND WITH WELL-ORDERED ANALYTICAL THINKING, TO DEVELOP INITIATIVE, TO THINK IN TERMS OF SCIENTIFIC GENERALIZATIONS, TO KEEP ABREAST OF THE NEW DEVELOPMENTS IN SCIENCE AND TECHNOLOGY AND TO CONTINUE TO GROW INTELLECTUALLY AND CULTURALLY AFTER THE END OF FORMAL EDUCATION.

ENGINEERING ADVANCEMENT IS CHARACTERIZED EITHER BY DEALING WITH NEW SITUATIONS OR BY OBTAINING NEW SOLUTIONS TO OLD ONES. THE SUCCESSFUL TREATMENT OF A NEW SITUATION INVOLVES THE APPLICATION OF WELL UNDERSTOOD FUNDAMENTAL PRINCIPLES AND WELL ORDERED ANALYTICAL THINKING IN DEFINING THE PROBLEM, PLANNING ITS SIMPLIFICATION WITHOUT LOSING ITS ESSENTIAL NATURE, CONCEIVING A METHOD OF ATTACK, CARRYING THE PROBLEM THROUGH TO A SUCCESSFUL

CONCLUSION, CHECKING THE SOLUTION AT EACH STAGE AND FINALLY TAKING STOCK TO SEE WHAT HAS BEEN LEARNED THAT IS OF VALUE IN THIS SITUATION AND IN OTHERS THAT MAY BE ENCOUNTERED IN THE FUTURE. SIGNIFICANT PROBLEMS RARELY COME TO THE ENGINEER IN CLEAR CONCISE FORM THAT CAN BE RECOGNIZED AS BEING SIMPLY MECHANICAL OR ELECTRICAL OR THERMAL OR CONFINED TO SOME OTHER WELL-DEFINED AREA. RATHER, IN PRACTICE, THEY ARE LIKELY TO CUT ACROSS SEVERAL FIELDS AND MAY INVOLVE, IN ADDITION TO TECHNOLOGICAL AND SCIENTIFIC FACTORS, ECONOMIC, HUMAN, AND SOCIAL ONES AS WELL. HENCE IT IS IMPORTANT TO EDUCATE ENGINEERS SO THAT WHEN CONFRONTED WITH THE COMPLEX PROBLEMS OF PROFESSIONAL PRACTICE, THEY CAN RECOGNIZE THE SEPARATE FACTORS AND DEAL WITH ALL OF THEM ADEQUATELY.

THE EVOLUTION OF ENGINEERING EDUCATION HAS BEEN CHARACTERIZED BY A CONTINUOUS PROCESS OF INVASION OF NEW SCIENTIFIC AND TECHNOLOGICAL KNOWLEDGE INTO THE CURRICULA. SUCH INNOVATIONS HAVE NECESSITATED THE DEVELOPMENT OF NEW CONCEPTS OR SHIFTS TO MORE FUNDAMENTAL AND SCIENTIFIC APPROACHES. IT SEEMS EVIDENT THAT THE FRONTIERS OF SCIENCE AND TECHNOLOGY ARE ADVANCING AT A MORE RAPID RATE NOW THAN AT ANY PREVIOUS TIME AND THAT MANY OF TODAY'S FRONTIERS WILL BE REDUCED TO SIGNIFICANT ENGINEERING PRACTICE IN THE YEARS AHEAD. IT IS THE RESPONSIBILITY OF THE ENGINEER TO IDENTIFY THE NEW DEVELOPMENTS IN SCIENCE AND TECHNOLOGY WHICH HAVE SIGNIFICANT POTENTIALITIES IN ENGINEERING PRACTICE. THE RATE AT WHICH NEW SCIENTIFIC KNOWLEDGE WILL BE TRANSLATED INTO ENGINEERING PRACTICE DEPENDS IN A LARGE MEASURE UPON THE ENGINEER'S UNDERSTANDING OF THESE SCIENTIFIC CONCEPTS.

THE TRANSLATION OF NEW SCIENTIFIC DEVELOPMENTS INTO ENGINEERING PRACTICE WILL BE FACILITATED BY INTEGRATING SCIENTIFIC SUBJECT MATTER. FOR EXAMPLE, THERE IS A GREAT DEAL OF SIMILARITY, BOTH IN CONCEPTUAL UNDERSTANDING AND IN ANALYTICAL METHODS IN THE GENERALIZATIONS OF HEAT FLOW, MECHANICS OF FLUIDS, ELECTROMAGNETIC FIELDS, AND VIBRATION THEORY. WHEN A STUDENT UNDERSTANDS THESE GENERALIZATIONS, HE HAS GAINED A CONCEPT OF SYSTEMATIC ORDERLINESS OF MANY FIELDS OF SCIENCE AND ENGINEERING WHICH ENABLES HIM TO APPROACH THE SOLUTION OF PROBLEMS IN WIDELY DIVERSE FIELDS, USING APPROXIMATELY THE SAME ANALYTICAL METHODS. THIS UNIFICATION OF METHODS OF ANALYSIS CAN BE ACCOMPLISHED TO A LIMITED DEGREE WITHOUT ASCENDING INTO HIGHER MATHEMATICAL LEVELS. IT CAN BE ACCOMPLISHED TO A CONSIDERABLY HIGHER DEGREE BY UTILIZING ADVANCED MATHEMATICAL CONCEPTS. UNIFICATION AT THIS ADVANCED LEVEL MAKES IT POSSIBLE TO DERIVE FUNDAMENTAL EQUATIONS IN THE MOST GENERAL FORM. SUCH GENERALIZATIONS AND THE METHODS OF REDUCING THESE TO THE SOLUTIONS OF SPECIFIC PROBLEMS OFTEN LEND THEMSELVES TO APPLICATION IN MANY FIELDS.

THE FOREGOING DISCUSSION RELATES TO INSTRUCTIONAL GOALS AS RELATED TO THE SCIENTIFIC-TECHNOLOGICAL STEM. IT IS EQUALLY IMPORTANT THAT INSTRUCTIONAL GOALS GIVE THE STUDENT AN UNDERSTANDING AND APPRECIATION OF OUR HISTORICAL AND CULTURAL HERITAGE, AS WELL AS A SENSE OF MORAL VALUE UPON WHICH THE INDIVIDUAL CAN BUILD A SOUND PHILOSOPHY OF LIFE. IT IS ALSO CLEARLY RECOGNIZED THAT MANY ENGINEERS PROGRESS INTO MANAGERIAL AND TOP EXECUTIVE POSITIONS IN INDUSTRY AND GOVERNMENT. HENCE, THE FOUNDATIONS SHOULD BE LAID IN COLLEGE FOR AN UNDERSTANDING OF HUMAN RELATIONSHIPS, BUSINESS MANAGEMENT, THE PRINCIPLES OF ECONOMICS AND GOVERNMENT AS WELL AS OTHER FIELDS UPON WHICH THE ENGINEER CAN BUILD.

EDUCATION FOR THE PROFESSION OF ENGINEERING DOES NOT STOP WITH THE ACQUISITION OF A DEGREE; IT MUST CONTINUE THROUGHOUT LIFE. PROBABLY THE MOST IMPORTANT GOAL OF ENGINEERING EDUCATION IS TO MOTIVATE THE STUDENT TO LEARN ON HIS OWN INITIATIVE. SELF-STUDY BOTH BY STUDENTS AND GRADUATES, CAN BE MADE MORE EFFECTIVE BY DEVELOPING A KNOWLEDGE OF CORRECT READING HABITS AND LIBRARY UTILIZATION.

#### CURRICULAR AREAS AND CONTENT

THE OBJECTIVES OF ENGINEERING ALLUDED TO IN THE PRECEDING SECTIONS OF THIS REPORT WILL, OF NECESSITY, BE RELATED CLOSELY TO THE CURRICULAR AREAS AND COURSE CONTENT OF THE ENGINEERING PROGRAM. THESE AREAS INCLUDE MATHEMATICS, PHYSICS, CHEMISTRY, THE ENGINEERING SCIENCES, ENGINEERING SYSTEMS, NON-DEPARTMENTAL TECHNICAL COURSES, AND HUMANISTIC-SOCIAL STUDIES.

THE PURPOSE OF THE STUDY OF THE BASIC SCIENCES IS TO PREPARE THE ENGINEERING STUDENT ADEQUATELY FOR LATER STUDY IN THE FIELDS OF ENGINEERING SCIENCE AS NOW BEING TAUGHT AND AS THESE FIELDS WILL EXPAND AND MULTIPLY DURING THE NEXT GENERATION. THE BASIC SCIENCES CONSIDERED ESSENTIAL TO ENGINEERING ARE MATHEMATICS, PHYSICS, AND CHEMISTRY. OTHER BASIC SCIENCES OF IMPORTANCE TO PARTICULAR FIELDS OF ENGINEERING ARE BIOLOGY AND GEOLOGY.

MATHEMATICS. THE ENGINEER FINDS THE USE OF MATHEMATICS OF CONTINUALLY INCREASING IMPORTANCE IN HIS PROFESSIONAL WORK. HOWEVER, THERE IS A BELIEF EXPRESSED BY ENGINEERING TEACHERS THAT ADVANCED COURSES IN MATHEMATICS OFTEN MAKE TOO LIMITED A CONTRIBUTION TO THE ABILITY OF THE ENGINEER TO USE THE MATHEMATICS STUDIED IN THE SOLUTION OF HIS ENGINEERING PROBLEMS. IT IS RECOMMENDED THAT THE MATHEMATICS PROPOSED FOR STUDY BY ENGINEERS BE REVIEWED AND REVISED SO THAT IT CAN MAKE A GREATER CONTRIBUTION TOWARD APPLIED MATHEMATICS AS NEEDED BY THE ENGINEERING STUDENT IN THE STUDY OF PHYSICS, CHEMISTRY, AND THE ENGINEERING SCIENCES. A MINIMUM LEVEL OF PERFORMANCE IN MATHEMATICS SHOULD BE ESTABLISHED WHETHER OBTAINED IN REQUIRED MATHEMATICS OR ENGINEERING COURSES. COMPETENCE IN THE THEORY AND USE OF SIMPLE ORDINARY DIFFERENTIAL EQUATIONS IN THE SOLUTION OF PHYSICAL PROBLEMS LIES CLOSE TO THE BOUNDARY OF MINIMUM ACCEPTABILITY OF MATHEMATICS IN ANY ACCREDITED ENGINEERING CURRICULUM. FOR STUDENTS WHOSE INTEREST WILL BE CENTERED IN RESEARCH, DEVELOPMENT AND THE HIGHER PHASES OF ANALYSIS AND DESIGN, ADDITIONAL STUDY OF MATHEMATICS IS NECESSARY.

PHYSICS. PHYSICS AS TAUGHT FOR ENGINEERS HAS UNDERGONE ONLY MINOR CHANGES DURING THE PAST GENERATION IN WHICH MANY REVOLUTIONARY NEW CONCEPTS HAVE BEEN DEVELOPED THAT ARE INFLUENCING ENGINEERING PRACTICE. MODERN PHYSICS INCLUDING NUCLEAR AND SOLID-STATE PHYSICS, SHOULD BE INCLUDED IN UNDERGRADUATE ENGINEERING CURRICULA. IT IS FELT THAT DUPLICATION BETWEEN PHYSICS AND STATICS, DYNAMICS, THERMODYNAMICS, AND ELECTRICITY SHOULD BE REDUCED OR ELIMINATED TO PROVIDE TIME FOR BASIC STUDY OF MODERN PHYSICS. THE STUDY OF ACOUSTICS AND OPTICS IS CONSIDERED DESIRABLE RATHER THAN ESSENTIAL SO THAT ITS CONSUMPTION OF TIME SHOULD BE SMALL.

CHEMISTRY. CHEMISTRY SHOULD INCLUDE TOPICS IN INORGANIC, ORGANIC, AND PHYSICAL BRANCHES PRESENTED IN CONDENSED AND GENERAL FORM. THE INITIAL STUDY MUST PREPARE ENGINEERS TO ENTER ADVANCED COURSES IN CHEMISTRY AND IN APPLICATIONS SUCH AS PROPERTIES OF MATERIALS, METALLURGY, FUELS AND COMBUSTION, CORROSION AND INDUSTRIAL CHEMICAL PROCESSES. HENCE, SUCH SUBJECTS AS RATES AND KINETICS OF CHEMICAL CHANGE, CHEMICAL EQUILIBRIA, PHASE DIAGRAMS, SOLUTIONS, ELECTROCHEMISTRY, AND COLLOIDS SHOULD BE INCLUDED. AS THE CONTENT OF THE SUBJECT OF ENGINEERING PHYSICS IS REVISED, CAREFUL CO-ORDINATION SHOULD BE EFFECTED BETWEEN MODERN PHYSICS AND CHEMISTRY.

ENGINEERING SCIENCES INCLUDE (1) STATICS, (2) DYNAMICS, (3) STRENGTH OF MATERIALS, (4) THERMODYNAMICS, (5) FLUID MECHANICS, (6) ELECTRICAL CIRCUITS, FIELDS AND ELECTRONICS, (7) HEAT TRANSFER, (8) ENGINEERING MATERIALS AND (9) PHYSICAL METALLURGY. IT IS BELIEVED THAT ALL OF THESE SUBJECTS SHOULD BE INCLUDED IN CURRICULA DESIGNED FOR PROFESSIONAL-SCIENTIFIC STUDENTS OF ENGINEERING.

THE EMPHASIS THAT HAS BEEN GIVEN TO ENGINEERING SCIENCE AND BASIC SCIENCE AS THE ESSENTIAL CORE OF ENGINEERING CURRICULA FOR RESEARCH AND DESIGN HAS AN EQUAL VALUE FOR THE MORE GENERAL ENGINEERING CURRICULA. HOWEVER, IT MUST BE RECOGNIZED THAT THERE ARE OTHER OBJECTIVES IN ENGINEERING PARALLELING THOSE OF RESEARCH, DEVELOPMENT AND DESIGN. SUCH OBJECTIVES ARE WIDELY DIVERSIFIED AND INCLUDE MANAGEMENT, CONSTRUCTION, OPERATION AND ALSO SERVICE IN MANY AREAS THAT LIE BETWEEN ENGINEERING AND THE OTHER PROFESSIONS OF LAW, MEDICINE, BUSINESS, AGRICULTURE, ETC.

ENGINEERING EDUCATION TRADITIONALLY HAS PREPARED STUDENTS FOR SERVICE IN ALL OF THESE FIELDS. CURRICULA DESIGNED FOR SUCH DIVERSIFIED OBJECTIVES CANNOT BE SPECIFIED WITH THE DEFINITENESS THAT IS POSSIBLE FOR THOSE IN RESEARCH AND DESIGN. INSTEAD EACH INSTITUTION HAS THE OPPORTUNITY TO SET ITS OWN OBJECTIVES AND TO DESIGN THE MORE GENERAL ENGINEERING CURRICULA TO MEET THE SPECIFIED OBJECTIVES. THE COMMITTEE MERELY WISHES TO RECOMMEND THAT IN EACH CASE FULL CONSIDERATION BE GIVEN TO THE NEEDED BACKGROUND OF THE STUDENT IN THE ENGINEERING SCIENCES AS PREVIOUSLY DEFINED AND THAT THERE BE NO STINTING OF THE STUDIES IN BASIC SCIENCE THAT ARE NECESSARY TO MAKE THE WORK IN ENGINEERING SCIENCE AN ADEQUATE BASIS FOR PROFESSIONAL ENGINEERING. WHEN THESE OBJECTIVES ARE MET THE REST OF THE PROGRAM MAY BE VARIED TO MEET THE SPECIFIED PURPOSE OF THE MORE GENERAL ENGINEERING CURRICULUM.

ANALYSIS, DESIGN AND ENGINEERING SYSTEMS. IT IS BELIEVED THAT PREPARATION FOR DESIGN RATHER THAN EXCESSIVE EMPHASIS ON PRACTICAL DESIGN ITSELF CHARACTERIZES ENGINEERING CURRICULA. CAPACITY TO DESIGN INCLUDES WILLINGNESS TO ATTACK A SITUATION NEVER SEEN OR STUDIED WITH AN ACCEPTANCE OF FULL RESPONSIBILITY FOR SOLVING THE PROBLEM PRESENTED ON A PROFESSIONAL BASIS. THE FOLLOWING MEANS ARE AVAILABLE FOR DEVELOPING AN UNDERSTANDING OF SYNTHESIS, DEVELOPMENT WORK AND DESIGN: (1) THESES, (2) PROJECT METHODS, (3) GROUP OPERATIONS, (4) COMPETITION BETWEEN GROUPS, (5) USE OF REALISTIC INDUSTRIAL PROBLEMS, (6) USE OF SOME UNSOLVED PROBLEMS FOR STIMULATION, (7) EXAMINATIONS OF A NON-ROUTINE NATURE, AND (8) REVERSAL OF THE USUAL SHORT PROBLEM STATEMENT IN INTRODUCTORY COURSES BY LEAVING ONE OR MORE DESIGN CHARACTERISTICS TO BE DETERMINED INSTEAD OF HAVING ALL CHARACTERISTICS GIVEN WITH ONLY PERFORMANCE REQUESTED. THE JUNIOR AND SENIOR COURSES IN ANALYSIS AND DESIGN PROVIDE THE MOST FAVORABLE OPPORTUNITY FOR USE OF PROBLEMS

INVOLVING NEW SITUATIONS FOR SOLUTION. ROUTINE REPETITIVE FEATURES OF DESIGN INCLUDING USE OF HANDBOOK MATERIAL SHOULD NOT BE EMPHASIZED. COURSES THAT EMPHASIZE DESCRIPTION OF STRUCTURES, EQUIPMENT OR MACHINES, OR INCLUDING THEIR CONSTRUCTION, OPERATION AND MAINTENANCE ARE NOT PROPERLY CLASSIFIED AS ANALYSIS OR DESIGN AND HAVE NO PLACE IN ENGINEERING EDUCATION. SUCH PHASES OF THE ART OF ENGINEERING ARE TAUGHT WITH RELATIVE INEFFECTIVENESS IN THE CLASSROOM AS COMPARED WITH FIELD OBSERVATION.

NON-DEPARTMENTAL ENGINEERING COURSES. THE VALUE OF NON-DEPARTMENTAL ENGINEERING COURSES SUCH AS ELECTRICAL ENGINEERING FOR NON-ELECTRICALS, HEAT ENGINES FOR NON-MECHANICALS, ETC., SHOULD NOT DEVOTE APPRECIABLE TIME TO THE TREATMENT OF SPECIAL MACHINES OR DEVICES. THE MOST IMPORTANT ENGINEERING BACKGROUND OF THE PROFESSIONAL ENGINEER BEYOND HIS SPECIALITY LIES IN THE ENGINEERING SCIENCES, THAT IS, IN HIS KNOWLEDGE OF MECHANICS, THERMODYNAMICS, FLUID FLOW, HEAT TRANSFER, CIRCUITS, ELECTRONICS, FIELD THEORY, ENGINEERING MATERIALS AND PHYSICAL METALLURGY.

THE STUDY OF ENGINEERING MATERIALS INCLUDING TESTING MATERIALS IS USUALLY SCATTERED THROUGH SEVERAL COURSES AND SHOULD BE COORDINATED TO STRENGTHEN THE CURRICULUM. CERTAIN PARTS OF LABORATORY AND SHOP COURSES MUST BE EVALUATED UPON THEIR CONTRIBUTION TO THIS OBJECTIVE, OR TO SUCH TRAINING IN THE THEORY AND EXPERIENCE IN MEASUREMENT AS IS NECESSARY FOR ENGINEERS. RECOGNITION THAT APPROXIMATIONS ARE ALWAYS INVOLVED, AND APPRECIATION OF THE DEGREE OF ACCURACY REQUIRED AND THAT AVAILABLE THROUGH DIFFERENT TYPES OF MEASUREMENTS, INCLUDING STATISTICAL ANALYSIS OF ERRORS, ARE IMPORTANT PHASES OF THE STUDY OF MEASUREMENT.

GRAPHICAL REPRESENTATION IS BOTH A FORM OF COMMUNICATION AND A TOOL FOR ANALYSIS. ITS PROFESSIONAL USEFULNESS MAY BE EVALUATED IN TERMS OF ITS SUCCESS IN THESE DIRECTIONS. ITS VALUE AS A SKILL ALONE DOES NOT JUSTIFY ITS INCLUSION IN A CURRICULUM. THE ABILITY TO CONVEY IDEAS BY DRAWING SHOULD BE MEASURED AT AN APPROPRIATE TIME AND WHERE DEFICIENT SHOULD BE DEVELOPED SO THAT ITS USE IS EVIDENT IN THE REPORTS PRESENTED IN ADVANCED COURSES. ANOTHER ABILITY TO BE DEVELOPED IN THIS STUDY IS SPATIAL VISUALIZATION. SINCE MOST CREATIVE ENGINEERING WORK IS INITIATED BY THE PROCESS OF ILLUSTRATING IDEAS BY SKETCHES, IT IS BELIEVED THAT AN EXPERIENCE IN THE USE OF TECHNICAL SKETCHING THAT MAY BE OBTAINED IN DRAWING OFFERS THE OPPORTUNITY FOR INITIATING THE CREATIVE PROCESS.

HUMANISTIC-SOCIAL STUDIES. SOCIAL STUDIES AND THE HUMANITIES SHOULD BE PART OF AN ENGINEER'S EDUCATION. SUCH STUDIES REVEAL THE RICHNESS OF HUMAN EXPERIENCE SO THAT STUDENTS MAY IN TURN ENRICH THEIR OWN LIVES. THEY TRACE THE POLITICAL, ECONOMIC, AND SOCIAL HISTORY OF MANKIND TO GIVE STUDENTS A CLEARER PERSPECTIVE OF OUR CIVILIZATION TODAY. THEY PROVIDE INSPIRATION FOR SEEKING GREATER KNOWLEDGE AND UNDERSTANDING. THEY ARE SOURCES OF KNOWLEDGE FROM WHICH TO DEVELOP JUDGMENT AND DISCRIMINATION, A SENSE OF VALUE, AND A SOUND PERSONAL PHILOSOPHY.

TRADITIONALLY ALL OF THIS HAS BEEN ACCOMPLISHED, SUPPOSEDLY, BY INCLUDING COURSES IN THE SOCIAL STUDIES AND THE HUMANITIES IN ENGINEERING CURRICULA. SUCH COURSES ARE NOT ENOUGH. THE ATMOSPHERE IN AN ENGINEERING COLLEGE, INTANGIBLE THOUGH IT MAY BE, MUST BE FAVORABLE TO LIBERAL EDUCATION. ONE ENGINEERING INSTRUCTOR DISDAINING THE HUMANITIES CAN REDUCE THE



VALUE OF SUCH COURSES FOR HIS ENGINEERING STUDENTS WHO NATURALLY RESPECT HIS OPINIONS. UNTIL ENGINEERING FACULTIES ADOPT AN APPRECIATIVE AND UNDERSTANDING ATTITUDE TOWARD THEIR COLLEAGUES IN LIBERAL ARTS, THE VALUE OF SUCH COURSES WILL BE PARTIALLY LOST. THEIR PRIMARY PURPOSE IS NOT TO SUPPLY TOOLS FOR SOLVING ENGINEERING PROBLEMS, BUT RATHER TO DEVELOP A BROADLY EDUCATED MAN CAPABLE OF INTELLECTUAL ENJOYMENT AND A WISE CITIZEN. IT IS RECOGNIZED THAT KNOWLEDGE IN MANY AREAS OF THE LIBERAL ARTS CAN BE USED TO ADVANTAGE AND FREQUENTLY MUST BE USED IN THE SOLUTION OF PROBLEMS BY THE ENGINEER. BUT, THIS MUST NOT BE THE "RAISON D'ETRE" FOR THIS PART OF AN ENGINEER'S EDUCATION.

THE VALUE OF PERSONAL ASSOCIATION OF THE ENGINEERING STUDENT WITH OTHER STUDENTS AND WITH PROFESSORS, BOTH IN ENGINEERING AND IN LIBERAL ARTS, CANNOT BE OVERLOOKED. THE EXCHANGE OF IDEAS AND OPINIONS IN OPEN DISCUSSION IS A SOURCE OF STIMULATION TO ACQUIRE GREATER KNOWLEDGE.

ONE ASPECT OF ENGLISH MERITS SPECIFIC COMMENT. INSTEAD OF SOLE DEPENDENCE UPON SPECIFIED COURSES, A LEVEL OF PERFORMANCE SHOULD BE REQUIRED IN WRITTEN AND ORAL COMMUNICATION OF ALL ENGINEERING STUDENTS WHICH WILL DEVELOP IN THEM THE ABILITY TO CONVEY THEIR IDEAS TO OTHERS IN A CLEAR, LOGICAL AND INTERESTING MANNER USING CORRECT AND CONCISE LANGUAGE. THE ATTAINMENT OF THIS OBJECTIVE IS THE JOINT RESPONSIBILITY OF ALL TEACHERS.

#### METHODS OF INTRODUCING REQUIRED NEW MATERIAL

IN THE PRECEDING SECTION IT WAS RECOMMENDED THAT ADDITIONAL MATERIAL BE INTRODUCED INTO THE CURRICULUM. AT THE SAME TIME IT IS SUGGESTED THAT MORE EMPHASIS BE PLACED ON THE DEVELOPMENT OF LEADERSHIP, INDIVIDUAL INITIATIVE AND THE ABILITY TO READ AND APPLY THE CURRENT LITERATURE TO NEW PROBLEMS. NO RECOMMENDATION IS MADE TO INCREASE THE NUMBER OF YEARS IN TRAINING. IT IS FELT THAT EACH SCHOOL WILL WISH TO CHOOSE ITS OWN METHOD OF ACCOMPLISHING THESE GOALS. NEVERTHELESS, SOME SPECIFIC ILLUSTRATIONS OF METHODS OF OBTAINING THESE OBJECTIVES MAY BE IN ORDER.

THERE ARE AT LEAST FOUR WAYS OF ACCOMPLISHING THE INCLUSION OF ADDITIONAL MATERIAL:

- 1) RAISE THE PREREQUISITES FOR ENTRANCE. THIS MIGHT ENTAIL
  - A. MORE ADEQUATE HIGH SCHOOL PREPARATION.
  - B. HIGHER SELECTIVITY.
  - C. PRE-PROFESSIONAL COLLEGE WORK.
- 2) EXTEND THE CURRICULUM TO COVER FIVE OR MORE YEARS.
- 3) ELIMINATE SOME OF THE MATERIAL NOW IN THE CURRICULUM.
- 4) INCREASE THE EFFICIENCY OF INSTRUCTION.

A GREAT DEAL HAS BEEN WRITTEN ABOUT HIGH SCHOOL PREPARATION. CONTINUING ENCOURAGEMENT SHOULD BE GIVEN TO HIGH SCHOOLS TO RAISE THEIR STANDARDS AND TO GIVE SPECIAL TRAINING TO COLLEGE BOUND YOUNGSTERS, INCLUDING ENGINEERING STUDENTS.

THE REQUIREMENT OF EITHER PRE-PROFESSIONAL WORK OR AN INCREASE IN THE PROFESSIONAL TRAINING PERIOD INVOLVES AN UNDESIRABLE FINANCIAL BURDEN AND A REDUCTION IN THE NUMBER OF PRODUCTIVE YEARS. HIGHER SELECTIVITY WOULD DECREASE THE NUMBER OF APPLICANTS AT THE VERY TIME WHEN NATIONAL SURVIVAL CALLS FOR THE ELIMINATION OF THE PRESENT SHORTAGE OF ENGINEERS.

THERE IS THE POSSIBILITY OF INCREASING THE EFFICIENCY OF INSTRUCTION OR OF ELIMINATING SOME OF THE EXISTING COURSE CONTENT. SEVERAL OF THE INSTITUTIONAL COMMITTEES HAVE DISCUSSED THE EXCESSIVE DUPLICATION EXISTING BETWEEN BOTH THE MATERIAL COVERED IN MATHEMATICS, PHYSICS AND MECHANICS, AND BETWEEN THE MATERIAL COVERED IN THESE BASIC COURSES AND THAT COVERED IN ADVANCED ENGINEERING COURSES. IT IS NOT UNCOMMON TO HEAR REMARKS REGARDING THE INABILITY OF STUDENTS TO LEARN FUNDAMENTALS OF ELECTRICITY IN PHYSICS, AND OF THEIR HAVING TO START ALL OVER AGAIN IN ELECTRICAL ENGINEERING. SIMILAR REMARKS INVOLVE MECHANICS AND MATHEMATICS, AND COLLEGE MATHEMATICS AND HIGH SCHOOL MATHEMATICS. THERE IS DOUBTLESS SOME TRUTH IN THESE STATEMENTS BUT USUALLY THE PROBLEM IS DEEPER AND FREQUENTLY RESULTS FROM A LACK OF COORDINATION, COOPERATION AND EXCHANGE OF INFORMATION AMONG DEPARTMENTS.

THE COMMITTEE FEELS THAT THE ADDED REQUIREMENTS IN BASIC ENGINEERING SCIENCE CAN BE MET BY (1) ELIMINATION OF SOME SPECIALIZED SUBJECTS IN THE PROFESSIONAL FIELD OF ENGINEERING AND (2) BY INCREASED EFFICIENCY OF INSTRUCTION. SUCCESSFUL PROFESSIONAL ENGINEERS IN THE INDUSTRIAL FIELD DEPEND UPON INCREASED EFFICIENCY FOR SUCCESS, AND A PROFESSIONAL ENGINEER IN EDUCATION SHOULD BE NO EXCEPTION.

#### PROVIDING OPPORTUNITIES FOR GIFTED STUDENTS

IT SEEMS EVIDENT THAT THE STANDARDIZATION OF ENGINEERING CURRICULA HAS PROVIDED LITTLE OPPORTUNITY FOR STUDENTS OF HIGH ABILITIES, AND FOR STUDENTS WITH CREATIVE TALENTS, TO DEVELOP THESE CAPACITIES AT THEIR GREATEST POSSIBLE RATE. TYPICAL CLASSROOM STUDIES ARE ORGANIZED TO PROCEED AT A RATE THAT CAN ALWAYS BE FOLLOWED BY THE AVERAGE AND COMMONLY BY THE BELOW-AVERAGE STUDENT. AT SOME PLACE IN THE UNDERGRADUATE PROGRAM THERE SHOULD BE AN OPPORTUNITY TO BREAK DOWN THIS LOCK-STEP AND PERMIT THE GIFTED STUDENT FULL PLAY OF HIS INTELLECTUAL AND CREATIVE POWERS.

A PART OF THE REASON WHY GIFTED STUDENTS HAVE PROBABLY RECEIVED THE LEAST BENEFIT FROM ENGINEERING EDUCATION IS THAT INDIVIDUAL ATTENTION IS CONSIDERED TO BE MORE COSTLY THAN MASS EDUCATION. HOWEVER, EVIDENCE HAS BEEN WIDELY PRESENTED THAT THE MAIN NEED OF GIFTED OR CREATIVE STUDENTS IS NOT LONG HOURS OF INSTRUCTIONS BUT FREEDOM TO PROCEED ALONE OR IN WORKING CONTACT WITH STAFF MEMBERS, BUT WITH VERY LIMITED FORMAL INSTRUCTION. IT IS DOUBTFUL THAT COST ALONE IS A SUFFICIENT REASON WHY STUDENTS OF EXCEPTIONABLE ABILITIES CANNOT BE GIVEN FAR GREATER OPPORTUNITIES TO DEVELOP TO THE FULL THEIR INTELLECTUAL POWERS INCLUDING CAPACITY FOR CREATIVE PRODUCTION.

IT DOES NOT SEEM NECESSARY TO OUTLINE HOW THE SPECIAL EDUCATION OF GIFTED STUDENTS MAY PROCEED. ALL OF THE EXPERIENCE OF "HONORS WORK" IN SCIENCE DEPARTMENTS IS AVAILABLE FOR CONSIDERATION. ACTIVE RESEARCH LABORATORIES EXIST IN A LARGE PROPORTION OF ENGINEERING INSTITUTIONS AND RESEARCH DIRECTORS SEEM TO HAVE A PERMANENT SHORTAGE OF COMPETENT ASSISTANTS. SUCH ASSOCIATION OF AN UNDERGRADUATE STUDENT WITH A COORDINATED RESEARCH PROJECT CAN HAVE GREAT EDUCATIONAL VALUE IF IT IS PROPERLY SUPERVISED. IT COULD, OF COURSE, BE ONLY A ROUTINE TECHNICIAN TYPE OF EXPERIENCE IF THIS SHOULD BE PERMITTED.



THE MAIN FACTOR IN THE ENCOURAGEMENT OF STUDENTS OF HIGH INTELLECT OR OF CREATIVE ABILITY IS THE WILL TO BREAK WITH THE TRADITIONAL ORGANIZATION OF COURSE, CLASSES AND CREDITS EARNED THEREIN AT SOME PLACE IN THE UNDERGRADUATE PROGRAM. THERE ARE OTHER VITAL EXPERIENCES WITHIN UNIVERSITIES THAT GO BEYOND THE CLASSROOM AND THE GREATEST OF THESE IS THE OPPORTUNITY TO SEEK KNOWLEDGE WITHOUT A DETAILED PLAN BEING SUPERIMPOSED FROM ABOVE THE STUDENTS' LEVEL. WHEN HE IS GIVEN A CONSIDERABLY ENHANCED RESPONSIBILITY FOR HIS OWN EDUCATION HE IS MORE THAN LIKELY TO RESPOND IN A FAVORABLE, ENTHUSIASTIC MANNER IF HE HAS INTELLECTUAL GIFTS ABOVE THE AVERAGE OF HIS FELLOWS. THE STRONGEST ENCOURAGEMENT SHOULD BE GIVEN TO THOSE TEACHERS AND ADMINISTRATORS WHO WOULD LIKE TO EXPERIMENT IN INCREASING THE RESPONSIBILITY OF GIFTED STUDENTS FOR THEIR OWN EDUCATION.

#### FUTURE DEMANDS ON ENGINEERING EDUCATION

THE CURRICULAR AREAS DISCUSSED IN ONE OF THE PREVIOUS SECTIONS COVERED IN DETAIL THE ESSENTIAL SUBJECT MATTER REQUIRED FOR A BROAD FOUNDATION IN SCIENCE AND THE HUMANISTIC-SOCIAL STUDIES, AS WELL AS THE MATERIAL PECULIAR TO ENGINEERING AND NECESSARY FOR FUTURE PROFESSIONAL DEVELOPMENT. THESE RECOMMENDATIONS MUST BE RECOGNIZED AS CURRENT SPECIFICATIONS DESIGNED TO ADVANCE THE PRESENT STATUS OF ENGINEERING EDUCATION AND TO PREPARE ENGINEERS FOR PRACTICE A GENERATION HENCE.

ENGINEERING EDUCATION CANNOT, HOWEVER, REMAIN STATIC. IN TIME, OTHER EXISTING AREAS MAY BECOME IMPORTANT TO ENGINEERING AND NEW SCIENTIFIC ADVANCES WILL BE MADE. THESE, TOO, WILL NEED TO BE INCLUDED AS THE BASE OF ENGINEERING SERVICE TO SOCIETY BROADENS.

IT IS ALWAYS HAZARDOUS TO PROPHECY THE FUTURE, BUT THERE NOW SEEMS TO BE LITTLE DOUBT THAT THE RECENT DEVELOPMENTS IN SOLID STATE AND NUCLEAR PHYSICS WILL FIND NUMEROUS ENGINEERING APPLICATIONS WITHIN THE NEXT GENERATION. SUCH TRENDS WILL PARALLEL THE APPLICATIONS OF PREVIOUS SCIENTIFIC DISCOVERIES TO SUCH PRESENT DAY DEVELOPMENTS AS JET ENGINES, ROCKET PROPULSION, FREQUENCY MODULATION AND ULTRASONICS.

ENGINEERING EDUCATION WILL NEED TO BROADEN ITS OBJECTIVES AND INCLUDE TECHNOLOGICAL PLANNING IN THE CONSERVATION OF RESOURCES, IN THE MORE EFFICIENT UTILIZATION OF MATERIAL AND CONVERSION OF POWER. SHEER PRESSURE OF THE WORLD'S POPULATION AND MAINTENANCE OF EVEN EXISTING LIVING STANDARDS WILL TAX THE ENGINEERING PROFESSION'S ABILITIES TO THE UTMOST. STUDENTS MUST BE MADE AWARE OF THESE TRENDS.

IF ONLY A FEW OF THE NEW DEVELOPMENTS IN SCIENCE ARE APPLIED IN PRODUCTIVE FIELDS, ENGINEERS TO COPE WITH THEM WILL NEED A MUCH MORE FUNDAMENTAL TRAINING IN SCIENCE AND MATHEMATICS THAN THAT SPECIFIED IN THE CURRICULAR AREAS DESCRIBED PREVIOUSLY. IT APPEARS EVIDENT THAT ENGINEERING EDUCATORS MUST FIND MORE EFFICIENT WAYS OF PRESENTING SUBJECT MATTER, AND BE ALERT TO INCORPORATE NEW THEORIES AND MATERIAL INTO AN EVER BROADENING EDUCATIONAL PROGRAM. AT THE SAME TIME, THE STUDENTS MUST BE MADE MORE COGNIZANT OF THE IMPACT OF TECHNOLOGY ON SOCIETY AND BE PREPARED TO ASSUME THEIR RESPONSIBILITY IN PUBLIC LEADERSHIP. THIS IS NO SMALL TASK AND CALLS FOR MORE TRAINING THAN A FOUR YEAR PROGRAM CAN HOPE TO PROVIDE. FOR MANY THIS INCREASED TRAINING WILL HAVE TO COME FROM GRADUATE STUDY AT THE HIGHEST

PROFESSIONAL LEVEL. FOR OTHERS, INDUSTRIAL EXPERIENCE OR SELF-STUDY MAY SUFFICE. CONSIDERING THE NEW DEMANDS CONTINUALLY BEING PLACED UPON ENGINEERS, IT APPEARS INEVITABLE THAT THE EDUCATIONAL LEVEL OF PRACTICING ENGINEERS WILL BE CONTINUALLY RISING FOR THE FORSEEABLE FUTURE.

## GENERAL FACTORS AND BROAD CURRICULAR DIVISIONS RELATED TO ACCREDITATION

### INTRODUCTION

THE RECENT EXTRAORDINARY ADVANCES OF SCIENCE AND THE PROJECTED APPLICATION OF THESE DISCOVERIES TO FUTURE ENGINEERING PRACTICE INDICATE THE NEED OF A REVISION IN CURRENT ENGINEERING EDUCATION IF MEN ARE TO BE TRAINED NOW WHO ARE CAPABLE OF ASSUMING PROFESSIONAL LEADERSHIP A GENERATION HENCE. SUCH EDUCATION SHOULD BE DESIGNED TO DEVELOP ADEQUATE PROFESSIONAL COMPETENCE IN STUDENTS UPON GRADUATION, AND SHOULD BE ACCREDITED TO AVOID IN SO FAR AS POSSIBLE THE TRAGEDY OF TALENTED INDIVIDUALS PURSUING QUESTIONABLE CURRICULA. THE FACTORS WHICH HAVE A BEARING ON THIS PROBLEM, AND WHICH ARE DISCUSSED IN THIS REPORT, INCLUDE ACADEMIC STANDARDS, FACULTIES, REQUIREMENTS FOR ADMISSION, ENVIRONMENT, AND TYPES AND CONTENT OF CURRICULA. MINIMUM STANDARDS FOR EACH OF THESE ARE ESTABLISHED AND HIGHER THAN MINIMUM STANDARDS ARE SUGGESTED.

### RESOLUTION ON ACCREDITATION ADOPTED BY ECPD

THE COMMITTEE ON THE EVALUATION OF ENGINEERING EDUCATION HAS RECEIVED REPORTS FROM THE INSTITUTIONAL COMMITTEES, FROM THE EDUCATION COMMITTEE OF ECPD, FROM RESEARCH AND INDUSTRIAL GROUPS, AND FROM STATE BOARDS OF REGISTRATION, ALL RELATING TO THE STATUS OF ENGINEERING EDUCATION WITH RESPECT TO UNDERGRADUATE PREPARATION FOR THE FUTURE NEEDS OF THE YOUNG ENGINEER. THE COMMITTEE IS IMPRESSED WITH THE PREPONDERANCE OF EVIDENCE THAT A SIGNIFICANT NUMBER OF ENGINEERING CURRICULA ARE NOT ADEQUATELY PREPARING THE ENGINEERING GRADUATE. IT IS CLEAR TO THE COMMITTEE THAT THE ACCREDITING FUNCTION OF ECPD CANNOT OF ITSELF EFFECTIVELY OR PROPERLY CARRY THE LOAD OF ADVANCING THE MINIMUM STANDARDS OF ENGINEERING CURRICULA. IN ADDITION, ECPD REQUIRES THE FULL SUPPORT OF THE ENGINEERING EDUCATIONAL PROFESSION IN SUCH AN EFFORT, IT IS, THEREFORE,

RESOLVED THAT THIS COMMITTEE APPROVES A SUBSTANTIAL RAISING OF THE MINIMUM STANDARDS OF ACCREDITATION OF UNDERGRADUATE CURRICULA BY ECPD; AND THAT IT SUPPORTS A MOTION THAT THE SOCIETY GO ON RECORD IN APPROVAL OF SUCH ADVANCEMENT OF MINIMUM STANDARDS.

THIS RESOLUTION WAS ADOPTED BY THE GENERAL COUNCIL OF ASEE AT GAINESVILLE, FLORIDA, ON JUNE 23, 1953. IT WAS LATER ACCEPTED BY ECPD AS A GUIDE FOR ACCREDITATION BY THE ECPD COMMITTEE ON EDUCATION.

### FACULTY REQUIREMENTS FOR ACCREDITATION

THE EXISTENCE OF AN ADEQUATE FACULTY IS MORE IMPORTANT TO THE ADVANCEMENT OF ENGINEERING EDUCATION THAN THE DETAILS OF CURRICULA OR THE EXTENT OF FACILITIES. THERE SHOULD BE IN EACH DEPARTMENTAL FACULTY RESPONSIBLE FOR ANY CURRICULUM SUBMITTED FOR ACCREDITATION, AND IN THE MAJOR SUPPORTING GROUPS AS WELL, AT LEAST ONE IN EVERY FIVE WHO HAS ATTAINED PROFESSIONAL DISTINCTION.

SUCH INDIVIDUALS WILL (1) BE CONDUCTING HIGH GRADE RESEARCH OF AN ENGINEERING OR EDUCATIONAL NATURE OR OTHER CREATIVE ACTIVITY INCLUDING PUBLISHING OF GOOD QUALITY, (2) BE ENGAGING IN CONSULTING WORK AT A CREATIVE LEVEL, (3) BE EXERCISING LEADERSHIP IN SCIENTIFIC, EDUCATIONAL AND PROFESSIONAL SOCIETIES, OR PREFERABLY (4) BE SERVING IN A COMBINATION OF SUCH ACTIVITIES. IN DETERMINING THE LEVELS AT WHICH THE CONTRIBUTION OF THE INDIVIDUAL CAN BE MADE, CONSIDERATION SHOULD BE GIVEN TO THE ACQUISITION OF THE DOCTOR'S DEGREE PARTICULARLY BY YOUNGER STAFF MEMBERS, AND TO THE BACKGROUND OF HIGH QUALITY INDUSTRIAL OR OTHER ENGINEERING EXPERIENCE THAT ENHANCES COMPETENCY FOR CREATIVE TEACHING, INCLUDING THE EXTENT OF RESPONSIBLE CHARGE. THE ACCOMPLISHMENTS OF OTHER MEMBERS OF THE FACULTY WILL BE VALUED IN TERMS OF THEIR PROGRESS TOWARD THE ATTAINMENT OF PROFESSIONAL DISTINCTION AS DEFINED ABOVE.

#### STUDENT SELECTION AND ADVANCED STANDING

REQUIREMENTS FOR ADMISSION WITH FULL STANDING TO AN ACCREDITED ENGINEERING SCHOOL MUST OF NECESSITY BE RATHER RIGOROUS TO INSURE ADEQUATE PREPARATION FOR THE STUDENT TO PURSUE AN ENGINEERING CURRICULUM IN AN ORDERLY AND EFFECTIVE MANNER.

THE COMMITTEE RECOMMENDS THAT THE FOLLOWING REQUIREMENTS FOR ADMISSION WITH FULL STANDING BE CONSIDERED AS MINIMUM STANDARDS FOR ACCREDITED ENGINEERING SCHOOLS FOR ALL STUDENTS:

1. GRADUATION FROM AN ACCREDITED HIGH SCHOOL.
2. STANDING IN THE UPPER QUARTER OF THE GRADUATING CLASS.
3. ACCUMULATION OF AT LEAST 3 UNITS OF MATHEMATICS (INCLUDING ALGEBRA AND GEOMETRY), 3 UNITS OF ENGLISH AND 1 UNIT OF SCIENCE OUT OF A TOTAL OF 16 UNITS, OF WHICH NOT MORE THAN 2 UNITS IN DRAWING, SHOP OR VOCATIONAL COURSES MAY BE INCLUDED.
4. EVIDENCE OF APTITUDE FOR ENGINEERING AS MEASURED BY AN EXAMINATION AND/OR BY A PERSONAL INTERVIEW.

IF ENGLISH AND MATHEMATICS APTITUDE OR COMPETENCY EXAMINATIONS ARE NOT INCLUDED IN ITEM 4 FOR ADMISSION, THEY SHOULD BE USED FOR POST ADMISSION PLACEMENT PURPOSES.

THOSE STUDENTS UNABLE TO MEET THE REQUIREMENTS FOR ADMISSION WITH FULL STANDING MAY BE ADMITTED ON A PROVISIONAL BASIS UNTIL THEY MAKE UP DEFICIENCIES IN SPECIFIED UNITS, WITHOUT COLLEGE CREDIT, AND HAVE DEMONSTRATED A CAPACITY TO MAINTAIN THE MINIMUM AVERAGE REQUIRED FOR GRADUATION. IT IS RECOMMENDED THAT THE NUMBER OF STUDENTS SO ADMITTED CONSTITUTE A MINORITY OF THEIR CLASS AND THAT THEY SHOULD NOT BE CONSIDERED AS BEING ENROLLED IN FULL STANDING UNTIL ALL DEFICIENCIES ARE REMOVED.

STUDENTS TRANSFERRING FROM ACCREDITED JUNIOR, LIBERAL ARTS OR OTHER ENGINEERING COLLEGES SHOULD BE ADMITTED ON A PROVISIONAL BASIS, AND THE FINAL TRANSFER OF THEIR CREDITS SHOULD BE DELAYED UNTIL THEIR SUBSEQUENT RECORDS INDICATE MAINTENANCE OF THE REQUIRED GRADE POINT AVERAGE FOR GRADUATION. A REALISTIC EVALUATION OF CREDITS PRESENTED FOR ADVANCED STANDING SHOULD BE MADE ON THE BASIS OF COURSE CONTENT RATHER THAN ON AN INFLEXIBLE BASIS OF EQUIVALENT CREDIT HOURS.

## ENVIRONMENT AS A FACTOR INFLUENCING EDUCATION

COLLEGIATE ENGINEERING EDUCATION EMBODIES TRAINING FOR A LIFE TIME OF PROFESSIONAL DEVELOPMENT IN ADDITION TO THE ACQUISITION OF CULTURE AND THE ACCUMULATION OF KNOWLEDGE. IF SUCH OBJECTIVES ARE TO BE REALIZED, IT IS ESSENTIAL THAT A SUITABLE ACADEMIC AND PHYSICAL ENVIRONMENT FOR BOTH FACULTY AND STUDENTS EXIST AT EVERY ACCREDITED INSTITUTION.

THE COMMITTEE RECOMMENDS THAT ACCREDITING TEAMS CONSIDER IN THEIR INSPECTION SUCH FACTORS AS STAFF ORGANIZATION, PERSONNEL RELATIONSHIPS, OFFICE SPACE AND FURNISHINGS, TEACHING LOADS, TENURE, SALARY SCALES, ETC., ALL AS RELATED TO THE QUALITY OF INSTRUCTION. THE COMMITTEE ALSO FEELS THAT PHYSICAL FACILITIES, SUCH AS CLASS ROOMS, LABORATORIES AND EQUIPMENT SHOULD BE ADEQUATE FOR FIRST RATE INSTRUCTION, RECREATIONAL FACILITIES SHOULD BE SUFFICIENT FOR THE DEVELOPMENT OF EXTRA-CURRICULAR STUDENT ACTIVITIES, AND A SUITABLE STUDENT COUNSELING SYSTEM FOR ACADEMIC, PERSONAL AND PROFESSIONAL GUIDANCE SHOULD BE MAINTAINED IN THE INSTITUTION AND SHOULD BE CONSIDERED IN AN ACCREDITING INSPECTION.

THE ADEQUACY OF THE LIBRARY, ITS ACCESSIBLE LOCATION AND REQUIRED USE ARE ESSENTIAL ELEMENTS IN ANY INSPECTION FOR ACCREDITATION. THE EXTENT OF INSPIRATION TOWARD PROFESSIONAL SELF IMPROVEMENT THROUGH SELF DIRECTED STUDY BOTH WHILE IN COLLEGE AND PARTICULARLY AFTER GRADUATION IS AN IMPORTANT MEASURE OF THE EFFECTIVENESS OF THE ENTIRE EDUCATIONAL OPERATION.

## MEASURING STUDENT ACCOMPLISHMENT

THE BEST FACILITIES AND CURRICULA WILL NOT IN THEMSELVES DEVELOP MEN CAPABLE OF ATTAINING PROFESSIONAL STATURE IF HIGH ACADEMIC STANDARDS ARE NOT MAINTAINED. STUDENT GRADES ARE NOT NECESSARILY AN INDICATION THAT THE INDIVIDUAL INSTITUTIONAL STANDARDS MEET PROFESSIONAL REQUIREMENTS FOR ACCREDITATION. SUCH STANDARDS CAN EASILY BE MEASURED BY INSPECTION OF REPRESENTATIVE EXAMINATIONS AND REPORTS AND BY THE FACULTIES' GRADING THEREOF. ACCREDITATION IMPLIES THE EXISTENCE OF SUITABLE STANDARDS OF ACCOMPLISHMENT IN ENGINEERING COLLEGES.

## FACTORS INFLUENCING FUNCTIONAL DIVERGENCE OF CURRICULA

ENGINEERING EDUCATION IS TRAINING FOR PROFESSIONAL SERVICE AND THE COMMITTEE RECOGNIZES ITS RESPONSIBILITY FOR DEVELOPING ENGINEERS WHO WILL APPLY THEMSELVES TO PROFESSIONAL SCIENTIFIC ACTIVITIES IN ENGINEERING. EDUCATION IN ENGINEERING ALSO HAS LONG SERVED A MOST USEFUL PURPOSE IN TRAINING LARGE NUMBERS OF INDIVIDUALS FOR GENERAL PROFESSIONAL SERVICE. BOTH TYPES OF EDUCATION HAVE IN COMMON THE RESPONSIBILITY FOR PREPARING THE LEADERS OF THE PROFESSION 25 YEARS HENCE.

GENERAL PROFESSIONAL ENGINEERING SERVICE IS FOUND IN THE AREAS BETWEEN ENGINEERING AND (1) BUSINESS, MANAGEMENT, LAW, REAL ESTATE, OR AGRICULTURE; (2) BETWEEN ENGINEERING AND A BRANCH OF SCIENCE WHERE THE OPPORTUNITIES FOR APPLYING ENGINEERING ANALYSIS AND DESIGN MAY BE LIMITED; OR (3) BETWEEN ENGINEERING AND A HIGHLY APPLIED TECHNOLOGY SUCH AS PRODUCTION PROCESSES, OPERATION, CONSTRUCTION OR AIR CONDITIONING, WELDING, WOOD TECHNOLOGY.

IN RETROSPECT, IT SEEMS CLEAR THAT THE TYPICAL ENGINEERING CURRICULUM OF THE PERIOD FROM 1910 TO NEARLY 1940 SERVED EQUALLY WELL AS SPECIALIZED PROFESSIONAL ENGINEERING EDUCATION AND ALSO AS EDUCATION FOR THOSE WHOSE INTERESTS WERE OF A GENERAL PROFESSIONAL NATURE. SINCE 1940 MANY IMPORTANT CHANGES HAVE OCCURED. ELECTRONIC DEVELOPMENTS HAVE DEMANDED GREATER KNOWLEDGE OF PHYSICS FROM ELECTRICAL ENGINEERS. STRUCTURAL PROBLEMS CREATED BY THE CONTINUITY PRODUCED BY WELDING, VIBRATIONS OF SUSPENSION BRIDGES, SOIL MECHANICS, ETC., DEMONSTRATED THE NEED FOR A GREATER SCIENTIFIC BACKGROUND FOR CIVIL ENGINEERS. MECHANICAL ENGINEERS HAVE FOUND NEW FIELDS OF RESEARCH IN HEAT TRANSFER, FLUID MECHANICS AND LATER IN JET PROPULSION. PRACTICAL METALLURGY CHANGED GRADUALLY FROM AN ART TO A SCIENCE BASED UPON PHYSICAL CHEMISTRY AND PHYSICS OF THE SOLID STATE. THESE AND OTHER SIMILAR INFLUENCES WOULD INEVITABLY HAVE CHANGED THE CHARACTER OF ENGINEERING EDUCATION EVEN IF NUCLEAR ENERGY HAD NOT BEEN THRUST FORWARD TO EXCITE THIS PROCESS OF EVOLUTIONARY CHANGE IN AN ALMOST VIOLENT MANNER.

IT IS NEVERTHELESS TRUE THAT THE DEVELOPMENT OF NUCLEAR ENERGY, WHICH HAS HAD A REVOLUTIONARY EFFECT UPON ENGINEERING, IS ONLY NOW HAVING AN IMPACT UPON ENGINEERING EDUCATION. THE DEVELOPMENT OF NUCLEAR POWER HAS STARTED A CHAIN REACTION IN THE STUDY OF NEW MATERIALS. STRENGTH OF HIGH TEMPERATURES, CORROSION RESISTANCE, NEUTRON ABSORPTION AND RESISTANCE TO DETERIORATION FROM RADIATION BOMBARDMENT ARE ONLY A PART OF THE DEMANDS PLACED UPON REACTOR MATERIALS. ENGINEERS ARE AT WORK TRYING TO PROVIDE ANSWERS. OTHER ENGINEERS ARE CONCEIVING NUCLEAR-THERMAL PROCESSES, DESIGNING NUCLEAR REACTORS OR POWER PLANTS AND DEVISING METHODS OF SAFELY DISPOSING OF RADIO ACTIVE END PRODUCTS. THESE ARE DIRECT OBSERVABLE INFLUENCES OF THE DEVELOPMENTS IN NUCLEAR ENERGY UPON ENGINEERING AND SUCH ARE THE OBSERVABLE DEMANDS COMING UPON ENGINEERING GRADUATES OF THE IMMEDIATE FUTURE.

FROM ANOTHER DIRECTION HAS COME AN EVEN GREATER INFLUENCE UPON ENGINEERING EDUCATION. BEFORE 1940 THE PERCENTAGE OF ENGINEERS ENGAGED IN ANY TYPE OF RESEARCH PROGRAM WAS SMALL ALTHOUGH IT HAD BEEN FOUND IN ONE SURVEY THAT ABOUT 15 PER CENT OF NEW ENGINEERING GRADUATES WERE ENTERING RESEARCH ACTIVITIES. SUCH ACTIVITIES, HOWEVER, MUST HAVE BEEN OF A STRONGLY APPLIED NATURE BEFORE 1940 SINCE MUCH FUNDAMENTAL RESEARCH IN WHAT IS NOW CALLED THE ENGINEERING SCIENCES WAS THEN BEING CONDUCTED BY PHYSICISTS. SINCE 1940 NEARLY ALL RESEARCH PHYSICISTS HAVE HAD THEIR INTERESTS REORIENTED TOWARD NUCLEAR PROBLEMS AND IT SEEMS DOUBTFUL THAT THIS INTEREST WILL BE ADEQUATELY RETURNED TO THE FIELDS OF VIBRATIONS, ELASTICITY, PLASTICITY, HEAT TRANSFER, ENGINEERING THERMODYNAMICS, FLUID FLOW, ELECTRONICS AND THE OTHER BACKGROUND SCIENCES OF ENGINEERING. HENCE, ENGINEERS HAVE BECOME RESPONSIBLE FOR THE CONTINUED RESEARCH IN ALL THE FIELDS OF ENGINEERING SCIENCE. THE LEADERS OF THE ENGINEERING PROFESSION 25 YEARS HENCE MUST BE ENGINEERS WHO ARE AT NO LOSS IN INTERPRETING, USING OR THEMSELVES CONTRIBUTING TO THE EXTENSION OF THE FIELDS OF ENGINEERING SCIENCE. TYPICAL ENGINEERING CURRICULA OF THE ERA 1910-1940 WERE NOT DESIGNED WITH SUCH AN OBJECTIVE IN MIND.

DEFINITIONS OF PROFESSIONAL-GENERAL  
AND PROFESSIONAL-SCIENTIFIC CURRICULA

THERE SEEMS TO BE NO MAJOR DISAGREEMENT THAT AN ENGINEER CANNOT BE TRAINED TO MAKE EFFECTIVE USE OF MODERN KNOWLEDGE OF ENGINEERING SCIENCE IN CREATIVE DESIGN WITHIN A 4-YEAR UNDERGRADUATE PROGRAM. IT IS EVEN MORE IMPROBABLE THAT EFFECTIVE CONTRIBUTORS TO RESEARCH IN THE ENGINEERING SCIENCES WHOSE DEVELOPMENT IS NOW AN ACCEPTED RESPONSIBILITY OF THE ENGINEERING PROFESSION, CAN BE TRAINED IN FOUR YEARS. THE ONLY QUESTIONS THAT REMAIN ARE HOW THE PROFESSIONAL-SCIENTIFIC EDUCATIONAL PROCESS IS TO BE CONDUCTED AND WHAT UNDERGRADUATE BACKGROUND IS CONSIDERED TO BE NECESSARY PREPARATION FOR EXTENSION OF THE STUDENT'S EDUCATION IN THE MORE SCIENTIFIC OR ANALYTICAL PHASES OF ENGINEERING. IT SEEMS MORE PROBABLE THAT 4-YEAR TRAINING MAY BE SUFFICIENT COLLEGE PREPARATION FOR MANY STUDENTS WITH GENERAL PROFESSIONAL OBJECTIVES.

TO ACCOMPLISH THESE DIFFERENT OBJECTIVES ENGINEERING EDUCATION IN THE FUTURE SHOULD BE MORE FUNCTIONAL THAN IN THE PAST. THE COMMITTEE RECOGNIZES THAT AT PRESENT THERE IS SUBSTANTIALLY NO DIFFERENCE BETWEEN CURRICULA OF THE SAME DESIGNATION. IF ENGINEERING EDUCATION IS TO SERVE TWO QUITE DIFFERENT DEMANDS: (1) SUPPLY ENGINEERING PERSONNEL FOR PRODUCTION, CONSTRUCTION, OPERATION, SALES, INSTALLATION OF ENGINEERING EQUIPMENT, ETC., AND (2) SUPPLY PROFESSIONAL ENGINEERS AND ENGINEERING SCIENTISTS ABLE TO INTERPRET AND USE FOR DESIGN PURPOSES THE INFORMATION BEING PROVIDED BY RESEARCH IN THE ENGINEERING SCIENCES, AND ALSO TO ADVANCE THE FIELDS OF ENGINEERING SCIENCE, THERE WILL BE NEED FOR GREATER FUNCTIONAL DIVERGENCE IN ENGINEERING EDUCATION. THE FIRST FOUR YEARS OF THE UNDERGRADUATE PROGRAM CAN HARDLY BE IDENTICAL ANY LONGER FOR THESE TWO TYPES OF ENGINEERING EDUCATION WHICH IN THIS REPORT WILL BE CALLED PROFESSIONAL-GENERAL AND PROFESSIONAL-SCIENTIFIC.

IT SHOULD BE EMPHASIZED THAT EITHER TYPE OF UNDERGRADUATE PROGRAM, IN ORDER TO BE CONSIDERED FOR ACCREDITATION AS A CURRICULUM IN ENGINEERING EDUCATION, MUST INCLUDE AN ADEQUATE CONTENT OF ENGINEERING SCIENCE AND OF APPLICATIONS THEREOF TO ENGINEERING ANALYSIS AND DESIGN.

CURRICULAR CONTENT RECOMMENDED FOR PROFESSIONAL-SCIENTIFIC ACCREDITATION

THE SPECIFICATIONS FOR THE CONTENT OF ANY CURRICULUM MUST OF NECESSITY LIST A SERIES OF SUBJECTS. THE COMMITTEE FEELS THAT THE INCLUSION OF CERTAIN SUBJECT MATTER IS <sup>OF</sup> MORE IMPORTANCE THAN THE TITLE OF ANY COURSE OR THE DEPARTMENT IN WHICH IT IS TAUGHT. THE MAIN ESSENTIAL INVOLVES THE TEACHING OF SUCH MATERIAL BY A THOROUGHLY COMPETENT STAFF CAPABLE OF MOTIVATING STUDENTS AND INSPIRING THEM TO STRIVE FOR THE HIGHEST PROFESSIONAL STATURE AFTER GRADUATION.

SINCE THE OBJECTIVE OF THE PROFESSIONAL-SCIENTIFIC CURRICULUM IS TO TRAIN MEN FOR THE FUNCTIONS OF RESEARCH, DEVELOPMENT AND DESIGN, IT MUST REST UPON A BROAD FOUNDATION IN BASIC AND ENGINEERING SCIENCE, ALL CORRELATED TO EQUIP INDIVIDUALS FOR CREATIVE ACTIVITY IN ANALYSIS AND DESIGN, ESPECIALLY AS APPLIED TO SYNTHESIS OF TECHNOLOGICAL SITUATIONS OR ENGINEERING SYSTEMS. THE COMMITTEE, THEREFORE, RECOMMENDS THAT THE FOLLOWING SUBJECTS BE CONSIDERED MINIMUM ESSENTIALS FOR ANY PROFESSIONAL-SCIENTIFIC CURRICULUM.

1. MATHEMATICS THROUGH ORDINARY DIFFERENTIAL EQUATIONS PLUS SUCH TOPICS OF ADVANCED MATHEMATICS AS ARE APPROPRIATE.
2. PHYSICS ENCOMPASSING AN INTRODUCTION TO ATOMIC, NUCLEAR, AND SOLID STATE PHYSICS, BUT EXCLUDING MECHANICS, ELECTRICITY AND HEAT FROM THE ELEMENTARY COURSE IF THIS MATERIAL IS ADEQUATELY COVERED ELSEWHERE.
3. CHEMISTRY INCLUDING AN INTRODUCTION TO ORGANIC AND PHYSICAL CHEMISTRY. CONSIDERATION OF MORE THAN THE USUAL ONE-YEAR COURSE IN FRESHMAN CHEMISTRY IS RECOMMENDED.
4. ENGINEERING SCIENCES INCLUDING STATICS; DYNAMICS; STRENGTH OF MATERIALS; THERMODYNAMICS; FLUID MECHANICS; ELECTRICAL CIRCUITS, FIELDS AND ELECTRONICS; HEAT TRANSFER; ENGINEERING MATERIALS; AND PHYSICAL METALLURGY. ALL OF THESE ARE TO BE DEVELOPED ON A LEVEL THAT MAKES FULL USE OF THE BACKGROUND PROVIDED IN ITEM 1.
5. ENGINEERING ANALYSIS AND DESIGN TRAINING FOR THE CREATIVE AND PRACTICAL PHASES OF ECONOMIC DESIGN, INVOLVING ANALYSIS, SYNTHESIS, DEVELOPMENT AND ENGINEERING RESEARCH IS THE MOST DISTINCTIVE FEATURE OF PROFESSIONAL ENGINEERING EDUCATION. SUCH TRAINING IN SETTING UP AND FORMULATING PROBLEMS AND EXPERIMENTS TO ATTAIN A GIVEN OBJECTIVE SHOULD BE INCLUDED IN EACH SEMESTER OF THE JUNIOR AND SENIOR YEARS, AND EARLIER IF POSSIBLE. THE FOLLOWING ARE SUGGESTED METHODS FOR DEVELOPING AN UNDERSTANDING OF SYNTHESIS, DEVELOPMENT WORK AND DESIGN: THESES, PROJECT METHODS, GROUP OPERATION, COMPETITION BETWEEN GROUPS, THE USE OF REALISTIC INDUSTRIAL PROBLEMS, THE USE OF UNSOLVED PROBLEMS FOR STIMULATION, EXAMINATIONS OF A NON-ROUTINE NATURE, AND REVERSAL OF THE USUAL SHORT ANALYTICAL PROBLEM STATEMENT TO INTRODUCE AN ELEMENT OF DESIGN IN INTRODUCTORY COURSES. ROUTINE REPETITIVE FEATURES OF DESIGN, THE USE OF HANDBOOKS, OR THE MERE DESCRIPTION OF STRUCTURES, EQUIPMENT OR MACHINES INCLUDING THEIR CONSTRUCTION, OPERATION AND MAINTENANCE ARE NOT PROPERLY CLASSIFIED AS ANALYSIS OR DESIGN AND SHOULD NOT BE EMPHASIZED. THE ART OF ENGINEERING IS LEARNED MORE EFFECTIVELY FROM FIELD OBSERVATIONS THAN FROM COLLEGE STUDY.
6. HUMANISTIC-SOCIAL STUDIES CULTURE IS A QUALITY OF THE EDUCATED MIND AND EMBODIES A RECEPTIVENESS TO BEAUTY AND HUMANE FEELING, AND SHOULD BE CONSIDERED AS ACTIVITY OF THOUGHT. EDUCATION INVOLVES A STUDY OF LIFE AND ALL ITS MANIFESTATIONS AND TRAINING IN THE ART OF USING KNOWLEDGE. THE ACCUMULATION OF FRAGMENTS OF KNOWLEDGE OR UNRELATED IDEAS IS A USELESS EDUCATIONAL OBJECTIVE. IT IS, THEREFORE, ESSENTIAL TO INTEGRATE THE SUBJECT MATTER OF ANY CURRICULUM, AND ESPECIALLY OF THE HUMANISTIC-SOCIAL STEM OF ENGINEERING EDUCATION. COURSES IN NON-TECHNICAL FIELDS SHOULD GIVE THE STUDENT A PERSPECTIVE OF THE PAST TO DEVELOP HIS UNDERSTANDING OF THE PRESENT AND HIS OUTLOOK TOWARD THE FUTURE, A KNOWLEDGE OF LANGUAGE TO ENHANCE HIS COMMUNICATION WITH OTHERS AND HIS ACQUAINTANCE WITH LITERATURE, AN ABILITY TO ENJOY INTELLECTUAL RELAXATION, AND A SENSE OF VALUES OR AN UNDERSTANDING OF ART, PHILOSOPHY, POLITICS AND INTERNATIONAL AFFAIRS.



NO PROGRAM CAN POSSIBLY FULFILL THIS IDEAL ENTIRELY, NOR NEED IT BE CONFINED ENTIRELY TO COURSES. THE ENVIRONMENT OF AN INSTITUTION, THE FACILITIES FOR EXTRA-CURRICULA ACTIVITIES, THE PERSONAL ASSOCIATIONS ESPECIALLY WITH FACULTY MEMBERS AND THE MOTIVATION TOWARD INTELLECTUAL EXTRA-CURRICULAR ACTIVITIES ALL PROVIDE MEANS FOR APPROACHING THIS GOAL. THE COMMITTEE SUBSCRIBES TO THE RECOMMENDATIONS OF EARLIER ASEE REPORTS THAT A REASONABLE BALANCE OF SUCH CULTURAL OPPORTUNITIES AND HUMANISTIC-SOCIAL COURSES SHOULD BE INTEGRATED INTO EVERY ACCREDITED ENGINEERING PROGRAM.

7. TECHNIQUES OF COMMUNICATIONS AND MEASUREMENT INSTEAD OF SOLE DEPENDENCE ON COURSES IN THESE FIELDS AN ADEQUATE LEVEL OF PERFORMANCE SHOULD BE REQUIRED OF ALL ENGINEERS. MEASUREMENT MAY BE TAUGHT IN LABORATORIES, SURVEYING AND SHOP COURSES. PROPER USE OF ORAL AND WRITTEN ENGLISH SHOULD BE DEMANDED OF STUDENTS THROUGHOUT EVERY COURSE IN THEIR ENTIRE CURRICULUM. DRAWING SHOULD BE TAUGHT IN SUCH A MANNER AS TO DEVELOP CREATIVITY, SPATIAL VISUALIZATION AND THE ABILITY TO CONVEY IDEAS, ESPECIALLY BY FREE-HAND SKETCHING. ITS VALUE AS A SKILL ALONE DOES NOT JUSTIFY ITS INCLUSION IN A CURRICULUM.

THE ATTAINMENT OF THESE OBJECTIVES OF ADEQUATE PERFORMANCE SHOULD BE THE JOINT RESPONSIBILITY OF ALL TEACHERS. TECHNIQUES CONSIDERED WORTH TEACHING TO FRESHMEN AND SOPHOMORES SHOULD BE VALUED TO THE EXTENT OF REQUIRED PERFORMANCE THROUGHOUT THE UPPER YEARS.

#### CURRICULAR CONTENT RECOMMENDED FOR PROFESSIONAL-GENERAL ACCREDITATION

THE REQUIREMENTS OF COURSE CONTENT FOR ACCREDITATION OF PROFESSIONAL-GENERAL CURRICULA IN ENGINEERING ARE BY DEFINITION LESS SPECIFIC THAN THOSE FOR PROFESSIONAL-SCIENTIFIC CURRICULA. THE CURRICULAR REQUIREMENTS FOR PROFESSIONAL-SCIENTIFIC STUDY IN ENGINEERING HAVE BEEN STATED ABOVE IN TERMS OF BASIC SCIENCE AND MATHEMATICS, ENGINEERING SCIENCE, AND ENGINEERING ANALYSIS AND DESIGN. IN PROFESSIONAL-GENERAL CURRICULA SOME ALTERNATIVE CHOICE OF ENGINEERING SCIENCE STUDIES IS REASONABLE AND PROBABLY NECESSARY IF A FOUR-YEAR CURRICULUM IS DESIRED. FOR EXAMPLE, THE BASIC CONCEPTS IN FLUID FLOW, HEAT FLOW AND ELECTRICAL FLOW ARE SUFFICIENTLY RELATED SO THAT A CHOICE BETWEEN SUCH STUDIES DOES NOT SERIOUSLY RESTRICT THE USEFUL BACKGROUND OF THE ENGINEER FOR MANY TYPES OF EMPLOYMENT. SIMILARLY, A BROAD STUDY OF ENGINEERING MATERIALS MAY HAVE TO TAKE THE PLACE OF THE STUDY OF PHYSICAL METALLURGY IN SUCH CURRICULA. HOWEVER, THE DECISION AS TO WHETHER A GIVEN CURRICULUM IS OR IS NOT ENGINEERING EDUCATION CAN BE MADE ONLY UPON THE BASIS OF ITS CONTENT OF ENGINEERING SCIENCE AND THE APPLICATION THEREOF TO ENGINEERING ANALYSIS AND DESIGN. THE CONTENT OF BASIC SCIENCE INCLUDING CALCULUS AND OTHER MATHEMATICS MUST BE ADEQUATE TO MAKE THE STUDY OF ENGINEERING SCIENCE INCLUDED IN THE PROFESSIONAL-GENERAL CURRICULUM USEFUL TO THE ENGINEER'S FUTURE PRACTICE. THE COMMITTEE RECOMMENDS THAT THE FOLLOWING SUBJECTS BE CONSIDERED MINIMUM ESSENTIALS FOR ANY PROFESSIONAL-GENERAL CURRICULUM.



MATHEMATICS DIFFERENTIAL AND INTEGRAL CALCULUS PLUS OTHER TOPICS FROM ADVANCED MATHEMATICS AS MAY BE APPROPRIATE TO THE PARTICULAR CURRICULUM.

PHYSICS GENERAL PHYSICS AND SUCH TOPICS OF MODERN PHYSICS AS MAY BE COVERED IN AN ACADEMIC YEAR BUT EXCLUDING MECHANICS, ELECTRICITY AND HEAT IF THESE ARE COVERED ADEQUATELY ELSEWHERE.

CHEMISTRY AT LEAST ONE YEAR OF GENERAL CHEMISTRY INCLUDING AN INTRODUCTION TO ORGANIC AND PHYSICAL CHEMISTRY IS ESSENTIAL.

ENGINEERING SCIENCE SEVEN OF THE NINE FIELDS SPECIFIED FOR THE PROFESSIONAL-SCIENTIFIC CURRICULA, BUT INCLUDING STATICS, DYNAMICS, STRENGTH OF MATERIALS AND THERMODYNAMICS.

ENGINEERING ANALYSIS AND DESIGN AS DEFINED FOR THE PROFESSIONAL-SCIENTIFIC CURRICULA, EXTENDING OVER AT LEAST ONE YEAR.

HUMANISTIC-SOCIAL THE EMPHASIS IN PROFESSIONAL-GENERAL CURRICULA CAN PROBABLY BE GREATER AND CERTAINLY SHOULD NOT BE LESS THAN IN PROFESSIONAL-SCIENTIFIC CURRICULA.

SPECIAL COURSES FOR PARTICULAR CURRICULA COURSES IN GEOLOGY, BIOLOGY, AGRICULTURE, PRODUCTION, PERSONNEL, MANAGEMENT, LAW, SALES, ETC., MAY BE INCLUDED IF APPROPRIATE. NOTE, HOWEVER, THAT THESE SUBJECTS ARE NEITHER ENGINEERING SCIENCE NOR ENGINEERING ANALYSIS AND DESIGN, NOR ARE THEY BASED ON THE ENGINEERING SCIENCES AS DEFINED HEREIN. THEREFORE, SUCH COURSES ARE NOT THOSE WHICH DISTINGUISH A CURRICULUM AS BEING APPROPRIATE FOR ENGINEERING ACCREDITATION.

#### LENGTH OF ENGINEERING CURRICULA

THE COMMITTEE HAS EXPRESSED HEREIN ITS RECOMMENDATIONS REGARDING CONTENT OF SATISFACTORY CURRICULA TO MEET PROFESSIONAL-SCIENTIFIC AND PROFESSIONAL-GENERAL OBJECTIVES. IT LEAVES THE NECESSARY LENGTH OF EACH INSTITUTION'S CURRICULA TO INSTITUTIONAL EXPERIENCE AND EXPERIMENT PLUS THE JUDGMENT OF ECPD AS TO THE RESULT ACHIEVED.

THE COMMITTEE DOES FORESEE DIFFICULTY IN MEETING WITHIN A FOUR-YEAR PROGRAM ITS RECOMMENDATIONS FOR AN ACCREDITED PROFESSIONAL-SCIENTIFIC ENGINEERING CURRICULUM PLUS ALL OF THE SPECIALIZED DEPARTMENTAL COURSES IN A GIVEN BRANCH OF ENGINEERING; I.E., IN THE CIVIL, ELECTRICAL OR MECHANICAL ENGINEERING DEPARTMENT. IT IS THE CONVICTION OF THE COMMITTEE, HOWEVER, THAT SUCH SPECIALIZATION IS OF FAR LESS VALUE IN PROFESSIONAL-SCIENTIFIC EDUCATION THAN A BROAD BACKGROUND OF ENGINEERING SCIENCE AND ITS APPLICATION IN ONE FIELD OF ENGINEERING ANALYSIS AND DESIGN.

FOR PROFESSIONAL-GENERAL ENGINEERING CURRICULA THE REQUIREMENTS OF ENGINEERING SCIENCE AND ITS APPLICATION TO ENGINEERING ANALYSIS AND DESIGN MAY BE SOMEWHAT REDUCED, PERHAPS BY 25 PER CENT, BUT THERE IS AN IRREDUCIBLE MINIMUM OF THIS MATERIAL BELOW WHICH THE CURRICULUM CANNOT PROPERLY BE CONSIDERED FOR ENGINEERING ACCREDITATION. STARTING WITH THIS IRREDUCIBLE MINIMUM OF STRICTLY ENGINEERING CONTENT, CURRICULA CAN DOUBTLESS BE DESIGNED FOR

A FOUR-YEAR STUDY THAT WILL PRODUCE EFFECTIVE ENGINEERS FOR THE LESS SCIENTIFIC AND MORE PRACTICAL FIELDS OF ENGINEERING INCLUDING CONSTRUCTION, PRODUCTION, MAINTENANCE, WELDING, AIR CONDITIONING, WOOD TECHNOLOGY, ETC., OR FOR SERVICE WITH ASSOCIATED PROFESSIONAL FIELDS SUCH AS BUSINESS, SALES, MANAGEMENT, LAW, GOVERNMENT, AGRICULTURE. ONLY SPECIFIC PLANNING CAN DETERMINE WHETHER FOUR YEARS OR LONGER WILL BE NEEDED IN SUCH NEW FIELDS AS BIOLOGICAL ENGINEERING, GEOLOGICAL ENGINEERING, GEOPHYSICAL ENGINEERING, ETC., IN WHICH A MAJOR ADDITIONAL SCIENCE STUDY IS REQUIRED BEYOND THE ENGINEERING SCIENCES AS CLASSIFIED ABOVE.

#### POSSIBLE CURRICULA ADJUSTMENTS INVOLVING BIFURCATION

SEVERAL PATTERNS OF ADJUSTMENT OF ENGINEERING CURRICULA COULD BE USED IN EXPERIMENTS DESIGNED TO ACHIEVE THE RESULTS INDICATED PREVIOUSLY. THE FOLLOWING POSSIBILITIES ARE LISTED MERELY TO MAKE IT CLEAR THAT NO ONE PATTERN IS FAVORED BY THE COMMITTEE ON EVALUATION. INSTEAD, THE COMMITTEE WOULD URGE EACH INSTITUTION TO DETERMINE ITS FUTURE PATH BY EXPERIMENT.

1. IN A LIMITED NUMBER OF INSTITUTIONS IT WOULD BE POSSIBLE TO CHOOSE BETWEEN THE PROFESSIONAL-GENERAL OR THE PROFESSIONAL-SCIENTIFIC APPROACH TO ENGINEERING EDUCATION AND TO SELECT THE STUDENT BODY TO FIT THE CHOSEN CURRICULUM PATTERN. THE LENGTH OF THE CURRICULUM WOULD BE DESIGNED TO MEET THE STATED OBJECTIVE. THE FACT THAT MOST UNIVERSITIES, INCLUDING NEARLY ALL STATE INSTITUTIONS, HAVE NO ADEQUATE SYSTEM OF SELECTION REMOVES THIS AS AN OVERALL SOLUTION TO THE PROBLEM. MOST INSTITUTIONS ALSO RECOGNIZE THEIR DUAL RESPONSIBILITY TOWARD ENGINEERING EDUCATION.

2. A SYSTEM OF OPTIONS ON A PROFESSIONAL-GENERAL VERSUS PROFESSIONAL-SCIENTIFIC BASIS MIGHT BE DEVELOPED WITHIN THE USUAL ENGINEERING DEPARTMENTS. REPORTED EXPERIENCE WITH THIS DEVICE HAS BEEN LIMITED TO ONE INSTITUTION. EVIDENTLY, IT ADDS COSTS AND IS LIMITED IN ITS APPLICATION TO RELATIVELY LARGE DEPARTMENTS. ITS SUCCESS WOULD BE DEPENDENT UPON STRONG INTEREST OF ADMINISTRATIVE OFFICERS INCLUDING DEPARTMENT HEADS SINCE IT COMPLICATES ADMINISTRATION.

3. A SINGLE PROFESSIONAL-SCIENTIFIC OPTION OUTSIDE OF THE USUAL ENGINEERING DEPARTMENTS HAS BEEN TRIED IN SOME INSTITUTIONS. THE RESULTS REPORTED INDICATE THAT SUCH AN OPTION ATTRACTS RELATIVELY FEW STUDENTS. MOST STUDENTS FEEL THAT THE NAMED DEPARTMENTAL DEGREES ARE ACTUALLY THE MORE DIRECT ENTRANCE TO PROFESSIONAL WORK. TO MAKE THIS SINGLE-OPTION APPROACH SUCCESSFUL WILL REQUIRE A FULL UNDERSTANDING OF THE PROFESSIONAL-SCIENTIFIC OBJECTIVES BY ALL STUDENTS PLUS DEPARTMENTAL SUPPORT AND COOPERATION OF A HIGH ORDER.

4. AN INSTITUTION MIGHT REALISTICALLY FACE THE TIME DIFFERENCE BETWEEN PROFESSIONAL-GENERAL AND PROFESSIONAL-SCIENTIFIC EDUCATION BY SETTING UP FOUR-YEAR AND FIVE-YEAR PROGRAMS RESPECTIVELY FOR THE FIRST DEGREE. TO MAKE THIS SYSTEM CLEAR TO THE STUDENT IT HAS BEEN SUGGESTED THAT THE FOUR-YEAR DEGREE BE DESIGNATED BACHELOR OF ENGINEERING WITH THE COMMON DEPARTMENTAL DESIGNATION OF DEGREES RESTRICTED TO THE GRADUATES OF FIVE-YEAR PROFESSIONAL-SCIENTIFIC PROGRAM BY THE PROCEDURE OF ACCREDITATION.

5. ANOTHER APPROACH WOULD BE TO SET UP A PROFESSIONAL-GENERAL CURRICULUM ON A FOUR-YEAR BASIS AND A PROFESSIONAL-SCIENTIFIC PROGRAM ON A FIVE-YEAR BASIS WITH SUFFICIENT DIVERGENCE THAT THE TRANSFER TO THE FIVE-YEAR PROGRAM COULD BE MADE WITHOUT LOSS OF TIME DURING THE EARLY SEMESTERS. THE FIVE-YEAR PROGRAM COULD BE PLANNED TO RESULT IN A MASTER'S DEGREE, BUT GRADUATES OF THE FOUR-YEAR PROGRAM PROBABLY WOULD REQUIRE TWO ADDITIONAL YEARS TO COMPLETE THE SAME MASTER'S DEGREE SINCE THEY WOULD NEED TO DEVELOP THE BACKGROUND OF BASIC AND ENGINEERING SCIENCE REQUIRED FOR THE FINAL YEAR OF ADVANCED STUDY. THERE COULD BE AN ACTUAL STRENGTHENING OF THE USUAL MASTER'S PROGRAM BY THE APPROACH.

6. TO AVOID UNNECESSARY DUPLICATION OF CURRICULA, A LOGICAL PROGRAM FOR PROFESSIONAL-SCIENTIFIC STUDENTS COULD BE DESIGNED OF ANY LENGTH CONSIDERED APPROPRIATE TO ACHIEVE CLEARLY DEFINED OBJECTIVES WITHOUT ADOPTING COMPROMISES FOR THE UTILITY OR CONVENIENCE OF OTHER STUDENTS. THEN, BY THE USE OF APPROPRIATE SUBSTITUTIONS AT EACH LEVEL, A WORKABLE FOUR-YEAR CURRICULUM FOR PROFESSIONAL-GENERAL STUDENTS COULD UNDOUBTEDLY BE DEvised WITHOUT THE ADDITION OF MANY SPECIAL COURSES. THIS CONCEPT PLACES SERVICE TOWARD ADVANCEMENT OF THE ENGINEERING PROFESSION FIRST ON THE LIST OF OBJECTIVES OF ENGINEERING EDUCATION. SINCE THE RESULTANT CURRICULA FOR PROFESSIONAL-SCIENTIFIC AND PROFESSIONAL-GENERAL STUDENTS WOULD DOUBTLESS DIVERGE, POSSIBLY BOTH IN CONTENT AND IN LENGTH, DISTINCTIVE DEGREES WOULD SEEM APPROPRIATE.

#### SPECIAL DESIGNATION OF ACCREDITED CURRICULA

THERE APPEARS MERIT IN IDENTIFYING THOSE CURRICULA WHICH MEET CRITERIA SUBSTANTIALLY ABOVE THE MINIMA. THE MAJOR FACTOR IN SUCH IDENTIFICATION SHOULD BE THE BACKGROUND AND EMINENCE OF THE FACULTY AND ITS ATTENTION TO CREATIVE TEACHING. WHEN THE PROGRAM CONDUCTED BY THIS FACULTY IS OF SUCH A NATURE AS TO DEVELOP IN A CONSIDERABLE PROPORTION OF THE GRADUATES A CAPACITY FOR CREATIVE TECHNICAL ACTIVITY OR CREATIVE LEADERSHIP IN ENGINEERING IT IS THE RECOMMENDATION OF THIS COMMITTEE THAT THIS CURRICULUM SHOULD BE GIVEN SPECIAL DESIGNATION. FOR SUCH DESIGNATION CURRICULA SHOULD BE TAUGHT BY FACULTIES INCLUDING A SUBSTANTIALLY LARGER PROPORTION OF DISTINGUISHED STAFF MEMBERS THAN IS REQUIRED FOR MINIMUM ACCREDITATION, AS DEFINED PREVIOUSLY.

THE RECOMMENDATION OF A CURRICULUM FOR SPECIAL DESIGNATION SHOULD BE REFERRED BY THE INSPECTION COMMITTEE FOR FINAL ACTION TO A GROUP OF NATIONAL REPRESENTATIVES WHOSE BACKGROUND OF EXAMINATION OF INSTITUTIONS COVERS A WIDE GEOGRAPHICAL AREA.

#### CONCLUSIONS

1. BY JOINT ACTION OF ASEE AND ECPD THE EDUCATION COMMITTEE OF ECPD HAS BEEN INSTRUCTED TO DEVELOP HIGHER STANDARDS FOR ACCREDITATION OF ENGINEERING CURRICULA.
2. ONE OBJECTIVE OF THE COMMITTEE ON EVALUATION HAS BEEN TO ESTABLISH A PHILOSOPHY OF ENGINEERING EDUCATION APPROPRIATE TO THE TRAINING OF ENGINEERS FOR LEADERSHIP A GENERATION HENCE, AND TO CLARIFY THE SIGNIFICANT FACTORS THAT CONTRIBUTE TO HIGH STANDARDS OF ENGINEERING EDUCATION.

3. ANOTHER OBJECTIVE HAS BEEN TO STUDY THE INFLUENCE OF HIGHER STANDARDS OF ACCREDITATION UPON THE ENGINEERING COLLEGES AND TO CONSIDER WAYS IN WHICH INSTITUTIONS MAY APPROPRIATELY JUSTIFY ACCREDITATION BASED UPON THE PERFORMANCE OF DIFFERENT FUNCTIONS IN THE BROAD FIELD OF ENGINEERING EDUCATION.
4. THE FUNCTIONAL DIVERGENCE SO EVIDENT IN ENGINEERING ACTIVITIES, WHICH RANGE FROM RESEARCH TO MANAGEMENT HAS LED TO THE COMMITTEE'S RECOMMENDATION THAT ACCREDITATION BE BASED UPON EITHER OF TWO DEFINED FUNCTIONS IN ENGINEERING EDUCATION; I.E., PROFESSIONAL-GENERAL EDUCATION AND PROFESSIONAL-SCIENTIFIC EDUCATION.
5. IN ORDER THAT THE DECISION TO DEVELOP ADVANCED STANDARDS OF ACCREDITATION MAY NOT UNDULY RESTRICT THE NUMBER OF POSSIBLE ACCREDITED CURRICULA, THE COMMITTEE RECOMMENDS THAT A SPECIAL DESIGNATION BE GIVEN TO ANY CURRICULUM TAUGHT BY A FACULTY OF UNUSUAL DISTINCTION WHERE THE PROGRAM CONDUCTED BY THE FACULTY IS OF SUCH A NATURE AS TO DEVELOP IN A CONSIDERABLE PROPORTION OF THE GRADUATES A CAPACITY FOR CREATIVE TECHNICAL ACTIVITY OR CREATIVE LEADERSHIP IN ENGINEERING.

OCTOBER 10, 1953