A COLLEGE COURSE IN ADMINISTRATIVE ENGINEERING

Thesis for the Degree of B. S.

MICHIGAN STATE COLLEGE

C. A. Eckert

1941

Copy 1

"A College Course in Administrative Engineering"

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

by

C. A. Eckert

Candidate for the Degree of

Bachelor of Science

June 1941

Dedication

This thesis was written because I earnestly believe there is a necessity for such a course. To Professor Allen go my grateful thanks for his willing and plentiful assistance. I am also grateful for the valuable opinions offered me by the members of the faculty and by the many gentlemen who were interested enough to answer my questionnaire.

Source of Information and Data

1. Dean of Engineering
2. Professor Allen, Head of C.E. Dept.
3. Dean of Liberal Arts
4. Members of Faculty
5. Students
6. Contractors
7. Practicing Engineers
8. Businessmen
9. Proceeding of the Society for Promotion of Engineering Education
10. Catalogs, bulletins and correspondence from the following universities and colleges:
    1. University of Alabama
    2. " " California
    3. " " Colorado
    4. " " Illinois
    5. " " Maine
    6. " " Michigan
    7. " " Minnesota
    8. " " Nebraska
    9. " " Cincinnatti
    10. " " Pittsburgh
    11. " " Washington
    12. " " Wisconson

13. Stanford University
14. Yale "
15. Purdue "
16. Harvard "
17. Princeton "
18. Columbia "
19. Cornell "
20. New York "
21. Ohio State "
22. Lehigh "
23. Penn State "
24. Northwestern "
25. California Institute of Technology
26. Massachusetts " " "
27. Armour " " "
28. Carnegie " " "
29. Brooklyn Polytechnic Institute
30. Rennselaer " "
31. Virginia " "
32. Georgia School of Technology
33. Case School of Applied Science

The following procedure was followed in developing the thesis.

I Historical Development

II Demand

III Conclusions from Investigations

IV Developed Curriculum

HISTORICAL DEVELOPMENT

"Out of the chaos came cosmos; then followed the sun
"And the earth, and all else since the world was begun--
"Down to Man".

We are told that the "gin" in "engineer" is from the same root (meaning to create) as "gen" in"Genesis". Not to be irreverent, this takes us back to Creation, which is really far enough.

Only now are we beginning to know about ancient engineering through archaeological research. All around the Mediterranean basin, the eastward into Mesopotamia, the Indies, China, and in our own hemisphere, the discoveries indicate that early engineering had progressed far. Relatively, for all we know, it had progressed as far as today. In the period of the Renaissance, there was Leonardo da Vinci, than whom no greater could be mentioned today if we keep in mind the difference in time and conditions. More recent is our own George Washington, the surveyor, as we think of him. But engineers in our country are descended from the surveyor. It was President Washington who recommended, during his administration, a school for artillerists and engineers, later established West Point.

Curiously enough, the greatest steps forward in the arts and sciences have been coincident with the great wars. Not so curious after all, when we think of the tremenduous demand made on all the resources, mental, physical, spiritual, and material, of warring peoples. For instance, the

first World War, in which the scientist and engineer waged so great a part, and now the second World War, in which the tide of the battle is dependent on the cleverist of these men.

The United States Military Academy, recommended by Washington and established in 1794, really began to function in 1817. It was, of course, military engineering that was taught there. Next came Rensealaer Polytechnic Institute in 1824, in which civil, as distinguished from military, engineering was taught. Civil engineering as such occupied the foreground for many years. Descended from the surveyor, civil engineering in turn sired a numerous progeny. Mining engineering was established at Columbia University in 1864. Stevens Institute of Technology came into being in 1870 with mechanical engineering. On April 21, 1885, the Board of Agriculture of Michigan State College announced the establishment of a Department of Mechanic Arts. This was the beginning of the present Division of Engineering in this college, which was created November 13, 1909.

Strange as it may seem, the education of the engineer of earlier years was broader than it is today. In the universities, engineering was not a separate department as it is nowadays, but was a course of study in the liberal arts colleges. Thus it was not uncommon to find many so-called cultural studies, such as Latin or Greek among accomplishments of engineering graduates.

The period following the Civil War was one of great

expansion. The development of our West was in progress. Our transcontinental railroads were being built, and great bridges were beginning to span our largest rivers. The engineer of those days, being liberally trained, was a man of vision, a wise counselor in great enterprises --- those which involved knowledge of people as well as of technical things.

During the period preceding 1900, engineering curricula were in a state of flux. They were constantly changing, partly because of new branches of engineering, and partly because of rapid developments in a particular branch. Knowledge of the sciences had greatly increased. Things that are now common necessities were then being created. Broadening studies had to be dropped to make room for the new technical studies. As a result, the men, while splendidly trained in a particular line, were completely ignorant in other lines.

While the engineering curriculum has never remained fixed, it became fairly stable around 1900. As written, the curriculum was thought to anticipate the needs of the country as they were then visioned. That it has done so is evidenced by the remarkable series of industrial developments following one after another so closely that the wonder of yesterday has become the necessity of today. And in this period have come great social and economic problems as the result of our industrial development, and also as the result of our rapidly increasing population.

And so it seems that *"modern education has taught us how to earn money more easily, but not how to spend it more wisely. It has broadened the scope of human endeavor, opened the way to unparalleled wealth, and enabled us to live in marvelous material surroundings. But in so doing, it has narrowed human relations, dulled our appreciation of natural pleasures and lessened our sense of spiritual values. It has loosed forces which until balanced must inevitably lead as their resultant points, be it for good or for evil."

Now we come to engineering education in the future --- in fact, all education. It is a condition that affects society that must be solved, not only in this country, but in all civilized countries. Science and its application has made us all neighbors. We are told that at the present rate of increase, our population will reach our food-producing capacity very soon, as we think of time. Resources will someday approach exhaustion. What of conditions then? It is none too soon to prepare for them. Engineering education in the future must do its part in conjunction and in harmony with education in other fields.

To that end, without greatly disturbing present requirements, why not add to the curriculum studies that would first of all enable comprehension of existing conditions and their causes. Add studies of the epochs in which engineering achievement has greatly changed the conditions of life, going back to earliest civilizations as they are uncovered. The rise and fall of nations should have a place -- the sources of wealth; the effect of wealth; the probable

*Vol. 20 Journal of Engineering Education, Page 943

duration of our natural resources. Of the greatest importance are studies that train for citizenship, particularly in this country of ours where each individual has a share in the government, and is responsible for its welfare. Thus the graduating engineer would go forth with a richer education, one that would enable him to get more out of life for himself, and give more to others.

This new curriculum would also make possible a type of engineer that is bound to appeal to those who believe our future welfare depends on continuing prosperity as in recent years. Such a prosperity demands the disposal of manufactured goods in excess of home consumption. That means foreign markets -- foreign relations. And foreign relations means knowledge of foreign peoples, their languages and customs. More than that, it means knowledge of their industries, and the conditions to be met in trading with them. Knowledge of their industries would require study, both engineering and economics.

So today, and tomorrow, there is and will be, the urgent need of broadly trained engineers to do their part in administering the affairs of a country that, largely as the result of its engineering achievements, stands foremost among all the nations.

PURPOSE

The course in Administrative Engineering is designed for students who wish to combine a knowledge of engineering principles with business studies. It should contain a comprehensive survey of the applications of science to the primary branches of engineering and business, designed to develop in its graduates the ability to visualize and adjust the correlated problems encountered in all fields of engineering.

Such a standard course cannot be expected to embrace all of the technical requirements of the industrial world. The demand for new courses in special fields of engineering will constantly arise and the educational opportunity will be provided in this course for their introduction and development. It is not intended for those students who expect to become professional engineers in the field of design and construction or for those who expect to fill executive positions in which a knowledge of engineering is a required equivalent to that ordinarily gained in any one of the other engineering courses.

The course prepares the student to enter industrial organizations in positions leading to superintendence, financing, scientific management, and business administration. It prepares the student for the competent handling of such subjects as departmental management in factories, determination of costs, costs engineering, determination of proper distribution of expense, depreciation, appraising, manufacturing statistics, economic production, personnel, production planning, efficiency, transportation, marketing, sales administration, etc., and allied work, leading ultimately to superintendence, works

management, and general management.

Enormous as this task seems, it actually is not. The wide variety of occupations mentioned above are relatively small to those in other fields of engineering. To hope to turn out finished, polished men into these fields is beyond the scope of this course. Just as the word commencement indicates, the graduate really commences his education when he concludes his college training. Experience is the keynote to the success of the young engineer, and experience is largely obtained outside of college. That his experience should prove of value is the aim of the engineering training in invoking proper methods of approach to problems in the developing mind of the student.

But now, as to why this course is deemed essential: Knowledge has been broken down into individual subjects and these have been combined into groups of subjects constituting schools or colleges within the university. But now these air-tight compartments are recognised as defective. Schools of business and engineering schools meet on overlapping fields when they get into production. It is not sufficient to teach law on the basis of preceding cases; law is being taught in its relation to psychology, business, economics, and changing social concepts. Engineering too should follow such lines.

Many, perhaps most men who come to engineering schools plan to be technical engineers. Although a majority of them later achieve administrative duties, they do so because of

technical attainment. Moreover, they usually assume administrative responsibilities in technical fields where administration is engineering. For such men, engineering education must remain highly technical. Yet for such men some instruction should be provided to give them a background of industrial relations, experience and principles, and a method of approach to problems of human management. For they must be so prepared that they will learn from experience to deal with human relations in spite of the tendency of industry to start them in work with the minimum of human contact.

Other men -- and as their needs are more specifically recognised by engineering schools they will increase in numbers --- take engineering courses as a means of gaining an understanding of the technical problems of industry as a preparation for administrative work. Such men need less extensive technical training than the engineer. They need much wider training in the economic and social sciences and in their application in the fundamentals of management of which the management of human relations is a vital part. In some schools, courses of study have already been developed to meet this end.

It is essential not to confuse these two problems: the education of the technical engineer, who, if he succeeds, must almost inevitably assume some managerial duties as part of his engineering but who is none the less a technical expert;.and the education of the general executive who in this technical age must understand technology in order to

fully grasp the problems of his job, but is none the less essentially a manager. Not to see this distinction will be to impair the development of the engineer and to fail to develop the manager -- for even in this technical age the positions are distinct. Each in their own way, however, involves dealing with men and often with industrial problems.

Insofar as engineering schools train engineers, they are performing an established work. Insofar as they attempt to develop technically competent managers, they are taking on a new task. But the surveys of what engineering graduates do and earn, give impressive evidence that in either case it is an important part of engineering to give students some vigorous training that will equip them to learn from experience to manage men, and that will make them professional in their capacity to deal with the human as well as the material factors of industry.

*In a study of engineering careers most of which were too mature to have been affected by Administrative Engineering courses, it was found that less than one third of the men remained in strictly technical work and less than one tenth of the men established themselves in an individual professional capacity. While the majority of graduates from all engineering courses do start strictly in technical work, an increasing number work over into some form of managerial duties until, after fifteen years of practice, two out of three have stabilized in that work.

*Proceedings of S.P.E.E. Volume I Page 232

*A study of 334 graduates, all of whom were in the Engineering Administration Department at Massachusetts Institute of Technology, found the distribution of men nine years out as follows: 46.2% major executives, 28.1% minor executives, 5.1% functional management, 5.1% sales, 5.1% miscellaneous, 7.7% technical and 2.6% editorial, or 79.4% managerial excluding sales.

That such a course is justified financially, according to an investigation by S.P.E.E. in 1930, the median earnings of non-administrative engineers did not exceed $5000 at any age. The median salary of the engineer in work involving administration passed $5000 at 35 years of age and reached $9500 at 55. That of the engineer in general managerial work exceeds $6500 at 35 and reached $12000 at 55.*

The desirable features of a thorough training in engineering fundamentals, of a cultural and humanistic background with the development of progressive courses emphasizing the interrelationships of economic and socialogical problems, can be realized in a general administrative engineering course.

Possibly this will be criticized as too large an order for an undergraduate course, but I do not think so. A student will not follow up all his undergraduate humanistic studies, but if he is a real student and he finds his stride and professional work that he likes, he will go far on his own initiative with this background. "If we work upon marble"

*The Technology Review March 5, 1930

says Daniel Webster, "it will perish; if on brass, time will efface it;.if we rear temples, they will crumble into dust; but if we work on immortal minds, and imbue them with principles, with the just fear of God and love of our fellow-men, we engrave on those tables something that will brighten to all eternity".

CONCLUSIONS FROM INVESTIGATION

In so controversial a field as this, it was deemed necessary to investigate the subject from every point of view within reach. Accordingly, catalogs from 33 major colleges and universities were obtained and the curriculum of each one analyzed carefully. The history and trend was considered vital, so the proceedings of the Society for Promotion of Engineering Education was reviewed over a period of ten years up to the present. That actual data might be available, a questionnaire was sent out to many men in every field of life; including contractors, engineers, salesmen, executives, sales managers and industrial men -- both college graduates and otherwise. Not the least important was a campaign of personal interviews among the college faculty to secure vital opinions. Logical conclusions followed in this order:

First, from the schools, it was found that 16 of the 33 offered a course such as the one under consideration, showing that as high as 50% of the leading colleges and universities have already found the necessity of such a course. The title of these varied under three general headings: Administrative, Industrial, and General Engineering, the majority preferring industrial. Practically all of the remaining schools offered a choice of administrative or technical options to the student, rather than placing it under a separate title, showing that they realized there was a definite distinction. This is a direct contradiction to the oft-expressed phrase that "there is only one type of engineer -- possessing both technical and administrative qualities".

The general requirements for admission were quite similar for each school, but the curriculum of those offering the proposed course varied considerably.

After studying Chart I, shown on page 34, it is at once apparent that the most important and outstanding subjects are: chemistry, drawing, descriptive geometry, mathematics, english, physics, mechanics, economics, principles of electrical engineering, commercial law, accounting, physical education and science. Inasmuch as these subjects were present in almost all case curricula, it is logical that they should be included in the proposed course.

The conclusions arrived at after a survey of the proceedings of the S.P.E.E. were much the same as above. Throughout the ten years there was a constant agitation in favor of retaining the basic, fundamental subjects, which the above-mentioned might be considered, with the recommendation of more economics and some humanities in the curriculum.

There was also some question as to the necessity of shop courses, with the feeling evident that although a working knowledge of the tools of pattern, machine and foundry shops was beneficial, the engineer who did not intend to become skilled in their use might better use that time in the study of the theory of their use, thereby making way for the addition of some more essential course in place of them.

Another study deemed essential to the modern engineer was one which taught the handling of men, revealing that today more than ever, the engineer must be adept in the art

of handling as well as associating with men. The general conclusion arrived at through this study was the definite and unmistakable trend toward the development of the personal characteristics of the student through the additions to the curriculum of humanities, revealing that the engineer is no longer considered an analytical machine able to do nothing but design and construct apparatus essential to civilization, but is also human and should be a vital cog in the machinery which makes up the government of this country, and in aiding industry to solve its problems which the engineer himself created.

Now, as to the questionnaires, and the interviews. The results obtained were interesting and varied, in that they covered so large a field. Contractors felt that appraisal and estimating courses had been neglected; salesmen desired the analytical judgement built in the minds of engineers to enable them to solve problems; executives wanted men who weretrained not only to solve technical problems, but who could manage financial and business difficulties as well; the faculty interviewed were rather variegated, but in general, the number of total opinions which favored the proposed course was decisive. There was a unanimous choice for more english when asked what courses they would advocate in such a field, and also for public speaking. The latter course has been made compulsory at Michigan State College for all engineers, but many felt that public speaking alone was insufficient and that either the course should be lengthened or another course such as conversational speaking or debate added. Economics was

another subject advocated by the majority. Here, however, a controversy arose as to whether or not it would be more favorable to teach economics from an engineering viewpoint, the controversy questioning the existance of such a distinction. Some members of the faculty fully believed that if all the proposed humanities were taught with a view to their relation to engineering, then such a course would be desirable, otherwise not. Others contended that only certain subjects could be or should be taught from that viewpoint, while still others believed that there was no distinction at all and that to alter the form of teaching of the subject would be to defeat its purpose, for problems in industry would not adapt themselves to the engineer's point of view. Naturally, the instructors teaching the controversial subjects, when questioned, felt that there was no doubt as to the singular meaning of their work. Since a decision is necessary on the part of the writer, he believes as the instructors, that the subject should be studied from a broad viewpoint, rather than entirely from an engineer's. Throughout the college course, the student will frequently come in contact with subjects which do not particularly appeal to him but which he must undertake, and which he later realizes the value of. However, the writer does believe there is a <u>method</u> of teaching which to a great extent determines the value which a student derives, and that occasional divergence on the part of the instructor will enhance that value.

The importance of psychology was realized if it were

applied to the better understanding of human actions and relations, but there was a question as to whether or not it could be obtained without a prerequisite of physiology, which time would not permit.

Accounting, law and history were others considered important. The skill of an engineer in practice for himself would be of little ultimate avail if he did not have a fair understanding of where his earnings were going. Accountants can be hired to keep accurate and neat records but the manager must understand how to read profits and losses when he finds a decision involving capital imminent. Further, a well-constructed building would not entirely justify the mistake of over-lapping a property line or a violation of the building or fire codes, in addition to many other valuable points which might be overlooked if the engineer was uninformed of legal aspects.

Other courses were suggested, many valuable, some feasible and others impractical. Naturally, to attempt to inaugurate each into the curriculum would be a gigantic task, involving from four to eight years schooling. So the logical ones must be dissiminated from the illogical, and successfully blended with the fundamental subjects previously listed.

With the large number of subjects whose maintenance in the existing curriculum is deemed essential, and with the advent of the large quantity of proposed subjects which are held to be almost equally valuable, brings to the surface

a difficult problem confronting the engineering schools today, that of extending the period of study. To develop this course, it was necessary to study the problem pro and con. Arguments obtained for continuing the present four year set-up were: that the development of engineering has not advanced far enough to warrent extension of that period, and that it would decrease the enrollment if the prospective student found that he could obtain the same degree somewhere else in four years. But the arguments against the continuence of the four year period were greater, mainly: that science has advanced to the point where a graduate no longer steps out of school alongside the frontier of science; that there is a great deal more theory to be studied; that law and medicene require six years training and engineering is relatively farther advanced than they; that custom alone is holding the majority of colleges to the four-year course; and that custom must soon be broken; and finally, that colleges now are turning out mediocre products by mass production methods, eliminating many essentials.

The writer firmly believes that four years to complete an administrative engineering course is definitely inadequate, yet he also believes that the change from four to five or six years will not be forthcoming in the very near future. For that reason then, this course, that it might fit into the present administration immediately, has been designed as a four year course.

Many colleges are offering the Bachelor of Arts and

Bachelor of Science degrees to students who complete two years of study in business administration and three years in engineering; some require four years of engineering and a year of graduate work in business administrative engineering for a degree of Bachelor of Science in General, Industrial, or Administrative Engineering; and some have already ventured to make their courses five years in length with the administrative engineering curriculum. The question as to whether an attempt at a four year course will be successful when five years is deemed essential, remains to be seen. The four year course can still accomplish a vital purpose, and for that reason it is hoped that this plan may be considered.

In conclusion, may I state that I am convinced that the important thing in engineering courses is to turn out young engineers who are capable of learning from their experience and who will develop with experience and will study after they leave the colleges and universities, rather than try to cram into the embryo engineer a vast amount of engineering knowledge, especially of fine details which he can not assimilate and for which he will have no use during the early years of his engineering experience. I also believe that no engineer will make a success because of what he learns in college. His success will depend on what he learns afterward. The function of his college course is to teach him how to learn, and to inspire him with a thirst for engineering knowledge, and to give him a vision of the possible career of a first-class engineer. I believe further, that that vision must include

a picture of the engineer as an industrial executive and business man and of the engineer as a constructive citizen,as well as a picture of the engineer as a technician.

CURRICULUM DEVELOPMENT

ADMISSION REQUIREMENTS

To gain admission into this engineering course, it need be no different from the admission requirements of the other engineering courses. However, high school preparation in commercial law, economics, bookkeeping, typing, public speaking, etc., will be of distinct advantage to the student entering this course. The admission requirements into the engineering course as taken from page 39 of the 1940 college catalog of Michigan State is as follows:

For admission to the courses in Engineering the applicant must offer the following:

English	3 units	
Algebra	1½ "	
Geometry (Plane & Solid).....	1½ "	
Physics	1 "	or more
Group I	4 "	" "
Group II	4 "	" "
Total	15 "	

GROUP I

From this group four units must be chosen, the number of credits accepted being shown.

English .... 1 unit	Botany .... ½ or 1
Math ..... 1 or 2 units	Physiography" " "
Physics .... 1 unit	Gen. Science" " "
Chem ..... 1 "	Geology ...." " "
Zoology .... ½ or 1 unit	History 1,2,3,or4
Physiology.. ½ or 1 "	Language ...2,3,or 4

GROUP II

This group is made up of subjects not included in Group I which are accepted for graduation by accredited high schools, except that not less than two units of any one language will be accepted, nor does the College accept physical training, penmanship, military training or spelling.

ADMISSION BY EXAMINATION

*"Students 21 years of age who have not graduated from high school may take examinations for admission. 15 units will be required for admission and must be chosen in accordance with the above requirements as to sequence."

Tearrive at a choice of subjects for this course, three investigation were conducted, the conclusions from which determined my choice. The proceedings of the S.P.E.E. were consulted over the most recent ten year period, questionnaires were sent out and personal interviews conducted; and the curricula of other schools offering courses similar to the proposed one were analyzed. An earnest effort was made to confine the subjects selected to those already existing in various departments of this institution.

From the investigations conducted, the following subjects were deemed of primary importance in all engineering curricula: Math. through Calculus, General Physics, English, Inorganic Chemistry, General Economics, Mechanical Drawing, Descriptive Geometry, Mechanics of Materials, Analytical Mechanics, Elements of Electrical Engineering, Hydraulics,

* 1940 Michigan State College Catalog, Page 40

Elements of Thermodynamics, Surveying.

The following subjects were suggestions advocated in a course of the proposed nature: General and Advanced Econ., Sociology, Business Writing, English Literature, Public and Business Speaking, Philosophy, Psychology, History, Ethics, Accounting, Estimating, Foreign Language, Commercial Law, Salesmanship and Debate.

The curriculum of the following colleges and universities was chosen as most nearly resembling the objective sought:

New York University

University of Cincinnatti

Lehigh University

Virginia Polytechnic Institute

University of Alabama

Massachusetts Institute of Technology

University of Illinois

Rensselaer Polytechnic Institute

These colleges and universities represent every section of the nation and many are the leading engineering schools of the country, a fact which lends great weight to this study. On the following pages, the curriculum of each is presented.

UNIVERSITY OF CINCINNATTI - COMMERCIAL ENGINEERING

FRESHMAN YEAR

FIRST TERM

Math. 111a	Mathematics	10	credit Hrs.
Math. 101a	Descriptive Geometry	8	" "
Math 100 a	Engineering Drawing	4	" "
Chem. 111a	General Inorganic Chemistry ..	12	" "
C. 101a	Co-ordination	2	" "
Eng. 169a	Composition and Literature....	4	" "
Mil. 111a	Military Science	6	" "

SECOND TERM

Math. 113b	Mathematics	9	credit hrs.
Math. 121b	Vector Algebra & Statics	8	" "
Math. 102b	Engineering Drawing	4	" "
Chem. 111b	Gen. Inorganic Chem.	12	" "
C. 101b	Co-ordination	2	" "
Eng. 169b	Comp. & Literature	4	" "
Mil. 113b	Military Science	6	" "

THIRD TERM

Math. 115c	Mathematics	5	credit hrs.
Math. 123c	Statics	6	" "
Math 104c	Engineering Drawing	2	" "
Ch. E. 171c	Industrial Chemistry	6	" "
Eng. 169c	Comp. & Literature	2	" "
Mil. 115c	Military Science	3	" "

SECOND YEAR

FIRST TERM

Math. 211a	Calculus	6	Credit Hours
Math. 221a	Dynamics	3	" "
Phys. 201a	General Physics	6	" "
Phys. 200a	Experimental Physics	2	" "
Eng. 267a	English	1	" "
C. 201a	Co-ordination	2	" "
Met. E. 271a	Gen. Metallurgy	3	" "
Met. E. 270a	Metallurgy Lab.	1	" "
Comm. E. 200a	Engineering Prob.	2	" "
Mil. 231a	Military Science	3	" "

SECOND TERM

Math. 211b	Calculus	6	Credit Hours
Math. 221b	Dynamics	3	" "
Phys. 203b	Physics	6	" "
Phys. 202b	Exp. Physics	2	" "
Eng. 267b	English	1	" "
C. 201b	Co-ordination	2	" "
Met. E. 271b	Gen. Metallurgy	3	" "
Met. E. 270b	Metallurgy Lab.	1	" "
Comm. E. 200b	Engineering Prob.	2	" "
Mil. 213b	Military Science	3	" "

SECOND YEAR

THIRD TERM

Math. 211c	Calculus	6	Credit Hours
Phys. 205c	Gen. Physics	6	" "
Phys. 204c	Exp. Physics	1	" "
Eng. 267c	English	1	" "
Comm. E. 211c	Kinematics	3	" "
Comm. E. 210c	Kinematic Draw.	2	" "
E.E. 299c	Electrical Eng.	3	" "
E. E. 298c	E. E. Lab.	1	" "
Mil. 215c	Military Science	3	" "

THIRD YEAR

FIRST TERM

Math. 321a	Tech. Mechanics	6	Credit Hours
M.E. 335a	Steam Engineering	6	" "
M.E. 434a	M.E. Lab.	2	" "
Com. 423a	Account. for Eng.	3	" "
Com. 422a	" Lab.	1	" "
Com. 411a	Economics	3	" "
Com. 381a	Statistics	2	" "
Com. 381a	" Lab.	2	" "
Eng. 360a	English	1	" "
Mil. 311a	Military Science	4	" "

THIRD YEAR

SECOND TERM

Math. 327b	Strength of Materials	6 Credit Hours
M.E. 335b	Steam Engineering	6 " "
M.E. 434b	M.E. Lab.	2 " "
Com. 423b	Account. for Engineers	3 " "
Com. 422b	" Lab.	1 " "
Com. 411b	Economics	3 " "
Com. 381b	Statistics	2 " "
Com. 380b	Statistics Lab.	2 " "
Eng. 360b	English	1 " "
Mil. 313b	Military Science	4 " "

THIRD TERM

Math. 327c	Strength of Materials	6 Credit Hours
Com. 425c	Accounting	3 " "
Com. 422c	" Lab.	1 " "
Com. 413c	Economics	3 " "
M.E. 312c	M.E. Lab.	4 " "
C.E. 328c	Elem. Surveying	4 " "
Eng. 360c	English	1 " "
Mil. 315c	Military Science	4 " "

FOURTH YEAR

FIRST TERM

Com. 421a	Cost Accounting	3	Credit Hours
Com. 420a	" " Lab.	2	" "
Com. 441a	Sales Management	3	" "
Math 413a	Differential Equations	3	" "
Ch. E. 471a	Prin. of Chem Engr.	3	" "
Eng. 313a	Comm. App. of English	2	" "
Geol 320a	Geology	4	" "
Ch. E. 475a	Thermodynamics	3	" "
C. 301a	Co-ordination	1	" "
Eng. 460a	English	1	" "
Mil. 411a	Military Science	4	" "

SECOND TERM

Com. 421b	Cost Accounting	3	" "
Com. 420b	" " Lab.	2	" "
Com. 441b	Sales Management	3	" "
Com. 413b	Differential Equations	3	" "
Ch. E. 471b	Chem. Engineering	3	" "
Eng. 313b	Comm. App. of English	2	" "
Geol. 320b	Geology	4	" "
Ch. E. 435b	Thermodynamics	3	" "
C. 301b	Co-ordination	1	" "
Eng. 460b	English	1	" "
Mil. 413b	Military Science	4	" "

FOURTH YEAR

THIRD TERM

Com. 421c	Cost Accounting	3	Credit Hours
Com. 421ca	" " Lab.	2	" "
Math. 413c	Differential Equations	3	" "
Eng. 313c	Comm. App. ofvEng.	2	" "
A.E. 331c	Aerodynamics	5	" "
Comm. E. 400c	Thesis	2	" "
C.E. 465c	Structural Analysis	5	" "
Eng. 460c	English	1	" "
Mil. 415c	Military Science	4	" "

FIFTH YEAR

FIRST TERM

E.E. 599a	Elect. Engineering	6	Credit Hours
C.E. 564a	Structural Design	1	" "
C.E. 565a	" " Theory	3	" "
Com. 331a	Corp. Finance	3	" "
M.E. 331a	Automotive Engr.	3	" "
Com. 571a	Bus. Management	3	" "
M.E. 338a	Power Plant Inspect.	1	" "
Com. E. 500a	Thesis	3	" "
Eng. 560a	English	1	" "
Mil. 511a	Military Science	4	" "

FIFTH YEAR

SECOND TERM

E.E. 599b	Elect. Engr.	12	Credit Hours
E.E. 598b	" " Lab.	6	" "
C.E. 564b	Struct. Design	2	" "
C.E. 565b	" " Theory	6	" "
Com. 331b	Corp. Finance	3	" "
C.E. 341b	Hydraulics	4	" "
Math 523b	Vibration Prob.	3	" "
Com. 571b	Bus. Management	6	" "
Com. E. 500b	Thesis	2	" "
Eng. 560b	English	2	" "
Mil. 513b	Military Science	1	" "

THIRD TERM

Com. 333c	Corp. Finance	2	" "
Math. 523c	Vibration Prob.	3	" "
Com. E. 500c	Thesis	2	" "
Eng. 560c	English	1	" "
Ch. E. 581c	Patent Law	1	" "
Mil. 515c	Military Science	3	" "

NEW YORK UNIVERSITY ** ADMINISTRATIVE ENGINEERING

FIRST YEAR

FIRST TERM

Chem 12	General Chemistry	2
Chem 12L	" " lab.	2
E.D. 11	Engineering Drawing	2
Eng. 10	Rhetoric & Composition	3
Math. 12	Analytic Geometry	4
Mil. Sci. 11	Military Science	2
Sp. 11	Fund. of Speech	2
	Total credit hours	17

SECOND TERM

Chem 22	General Chemistry	2
Chem 22L	" " Lab.	2
E.D. 21	Descript. Geometry	3
Eng. 20	Rhetoric & Comp.	3
Math. 22	Adv. Alg. & Calculus	4
Mil. 21	Military Science	2
Sp. 21	Fund. of Speech	2
	Total credit hours	17

SECOND YEAR

FIRST TERM

Eng. 35	Lang. and Lit.	2
Ad. E. 30	Manuf. Proc. & Eqpt.	3
Math 32	Calculus	4
E.M. 30	Statics	3
Mil. 31	Military Science	2
Phys. 32	Mech.,Heat & Sound	4
Phys. 32L	" " " Lab.	1
	Total Credit Hours	19

SECOND TERM

Econ. 46	Economics	2
Eng. 45	Cultural Backgrounds	2
Math 42	Calculus	3
E.M. 40	Dynamics	3
Mil. 41	Military Science	2
Phys. 42	Light, Magn.,& Elect.	4
Phys. 42L	" " " Lab	1
M.E. 40	Shopwork	1
	Total Credit Hours	18

THIRD YEAR

FIRST TERM

Ad. E. 52	Indust. Dev. of the U. S.	2
Ad. E. 54	Indust. Admin. & Mgt.	2
Ad. E. 54L	Graphical Presentations	1
Ad. E. 55	Corp. Fin.	2
E.E. 52	D. C. Machinery	2
E.E. 52L	" " " Lab.	1½
E. M. 50	Mech. of Materials	4
M.E. 52	Thermodynamics	2
M.E. 52L	Heat-Power Lab.	1
Electives		2 or 3

Total Credit Hours 19½ or 20½

SECOND TERM

Ad. E. 60	Srvy. of Acc. Practice	2
Ad. E. 61	Indust. Plants	3
Ad. E. 64	Indust. Admin. & Mgt.	2
C.E. 58	Materials-Testing Lab.	½
E.E 62	A. C. Mach.	2
E. E. 62L	" " " Lab.	1½
E.M. 64	Fluid Mech. & Lab.	3
M.E. 56	Kinematics & Theory of Mach.	3
Electives		2 or 3

Total Credit Hours 19 or 20

FOURTH YEAR

FIRST TERM

Ad. E. 71	Econ. of Indust. Enterprises	2
Ad. E. 74	Jigs, Fixtures & Gages	2
Ad. E. 76	Cost Accounting	2
Ad. E. 77	Motion Study	2
Ad. E. 78	Mktg. & Merchandising	2
Ad. E. 91	Seminar	1
M.E. 74	Machine Design	3
Psych. 53	Indust. Psych.	2
Electives		2 or 3
	Total Credit Hours	18 or 19

SECOND TERM

Ad. E. 81	Labor & Pers. Mgt.	2
Ad. E. 82	Appld. Engr. Econ.	3
" 87	Time Study	2
" 83	Statistics	3
" 83L	" Prob.	1
" 92	Seminar	1
C.E. 81.	Industrial Structures	2
E.L. 82	Engineering Law	2
Electives		2 or 3
	Total Credit Hours	19 or 20

CHART I

	N.Y.U.	Lehigh	U. of Cinn.	Univ. Poly.	Rensselaer	Alabama	Illinois	M.I.T.
Chemistry	X	X	X	X	X	X	X	X
Drawing	X	X	X	X	X	X	X	X
Descript. Geo.	X	X	X	X	X	X	X	X
Math.	X	X	X	X	X	X	X	X
English	X	X	X	X	X	X	X	X
Phys. Ed.		X		X	X		X	X
Military	X	X	X	X		X	X	X
Physics	X	X	X	X	X	X	X	X
Mechanics	X	X	X	X	X	X	X	X
Economics	X	X	X	X	X	X	X	X
Shop	X				X	X	X	X
Surveying			X	X	X	X	X	X
Elect. E.	X	X	X	X	X	X	X	X
Speech	X				X	X		
Manuf. Proc.	X			X	X			
Ind. Dev. of U.S.	X				X			X
Ind. Ad. & Mgt.	X	X		X	X	X	1	X
Electives	X	X			X	X	X	X
Corp. Finance	X	X	X		X		X	X
Thermodynam	X	X	X		X	X	X	X
Heat - Power	X	X	X	X			X	X
Accounting	X	X	X	X	X	X	X	X
Materials	X				X		X	X
Hydraulics	X		X		X	X	X	X
Cost Acct.	X	X	X		X	X		
Mkty & Merch.	X				X		X	
Seminar	X		X					
Mach. Design	X	X		X	X		X	X
Indust. Psych.	X	X	X		X			
Labor & Personnel	X	X			X	X	X	
Statistics	X	X	X					X
Ind. Struct.	X					X	X	X
Bus. Law	X	X	X			X	X	
Energy Lect.	X	X	X	X		X		
Metallurgy		X	X		X	X	X	

X INDICATES COURSE OFFERED

The following is the proposed course which the writer offers:

FIRST YEAR

FALL TERM

Chem. 101a	General Chemistry	3
D.& D. 104a	Mechanical Drawing	3
Eng. 102e	Composition	3
Math. 101	Algebra	3
M.E. 131	Pattern Work	2
M.E. 101	Elements of Engr.	0
Mil. 101	First Year Basic	1½
Phys. Ed.	Service Course	1

WINTER TERM

Chem. 102a	General Chemistry	3
D. & D. 105a	Descriptive Geometry	3
Eng. 102f	Composition	3
Math. 103	Analytic Geometry	3
M.E. 141	Machine Shop	2
Mil. 102	Military Science	1½
Phys. Ed.	Service Course	1

FIRST YEAR

SPRING TERM

Chem. 103a	General Chemistry	3
D & D 105b	Descriptive Geometry	3
Eng. 102g	Composition	3
Math 103	Analytical Geometry	3
M.E. 151	Foundry	2
Mil. 103	Military Science	1½
Phys. Ed.	Aquatics	1

SECOND YEAR

FIRST TERM

C.E. 202	Surveying	3
Math. 204	Calculus	5
Physics 210	Mechanics & Heat	5
Econ. 332	Accounting for Engrs.	3
Mil. 204	Military Science	1½

SECOND YEAR

WINTER TERM

Sp. 101	Fund. of Speech	3
Math 205	Calculus	5
Physics 220,221	Heat, Elec., & Magn.	5
Econ 210a	General Econ.	3
Mil. 205	Military Science	1½

SPRING TERM

Sp. 102	Advanced Speech	3
Math 206	Calculus	5
Physics 230,231	Light & Sound	5
Econ 210b	General Econ.	3
Mil. 206	Military Science	1½

THIRD YEAR

FALL TERM

C.E. 304a	Mech. of Engr.	5
E.E. 305a & ab	D. C. Machinery	3
M.E. 211a	Metallurgy	2
Econ. 318	Money, Credit, Banking	5
History 101	History	3

THIRD YEAR

WINTER TERM

C.E. 304b	Mechanics of Engr.	5
C.E. 305	Hydraulics	3
E. E. 30ob & bc	A.C. Machinery	4
History 102	History	3
Econ. 307	Personnel Mgt.	3

SPRING TERM

C.E. 304c	Resist. of Materials	5
Math 318	Statistics	3
Hist. 103	History	3
Econ 316	Corp. Finance	3
Econ 217	Bus. Org. & Mgt.	4

FOURTH YEAR

FALL TERM

M.E. 405a	Industrial Mgt.	3
Psych. 201	General Psychology	4
Econ 414	Labor Problems	3
Acct. 325a	Cost Accounting	3
Econ. 445a	Business Law	3
C.E. 431	Seminar	1

FOURTH YEAR

WINTER TERM

M.E. 309a	Thermodynamics	3
C. E. 432	Seminar	1
C. E. 316a	Sand, Cement & Concrete	3
Psych. 305	Industrial Psych.	3
Phil. 321	Philosophy	
~~Econ. 445a~~	~~Business Law~~	3
Econ. 442	Public Utility Econ.	3
M.E. 313c	Materials Testing Lab.	1

SPRING TERM

M.E. 405c	Industrial Mgt.	3
C.E. 411	Thesis	6
Econ 330	Investment Banking	3
Journ. 302	Business Writing	3
Econ 452	Business Cycles	3

CATALOG

Chem 101a. General Chemistry 3(2 -6) Similar to Course 101, but assuming a knowledge of certain fundamentals.

Chem 102a. General Chemistry 3(2-6) Qualitative analysis.

CHEM 103a. General Chemistry 3(2-6) Carbon Compounds. A course in which the student becomes familiar with the chemistry of the carbon compounds, particularly those of the aliphatic series. In the laboratories the student prepares a number of typical organic compounds and makes some determinations of their physical constants

MECHANICAL DRAWING 104a. 3(0-9) Lettering and the use and care of instruments. Orthographic projection, working drawings, machine sketching, and isometric drawing.

D.&D. 105a. DESCRIPTIVE GEOMETRY 3(2-4) Solution by graphical methods of problems involvong the relations of points. lines and planes.

D.&D. 105b. DESCRIPTIVE GEOMETRY 3(1-6) A continuation of course 105a, including the intersection of planes and curved surfaces and the development of cones and cylinders.

Eng. 102e. COMPOSITION 3(3-0) Careful training in composition through the study of models and frequent writing of themes.

Eng. 102f. COMPOSITION 3(3-0) A continuation of 102e.

Eng. 102g. COMPOSITION 3(3-0). A continuation of 102f.

Math. 101. ALGEBRA 3(3-0).

Math. 103. ANALYTIC GEOMETRY 3(3-0).

Math. 102. TRIGONOMETRY 3(3-0).

Math. 204. CALCULUS 5(5-0).

Math. 205. CALCULUS 5(5-0). Continuation of Course 204 .

Math. 206. CALCULUS 5(5-0). Continuation of Course 205.

Math. 318. STATISTICS 3(3-0). A course in the elementary principles of the scientific interpretation of statistical data.

M.E. 131. PATTERN WORK 2(1-3). Instruction and practice in the use of wood-working tools, followed by exercises in joinery, wood-turning, and simple pattern-making.

M.E. 101. ELEMENTS OF ENGINEERING No Credit. This course is designed to give the student a general view of the field of engineering achievement and to interest him in his work.

M.E. 141. METAL WORKING 2(1-3). Instruction and practice in forging and welding iron and steel, tempering steel for hand and machine tools.

M.E. 151. FOUNDRY 2(1-3). Instruction and practice in hand and machine molding; in melting, cleaning, and trimming castings in iron, brass, and bronze.

M.E. 211a. ENGINEERING MATERIALS 2(2-0). An elementary study of the methods of manufacture and properties of the materials used in engineering, with special emphasis on iron and steel.

M.E. 405a. INDUSTRIAL MANAGEMENT 3(3-0). A study of the methods of corelation and control of materials, methods, money and men, in a modern industrial organization. Problems dealing with power, scientific determination of lot-sizes, expense burden sizes, etc.

M.E. 405c. INDUSTRIAL MANAGEMENT 3(2-3). The selection of a factory site, type of factory construction, heating, ventilation, sanitation, processing of work, selection and arrangement of equipment and predetermining cost of product.

M.E. 309a. THERMODYNAMICS 3(3-0). A study of heat and power transformations through the media of perfect gases, real gases, and vapors followed by application of prime movers.

Mil. 101-103. FIRST YEAR BASIC 1½(3-0). The first year of instruction in all units is a course in military fundamentals embracing the national Defense Act, obligations of citizenship, military history and policy, military discipline, map reading, military organization, and dismounted drill. In addition to these subjects common to all arms, each unit gives instruction in its particular technique.

Mil. 204-206. SECOND YEAR BASIC 1½(3-0). Dismounted drill, anti-aircraft weapons and materiel, fire-control and position-

finding for seacoast and anti-aircraft, and characteristics of naval targets.

PHYSICAL EDUCATION 1(0-3). All students, unless excused by the Health Service, must take three of the four groupings; Games, Aquatics, Stunts, Combatives.

C.E. 202. SURVEYING AND LEVELING 3(3-0). Elementary surveying, covering the use of the tape, compass, level, and transit, with practice in making simple maps.

C.E. 304a. MECHANICS OF ENGINEERING 5(5-0). Elementary statics and dynamics, theory of center of gravity, friction and moment of inertia comprise the first term's work.

C.E. 304b. MECHANICS OF ENGINEERING 5(5-0). A continuation of Course 304a, using the same textbook in class. Kinetics, kinematics, work and impulse are some of the divisions of this study.

C.E. 304c. RESISTANCE OF MATERIALS 5(5-0). Among other considerations dealt with are simple tension, compression and shear; moment and shear in flexure of beams, with diagrams; long columns.

C.E. 305. HYDRAULICS 3(3-0). The fundamentals of the science of hydaulics are given, including: hydrostatics, discharge from orifices and over weirs, and the flow through pipes and open channels.

C.E. 431. SEMINAR 1(0-3). A course in reading and discussion of current engineering magazines and literature.

C.E. 432. SEMINAR 1(0-3). Continuation of Course 431.

C. E. 31ba. SAND? CEMENT? &CONCRETE 3(2-3). A study of the properties of concrete aggregates and concrete, including their manipulation in construction together with laboratory exercises in making the standard acceptance tests and others.

C.E. 411. TECHNICAL PROBLEMS AND REPORTS 6(0-18).

Original investigations and analysis are made by the students, for which a definite assignment of hours is made.

Physics 210; 220, 230 MECHANICS, HEAT, MAGNETISM, ELECTR., SOUND & LIGHT 5(0-2). This course, together with 211, 220, 221, 230, 231, constitutes a year of thorough work in the field of General Physics, emphasizing that, as one of the basic sciences, its facts and methods of combining math. and experimental data are a necessary part of the mental equipment of either a technically trained or a liberally educated person.

Econ. 332. ACCOUNTING FOR ENGINEERS 3(3-0). A survey course planned for students in Engineering Administration. Emphasis is placed on the construction and analysis of accounting statements, the problems of valuation, and the propriety accounts.

Econ. 210a. GENERAL ECONOMICS 3(3-0). Designed as a general introduction to economics. An examination is made of the basic characteristics of the modern industrial and credit economy, with special attention to production, exchange, money, banking, and business cycles.

Econ. 210b. GENERAL ECONOMICS 3(3-0). Continuation of 210a, with special attention to price determination and control, international trade, and distribution of national income.

Econ. 318. MONEY? CREDIT & BANKING 4(4-0). A survey of the financial organization of society. Consideration of monetary systems, foreign exchange, credit instruments, and the principal types of modern financial institutions.

Econ. 307. Personnel Management 3(3-0). A course in the principles and practices of industrial and personnel work. Among the subjects treated are personnel department organization, selection training health and safety as well as wage incentives and profit sharing.

Econ. 316. CORPORATION FINANCE 3(3-0). A study of the corporate form of business organization with reference to its financial administartion. It treats of promotion, types of stocks and bonds, management of income, etc.

Econ. 414. LABOR PROBLEMS 3(3-0). This course proposes to examine the more important labor problems in modern industry.

Econ. 217. BUSINESS ORGANIZATION AND MANAGEMENT 4(4-0).

This course is designed to be an introduction to the field of business. It examines the fundamentals of management underlying thesolution of problems of organization and operation in all business enterprise.

Econ. 325a. COST ACCOUNTING 3(3-0). This course applies the principles of accounting to the problems of scientific accumulation of manufacturing costs to determine unit costs and job costs.

Econ. 445a. BUSINESS LAW 3(3-0). This course attempts to give an understandingof the part which law and legal institutions play in the economic organization.

Econ. 442. public utility economics 3(3-0). Deals with public utilities other than railroads from the double standpoint of management and public policy.

Econ. 330. INVESTMENT BANKING 3(3-0). Organization and operation of investment banking and underwriting institutions, security exchanges, brokers, etc.

Econ. 452. BUSINESS CYCLES 3(3-0). Historical and descriptive analysis of booms, depressions, crises and panics.

E.E. 306a & ab. DIRECT CURRENT CIRCUITS AND APPARATUS.3(3-0).

Electric circuits, details of dynamo construction, generator and motor operating characteristics.

E.E. 306b & bc. ALTERNATING CURRENT CIRCUITS & APPARATUS 4(4-0) Single and polyphase circuits, generators, motors, and converters.

Hist. 101, 102, 103 HISTORY 3(3-0). This series of courses presents the origin, evolution, and interrelation of social ideas and institutions which have contributed in the course of time to the complexities of modern civilization.

Psych. 201. GENERAL PSYCHOLOGY 4(4-0). This course provides an introduction to the scientific study of human activities. The psychological attitude will be contrasted with certain other attitudes toward the human organism.

Psych. 305. INDUSTRIAL PSYCHOLOGY 3(3-0). The application of psychological principles to the problems of modern industry.

Phil. 321. INTRODUCTION TO PHILOSOPHY 3(3-0). An examination of the different philosophical views with emphasis on the writings of certain philosophers and the reasons underlying the positions taken.

Journ. 302. BUSINESS WRITING 3(3-0). This course presents the general principles of business correspondence, with thorough training in the composition of effective business letters.