HISTORICAL DEVELOPMENT OF THE ELECTRONICS TECHNOLOGY CURRICULUM AT OKLAHOMA STATE UNIVERSITY'S TECHNICAL INSTITUTE

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Bachelor of Science

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Stillwater, Oklahoma

1966

Submitted to the faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1967

HISTORICAL DEVELOPMENT OF THE ELECTRONICS

TECHNOLOGY CURRICULUM AT OKLAHOMA

STATE UNIVERSITY'S TECHNICAL

INSTITUTE

Thesis Approved:

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Dean of the Graduate College

[redacted]

ACKNOWLEDGMENTS

The writer is indebted to many people for their contributions to the study.

Deep appreciation and gratitude are expressed to Dr. Paul Braden, Associate Professor of Industrial Education, whose inspiration, guidance, patience, and helpful suggestions have made this study possible.

Thanks and appreciation are due Dr. Aaron J. Miller, Dr. Jack Tompkins, Mr. Russell Heiserman, Mr. Rodney Faber, and Mr. Paul McCollum for their cooperation and guidance in providing much of the data for this study.

Indebtedness is also acknowledged to Mr. Donald Phillips and Mr. Raymond Millimet for their inspiration and guidance and for their interest in the writer's professional growth.

Special thanks is due Mrs. Carolyn Laverde for her help in obtaining data from the Technical Institute files.

Sincere gratitude is expressed to my wife, Donna, whose encouragement and help in typing the rough draft, made the completion of this study possible.

D. L.

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CHAPTER I

THE PROBLEM

The rapid technological advancement in American industry has caused a number of significant occupational changes. Of these changes, the occupations between the craftsman and the engineer have experienced the fastest rate of growth. Many of these occupations are being filled by the technical institute trained person known as the engineering technician.

Before World War II the engineer performed both the theoretical and the technical aspects of engineering. Today the engineer is more concerned with work of a scientific nature. Engineering is no longer an individual effort and America's high level of production is accomplished by engineering teamwork. In a 1960 publication of "The Engineering Technician," the engineering team was defined as having the following main parts:

1. Engineers and scientists who formulate ideas and create new products and services.
2. Engineering technicians who help develop, test, and apply these ideas and creations.
3. Skilled workers who make the products and perform the routine services. (1)

It is a wasteful use of manpower to use the engineer in work that could be performed by technical workers who can be trained in a shorter period of time. Not only is this wasteful but a critical look at engineering resources reveals that a sufficient number of engineers simply does not exist. With this shift of concentration of the engineers' tasks from technical engineering to scientific engineering comes new opportunities for the employment of the second part of the engineering team: the engineering technician.

Trying to estimate the number of technicians needed by the government and industries in the United States has been the topic of several studies in the past. The number of technicians needed each year between now and 1970, was estimated in a National Science Foundation survey as from 68,000 to 226,000. (7) Another indication of the great demand for technicians can be seen in a recent United States Department of Labor survey. A report from 30 major employment centers indicated that the trend first noted near the end of 1964 toward dwindling applicants supply and rising demand in the engineering, scientist and technicians has accelerated. (22) Where in 1964 there were two or more applicants for each technical position, today the number of openings outnumber the applicants.

Indications show that when more engineers are needed the demand for engineering technicians is even greater. The National Science Foundation study noted the estimated ratio of (.7 to 1) technicians to engineers and scientists appears to be low. (7) In his book, "The Technical Institute of America," Henninger concludes that the employers would like to hire more than twice as many engineering technicians as new graduate engineers. (12)

With the demand for engineering technicians well in mind, the other side of the coin or the supply side has to be examined. What is the possibility of supplying the 200,000 technicians needed each year between now and 1970? "The Tenth Survey of Engineering Technician Programs," indicates that the programs surveyed in 1964-1965 will graduate 15,000 full-time engineering technicians. (17) The two figures together add up to about 25 percent of the total need. Similar figures were reported in a report by the Division of Vocational and Technical Education, United States Office of Education. (18)

These 29,000 engineering technicians come from many different kinds of training centers. A partial list would include technical institutes, community and junior colleges, military programs and company operated schools. Figures indicate that the majority of technicians receive their training from technical institutes and community or junior colleges. (18) Mr. Russell Beatty, President, Wentworth Institute, adds support to these figures in saying, "Engineering technicians are usually the product of technical institutes, although many have been educated for their work in company operated schools, in military programs, and even through on-the-job training programs." (2)

With the demand for technicians keeping ahead of the supply, training programs must be administered as efficiently as possible. The engineering technician curriculum presents problems found only in two-year college level engineering programs, which lead to an associate degree. Perhaps, the development of technical curricula will be the greatest problem to overcome. Within the scope of curriculum design major emphasis has to be given to the integration or correlation of mathematics, science and technology. Another consideration has to be given to the kind of students who enter a technical institute. Their main concern is in receiving instruction in a specialized field of study as soon as possible, e.g., electronics, metals, drafting and design, and aeronautics. This can be accomplished by introducing the field of specialization in the first semester. In addition to satisfying this need for technical knowledge, including the technical speciality in the first semester, it allows for greater depth in the curriculum. With the basic electronics and electricity covered in the first semester the student is able to proceed into more advanced topics in the next three semesters.

The problem in this study is to trace and record the historical development of the Electronics Technology curriculum at Oklahoma State University's Technical Institute.

Significance of the Study

A study of the development of the Electronics Technology curriculum at Oklahoma State University's Technical Institute will benefit beginning electronic technology instructors, supervisors, department heads, and lay advisory committees in planning a new or revising existing curricula. These people need as many guidelines as possible in setting up programs. With the demand for technical institute graduates so great and the resources so scarce, every wasted day could affect the nation's economy and the national defense.

The main reason for studying history of any kind is to try and benefit from the past. Technical curriculum cannot be pieced together without making an adequate study of the proposed curriculum. It is realized that one curriculum cannot possibly fit every situation and it should be that way. However, much of the knowledge and basic skills required by engineering technicians (electronic technicians) is the same in each curriculum. Industrial representatives want a man with a broad base in electronics from which they can teach him the specialization needed for their particular products and processes.

Purpose of the Study

The major purpose of the present study is to trace and record the historical development of the Electronics Technology curriculum of Oklahoma State University's Technical Institute. Special emphasis is to be placed on the correlated or integrated curriculum that developed in the early 1960's.

Methodology of the Study

The methodological approach used in this study was the historical survey method. Historical research is defined in Good's Dictionary of Education as:

> The type of research that has as its chief purpose the ascertaining of facts that fit into a significant time sequence and the relationships among these facts; usually concerned in a broad way with some delimated subject, delineating many aspects of the subject as each throws light on other aspects or on the general story; normally concerned with course, but these may have to be imputed. (The term implies that a story will be reconstructed from observations that were not made especially for the purpose of the study; sources must be discovered and evaluated as to authenticity and accuracy.) (9)

Several sources of data are included in the study. Available catalogues were obtained and copies made of the electronics curricula. The catalogues were examined to ascertain the curriculum changes. This information was supplemented by personal interviews with as many of the past department heads as possible (see Appendix A). Communication with

Russell Heiserman, department head, was done by mail and an exchange of recording tapes. In so far as possible, data obtained from the interviews were checked with data obtained from the official catalogues and only data on which there was agreement was used in the study.

Limitations

Limitation as to schools: The study was limited to the Electronics Technology curriculum of Oklahoma State University's Technical Institute.

Limitations as to number of people interviewed: Four Electronics Technology department heads from the Stillwater branch and one from the Oklahoma City branch were interviewed.

Limitation as to lack of documented material: The chief source of documented materials for this study was Oklahoma State University's college catalogues. These catalogues do not always give an accurate picture of the present curriculum or of its recent changes: most of the time these catalogues are one or two years behind what is actually being taught.

Definition of Terms

Technical Institute: An institution which offers a two-year post high school curriculum in one or more branches of technology leading to an associate degree. The programs offered are oriented to fields of applied science with heavy emphasis upon application. The Technical Institute at Oklahoma State University is administered by the College of Engineering.

Integrated Technical Institute Curriculum: Curriculum offering a a correlation of course work in mathematics, technology and science. The duration of these courses should be at least two years in length. The main areas of the curriculum are: (1) technical speciality courses, (2) non-technical or general courses, and (3) mathematics and science.

Engineering Technology: The part of the engineering field which requires the application of scientific and engineering principles coupled with the technical supporting skills; it falls in the occupational spectrum between the craftsman and the engineer at the end of the spectrum nearest the engineer. (15)

Engineering Technician: One who serves as a liaison between the engineer or scientist and the skilled worker. Their education and experience enables them to work in most phases of engineering, such as, design, research, engineering calculations, development of experimental equipment and models.

Electronic Technician: He is included under the broad heading of engineering technician. His education and experiences are concentrated in electronics, i.e., vacuum tube and transistor circuit theory, instrumentation and measurements, electronic communications and computers. Some of the job clusters he may enter are: Research and Development Technician, Communications Technician, Operations Technician, and Biomedical Technician.

CHAPTER II

REVIEW OF LITERATURE

Within the past ten years several studies and articles have been devoted to the presentation of engineering technician curricula. Some have been aimed at advancing a general technical program while others are directed at specific technologies. The main objective of many studies, including this one, is pointed at setting guidelines for construction and improving technical institute curricula. However, few have been directed toward a particular institute or technology. In addition to these general guidelines, a study devoted to a particular successful curriculum will provide added meaning.

The next section of technical institute education receiving consideration is the evaluation of program quality. All present guidelines are useless until they are put into practice and effectively evaluated. To assure the public that the curricula, faculty, and facilities of a technical institute met the standards needed to obtain recognition in the professional field, a respectable accrediting agency seems necessary.

The remainder of this chapter incorporates the ideas mentioned above by dividing the material into the following three areas:

1. Literature related to general engineering technician curricula.
2. Literature related to electronic technology curricula.

3. Literature related to the accreditation of engineering technician curricula.

General Study

Rated high among recent studies intended to help improve the nature of technical institute education is the McGraw Report of 1962. This report of a study sponsored by the American Society for Engineering Education was financed by a grant from the National Science Foundation and is titled, "Characteristics of Excellence in Engineering Technology Education." The purpose of the study was to develop quality standards to serve as guidelines for construction, improving and evaluating engineering technology curricula. This report was reviewed by almost 200 individuals qualified to evaluate some aspect of it. The report covers the following portions of engineering technician education:

1. Definition of terms
2. Faculty
3. Students
4. Curriculum

The curriculum is broken down into three main parts: technical courses, which include technical skills and specialties; basic science courses, which include mathematics and physical sciences; and non-technical courses, which include communications, humanities, and social sciences. The minimum credit hours for each area are given along with an illustration of their possible application to a 72-hour curriculum. (15)

Supplying further information on the development of technical institutes and their curricula are two books written by leading figures in technical institute education. Henninger's book titled, "The Technical Institute of American," (12) and Grany's, "The Technical Institute," (10) both offer a number of general guidelines to help establish engineering technician programs.

Another useful document is an United States Office of Education publication, "Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs." This booklet furnishes many useful hints concerning the definition, occupational, and educational requirements for establishing post-high school technician type educational programs. (20)

Guide for Electronics Technology

The Division of Vocational and Technical Education of the United States Office of Education has constructed a series of publications designed to aid in the development of technician training programs operated under Title VIII of the National Defense Education Act of 1959. Publications are available in electronic, electrical, mechanical, instrumentation, and other technologies. The revised electronic technology series of 1966 covers the following areas:

1. General Considerations
   - (a) Faculty
   - (b) Student Selection
   - (c) Textbook, References and Visual Aids
   - (d) Laboratory Equipment and Facilities
2. The Curriculum
   - (a) Curriculum Outlines

(b) Brief Description of Courses

3. Course Outlines

(a) Technical Courses

(b) Mathematics and Science Courses

(c) Auxiliary and Supporting Technical Courses

(d) General Courses

The curriculum is designed to meet the following requirements:

1. Training should prepare the graduate to be a productive employee in an entry level job.
2. The broad technical training together with a reasonable amount of experience, should enable the graduate to advance to positions of increasing responsibility.
3. The foundations provided by the training must be broad enough so that the graduate can do further study within his field. This further study may consist of the reading of journals, new text materials, or enrolling in formal courses. (21)

In addition to furnishing course outlines, laboratory layout and equipment, and suggested textbooks, an explanation of the relationship between curriculum content and the entire program is clearly stated.

Accreditation

To ensure the public that each school training engineering technicians is accomplishing their objectives and that these objectives are considered to be appropriately within the accepted scope of engineering technology is best done by a professional accrediting agency. Since 1944, the accreditation of engineering technology curricula has been done by a sub-committee of the Engineering Council for Professional Development. E.C.P.D. does not dictate details of the curricula but rather professional accreditation tends to serve as a recognition of those curricula which meet professionally established standards of academic level and competence. In addition to accreditation E.C.P.D. has been active in several other areas representing the broad field of professional development. These areas include: (1) guidance, (2) student development, (3) continuing education, and (4) recognition. (12)

In addition to the professional accreditation done by E.C.P.D., which accredits only curricula, there is a regional accreditation carried on by six regional accrediting agencies such as North Central Association, Middle State Association, etc. The purpose of these agencies is to accredit entire institutions. Not only does this accreditation inform and protect the public by indentifying the objectives, quality, and academic level of the programs of the institution, but the accreditation also helps the institutions receive guidance and support in maintaining and raising the general standards of the institutions.

CHAPTER III

HISTORICAL DEVELOPMENT OF THE ELECTRONICS TECHNOLOGY CURRICULUM

The material presented in this chapter concerns the development of the Electronics Technology curriculum at Oklahoma State University's Technical Institute. The development of the Electronics Technology curriculum is divided into the following three stages: beginning, present and future. Each stage will be explained separately after a treatment of the setting in which these developmental stages unfolded or will unfold.

Setting

Oklahoma State University was founded in 1890 as Oklahoma Agricultural and Mechanical College by an act of the first territorial legislature in order to comply with the Morrill Act of 1862. The name of the college was changed to Oklahoma State University of Agriculture and Applied Science in 1957. (6) At this time the University is organized into colleges and divisions as follows:

The Division of Agriculture

The College of Arts and Sciences

The College of Business

The College of Education

The Division of Home Economics

The College of Veterinary Medicine

The Graduate College

The Division of Engineering. Included College of Engineering, Engineering and Industrial Extension, Engineering Research, and the Technical Institute. (6)

Currently University property includes the main campus of 150 acres at Stillwater, a Technical Institute Branch in Oklahoma City, and a School of Technical Training at Okmulgee. In addition, there are various farming and experimental stations throughout the state.

Beginning Stage

Until 1937, a two-year curriculum was nonexistent at Oklahoma State University. Before this time the region of education between the skilled worker and the engineer was not part of the University's mission. By use of a survey and personal contact with employers and employees, it was shown that there was a need for technicians to fill the gap of employment opportunities between the skilled worker and the engineer. It was this need for technicians that lead to the establishment of the School of Technical Training on the Stillwater campus. (3)

The two-year technician curricula offered in 1936 were: Firemanship, Internal Combustion Engines, Welding and Machinist Training. In September, 1938, the Electrical Technician Training curriculum was offered for the first time.

During World War II the communications industry, e.g., radio, microwave, and airplane communications, began to develop in the United States. With this came the need for persons to supervise, install and maintain the electronic equipment needed in communications. In response to this need, the Radio and Electronics curriculum, forerunner of the present Electronics Technology curriculum, was started in 1945. (14) The purpose of the Radio and Electronics curriculum was to supply individuals who were needed to perform technician tasks in the rapidly developing communications industry. Although, the main objective of this two-year program was to train Radio Technicians, the curriculum was arranged in such a manner that it could effectively serve persons wishing to obtain positions as radio mechanics and radio operators. (4)

The first Radio and Electronics curriculum was developed by Mr. Paul McCollum, department head, and Mr. Maurice W. Roney, instructor. The two-year curriculum contained 82 semester credit hours, with one semester credit hour given for each lecture hour and one semester credit hour given for every three hours of laboratory time. On the average, each student spent two hours in laboratory for every one hour in the classroom, indicating the importance of the laboratory in a technician education curriculum.

The electricity and electronics courses concentrated primarily on the principles of radio tubes and circuits and their applications in communications equipment. Also included was a five-hour technical mathematics course that emphasized application to problems of a technical nature. General supporting courses rounded out the curriculum. A complete listing of the entire curriculum appears in Appendix B.

In 1946, Mr. Hugh Lineback joined Mr. McCollum and Mr. Roney as a Radio and Electronics instructor. Mr. Lineback later became the department head. By the fall of 1949, these three men had reorganized and strengthened the curriculum until it was ready to be evaluated by E.C.P.D. These changes included the following:

1. The total credit hours for each semester was reduced from 19 and 20 to 17 hours.
2. The employment relations course was moved from the second semester to the first and the hand tools course from the first to the second.
3. The beginning code course was moved from the second semester to the summer session.
4. The radio broadcasting course was moved to the third semester and a new television course was added in the fourth.

The television course was added to the curriculum because of the increased importance of television in the communications field. With the need for Morse Code diminishing, this course was moved to the summer session, and finally dropped from the curriculum in 1960. These changes are good examples of how engineering technician curricula change with changes in engineering technology. The curriculum met the evaluation standards of E.C.P.D. and was accredited in the spring of 1949.

In the fall of 1954, Paul McCollum resigned as department head and became a member of Oklahoma State's Electrical Engineering faculty. Hugh Lineback replaced him as department head and Mr. Aaron J. Miller was added to the department as an instructor.

In Mr. Lineback's first year as department head, a few minor changes occured in the curriculum. The total number of credit hours was increased from 17 to 18 and a one credit occupational guidance course was added to the first semester. The purpose of this course was to orient new students concerning the place of the engineering technician in industry. (5) A second addition was a machine shop practice course added to the second semester. The main objective of this course was to familiarize the electronics students with the fundamental processes of the machine shop.

Until 1958, the two-year programs were administered under the School of Technical Training. However, in 1958 the school became the Technical Institute, with Mr. Maurice Roney as acting director. No major changes occurred in the curriculum with this change in the name.

Present Stage

In the fall of 1958, Mr. Russell Heiserman joined the Electronics Technology Department faculty, and two years later Mr. Rodney Faber and Mr. Richard W. Tinnell joined the faculty. Between the years 1959 and 1963 the ground work for the integrated curriculum (see Page 6) was being laid.

A summary of the philosophy and attitudes that prevailed during this period seems necessary before any mention is given to the changes that occurred in the curriculum. The idea of an integrated curriculum was carried on in minor fashion before 1963. The instructors met periodically and discussed methods of improving their curriculum by arranging the course material in a sequence that could improve the performance of the students. However, no particular schedule was set aside for these meetings. (13)

There has always been a certain amount of correlation between the mathematics and the electrical and electronics curricula. The mathematics courses have always been taught within the technical institute. Very often the electronics instructors would teach these courses in a separate course not as part of an electronics course. If they did not teach the mathematics course, they worked closely with those who did. Mr. Heiserman, in a personal communication, mentioned talking to other electronics instructors throughout the country about teaching technical mathematics. He noted that when mathematics was not taught within the technical institute, the electronics instructors invariably had to review or teach for the first time about 40 to 50 percent of the required mathematics. (13)

During the 1959-1963 period, there was considerable discussion about changing the Electronics Technology curriculum. The conversation during faculty meetings and coffee breaks was used as a sounding board for discussing the rationale for changing the curriculum as well as suggested ways of effecting these changes. One of the main topics of conversation centered around the amount of time wasted in the first semester. A careful look at the first semester (prior to 1963) reveals course work emphasizing direct current, alternating current, mathematics, and two general courses in English and Technical Drawing. Yet, certain mathematical principles are necessary before course work featuring direct current, and, in turn, alternating current, could be profitably presented. Work in alternating current had to be deferred until courses in mathematics and direct current reached the sophistication in content necessary for study in that area. This point was reached about mid-semester, and then the alternating current course had to accelerate to cover the material in preparation for the electronics courses of the second semester. After the first semester, 25 percent of the estimated total training time had elapsed and the student, as yet, had received little instruction in electronics. (8)

A second failing often mentioned was the time wasted in the laboratories. Department heads estimated that one-third of the laboratory time was wasted looking for suitable parts and equipment. First year students used old equipment, which often functioned erratically, adding to further delay. It was reasoned that lack of experience and poor laboratory techniques would prove damaging to the equipment. This lead to frustration for both the student and the instructor. When the desired results were not obtainable because of inefficient equipment, the instructor had to apologize to the student and explain what the results should have been under suitable conditions.

An Oklahoma City branch of the Technical Institute was established in the fall of 1961. The first Electronics Technology department head was Mr. Jack Tompkins. In the beginning, this branch adopted the curriculum offered at the Stillwater campus. Mr. Tompkins shared the views of the faculty members at Stillwater concerning the failing of the present curriculum. (19) In addition to these failings, the curriculum did not meet the needs of the many part-time students in Oklahoma City. To enable these students to complete a laboratory and attend a lecture in a morning or afternoon, the courses had to be shortened and the three-hour laboratories reduced to two hours. Mr. Jack Tompkins constructed a new curriculum that incorporated these shorter courses and laboratories. The sequence of courses contained in this new curriculum turned out to be the bases for the integrated curriculum of 1963. (19)

The curriculum developed by Mr. Tompkins also included new course titles and numbers which took affect in Oklahoma City in the spring of 1962 and were adopted in Stillwater in the fall of 1963. The electronics courses were changed from Tec R (Technical Radio) to Tec ET, i.e., Tec R 125 became Tec ET 204 and Tec R 215 became Tec ET 214. In a personal communication with Mr. Tompkins, he gave two main reasons for these changes. (19) First, the term Electronics Technology (Tec ET) more accurately describes the type of training now being offered by the department. The name Tec Radio was adequate in the "old days" when a Radio Technician was trained. However, this curriculum was designed to train a much broader technician capable of finding employment in a cluster of closely related occupations rather than a single occupation. Second, Electronics Technology is more appealing to perspective students than the limited Tec Radio.

Another important situation was developing at this time. Mr. Heiserman, as well as others, began to realize that industrial representatives were bypassing the Technical Institute on their recruiting trips. Oklahoma State University's Technical Institute was one of the few technical schools in the Southwest; therefore, they had a virtual monopoly in educating engineering technicians in this area. Federal money began to flow into Oklahoma and surrounding states, resulting in new technical training programs being established at a variety of schools. Many of these new programs were located near industrial communities and, therefore, industrial representatives did not have to travel to Stillwater to find technicians. Mr. Heiserman soon realized that if the program was to survive and grow it would be necessary to start producing a better technician than the other schools. (13)

In the spring of 1962 Mr. Miller left the staff of the Electronics Department and became Director of the Technical Education Department at Oklahoma State University. He later received his Doctor of Education degree and joined the faculty at Ohio State University in Columbus, Ohio. With Dr. Miller's departure, Mr. Heiserman became the department head.

The faculty (Heiserman, Faber, Tinnell) took a long, hard look at their present curriculum and decided to implement the sequence of courses developed by Mr. Tompkins. All four men agreed it would be advantageous to use the first semester as a practical training period instead of a survey of the area of electronics. Mr. Tompkins accomplished this by adding an electronics course to the first semester and combining the alternating current and direct current courses. (19) Electronics was handled quite carefully in the early part of the semester, i.e., verbal treatment rather than mathematical formulation was applied to electronic considerations. As the mathematics development and academic sophistication increases, the student was required to engage in more detailed subject matter. (13)

The ideas presented in the latter section are seen as the bases for an integrated curriculum. The first step in this integration was to synchronize the contents of the mathematics and other first semester courses. Mathematics, it may be seen, is primarily a tool for understanding electrical and electronic course materials. Therefore, it is advisable that the student receive the required mathematics just prior to needing it in the technical courses. It is felt that more effective learning takes place when the student "sees" an immediate use or application for the mathematics he has learned. In addition to the mathematics courses, the electrical and electronics courses are most effective in proper sequence. In this manner, precautions against presenting similar materials may be installed. Today daily meetings among faculty members are necessary to prevent redundant presentation. (13)

A unique type of faculty is required to make an integrated curriculum function properly. The key to promising, progressive instruction, it would appear, is full cooperation among faculty members. Each instructor must be able to give and receive criticism. To be certain the curriculum stays in proper synchronization all instructors must know in advance the respective course outlines. Mr. Heiserman believed strongly in the full maintenance of synchronization of all course materials. (13)

Student characteristics was another area that received considerable consideration in developing the integrated curriculum. Mr. Heiserman described his incoming students as capable, but many were underachievers, i.e., their motivations for achievement in technical areas were low. Mr. Heiserman mentioned an interesting phenomenon that occurs when an underachiever manages to periodically achieve. After the realization of achievement becomes evident, a pride factor builds and seldom does the student recede back to an underachiever again. (13)

The logical place for achievement to become manifest is in the laboratory. Here the student would be given an individual project to complete in the form of a laboratory experiment. Mr. Heiserman, Mr. Faber, and Mr. Tinnell worked very hard reorganizing laboratory experiments and arranging them such that the student could make better use of laboratory time. Experiments were shortened, particularly in the first semester, allowing for completion in one two-hour period. Being able to finish these experiments helped to build the student's confidence (perhaps to achiever status?).

An interesting bi-product of the program soon became evident.

Mr. R. E. Wooldridge, professor of Industrial Education, Washington State University, visited Oklahoma State while awaiting assignment to Pakistan. During his stay he performed a study comparing the drop-out rate of those students in electronics who had received instruction in the integrated curriculum (1963-1964) with those students who had received instruction prior to the advent of the curriculum (1961-1962). The results indicated a 25 percent reduction in the drop-out rate occurred when the integrated curriculum was introduced. Mr. Wooldridge points out, however, that other factors could have reduced the drop-out rate. Further study, it was advised, would be profitable. (23)

In addition to the philosophies and attitudes already mentioned, still others went into the development of the Electronics Technology curriculum of 1963. The major changes that occurred were:

1. Theory and applications of solid state devices (transistor, diodes, etc.) were officially added. Although these topics were taught as far back as 1959, they were not included in the catalogue course description. Before this time the instructors had to "stuff" this material into the curriculum. That is, include materials not accounted for under standard course headings.
2. Since 1961 electronics students were required to take two mathematics courses. The five-hour first semester course was reduced to four and an additional three-hour course was added to the second semester. The purpose of the second courses was to give electronics students an introduction to applied calculus to solve electronics circuit problems. The content of these courses was extended in 1963 and each

became a five-hour course.

3. Introduction to Electronics was added to the first semester. The objective of this course was to expose the student to the principles of transistors and thermionic tubes and the application of these devices as elementary amplifiers.
4. Applied Physics was added to the second semester. Before this, a Practical Mechanics course was the only physics taught to electronics students.
5. Courses in Circuit Analysis and Electronic Amplifiers were added to the second semester. These courses stressed transistor circuits and their application.
6. Technological Practice was added to the summer session. This course was not well received and was dropped two years later.
7. Four new courses were added to the fourth semester: (1) Electronic Computers, (2) Electronic Design, (3) Microwave Systems, and (4) Transmission and Radiation. These courses represent advanced electronic topics and added depth to the curriculum.

The years 1959, 1963, and 1967 represent significant changes in the Electronics Technology curriculum. Therefore, the complete curriculum for these are given in Appendix B.

Future Stage

A careful look at the present curriculum (see Appendix B) will reveal course titles and descriptions which, as of this writing, would appear to be useful for many years to come, i.e., Electronic Amplifiers, Communications Systems I and II, Electronic Design. With these titles, course material may effectively switch from one active element to another without necessitating change in title. Another advantage of the present curriculum is the inherent philosophy of the designers who foresaw the need for making the curriculum more insensitive to staff changes. This was accomplished by developing softwear (laboratory manuals, course outlines, etc.) which allowed the curriculum to maintain itself in the light of faculty change. This relative insensitivity to faculty change seems to be working effectively even though only Mr. Faber remains. (13)

According to Mr. Faber, department head, (as of January, 1966) presently foreseeable changes in the curriculum will be the addition of topics generated by technological change. A partial list would include: integrated circuits, field effect transistors, solid state microwave devices, and light emitting semiconductors. However, the curriculum is now straining to accommodate present course requirements. Mr. Faber offered two solutions to this problem. First, with the vacuum tube being replaced by the transistor, less time will be required for vacuum tube considerations. Therefore, this time can be spent on the new topics mentioned above. Second, the staff is developing improved teaching methods, i.e., programmed instructional techniques, enabling them to present the material in less time.

CHAPTER IV

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The purpose of this study was to collect data pertaining to the historical development of the Electronics Technology curriculum at Oklahoma State University's Technical Institute. To keep todays rapidly expanding technological society growing at a continuous rate an increasing number of well-trained engineers and technicians are needed. Figures indicate that the demand for technicians is about twice as great as that for engineers. The demand for technicians is far ahead of the supply, and therefore, training programs must be administered as efficiently as possible. A study of this kind will benefit beginning Electronics Technology instructors, supervisors, department heads, and lay advisory committees in planning new or revising existing curricula. These people need as many guidelines as possible in setting up their programs.

Summary

The present Electronics Technology curriculum at Oklahoma State University's Technical Institute has been continuously strengthened and reorganized since its beginning immediately after World War II. Mr. Paul McCollum and Mr. Maurice W. Roney developed the first curriculum. The main objective of this curriculum during the beginning stage was to train Radio Technicians. During the years 1945-1965 the curriculum changed to accommodate advancing electronic technology concepts and practices. The most significant change occurred in 1963 with the introduction of an integrated curriculum. Mr. Russell Heiserman, department head, Mr. Rodney Faber and Mr. Richard Tinnell, instructors, implemented the sequence of courses developed in 1962 by Mr. Jack Tompkins when he was department head of the Oklahoma City branch. The significant reasons for changing the curriculum appeared to be the following:

1. The need for a higher quality Research and Development Technician.
2. A more efficient method of training technicians could be provided by using an integrated curriculum.
3. Too much time was wasted in the lectures and laboratories.
4. A large amount of outdated material was in the curriculum.
5. The need to make the curriculum more insensitive to staff changes.

The above reasons were the basis for making the following additions:

1. Solid state theory and applications integrated in several courses.
2. An Electronic Device course in the first semester.
3. A five-hour mathematics course in the second semester.
4. An Applied Physics course in the second semester.
5. A Circuit Analysis and Electronic Amplifiers course in the second semester.
6. Four advanced electronics courses to the fourth semester, viz., Electronic Computers, Electronic Design, Microwave

Systems, and Transmission and Radiation.

Conclusions

The historical development of Oklahoma State University's Electronics Technology curriculum shows a gradual change from training a specific Radio Technician to a much broader Research and Development Technician. The present graduate is capable of entering industry through a cluster of related occupations rather than a single occupation. This type of technician seems to be trained best by the use of an integrated or correlated curriculum. A reduction in the drop-out rate occurred at the time the integrated curriculum was introduced. In addition, an increased number of industrial representatives came to interview Electronics Technology graduates. Most students graduating since 1963 have had a choice between two or more positions. Factors other than the integrated curriculum could account for the apparent success of the Electronics Technology program. Further study in this area seems to be indicated before additional conclusions are possible.

Recommendations

1. Further studies should be made concerning the use of an integrated curriculum for other technologies, e.g., Mechanical Design, Instrumentation, Radiation, etc.
2. Further studies should be made comparing the historical development of two and four-year Electronics Technology curricula.
3. Further studies should be made concerning the historical development of Electronics Technology curricula in other

parts of the United States.

4. Further studies should be made comparing the Electronics Technology curriculum of a technical institute with that of a junior or community college.

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APPENDIX A

QUESTIONS ASKED DEPARTMENT HEADS
HEISERMAN, MILLER, FABER, TOMPKINS

1. When were you the department head?
2. What were the main objectives of the curriculum?
3. How integrated was the curriculum before 1963?
4. Why was the curriculum changed in the fall of 1963?
5. What new basic principles were introduced into the curriculum?
6. What kind of cooperation is required between instructors to form an integrated curriculum?
7. How important are the laboratories to the success of a two-year curriculum?
8. How organized were the laboratories?
9. What was the condition and quantity of the laboratory equipment?

ADDITIONAL QUESTIONS ASKED DEPARTMENT HEAD
McCOLLUM

1. What influence did World War II have on the content of the curriculum?
2. What influence did the United States Government have on the curriculum?
3. Why was the total credit hours cut from 19 and 20 to 17 hours?

APPENDIX B

PAST CURRICULA

RADIO AND ELECTRONICS - 1945

First Year

First Semester	Theory	Lab	Credit
Tech E 115, Fundamentals of Electricity	3	6	5
Tech E 105, Fundamentals of Electricity	3	6	5
Tech R 115, Principles of Radio Tubes	3	6	5
Tech 101, Hand Tools and Basic Shop Work	0	3	1
Tech E 113, Technical Drawing	2	3	3
			19

Second Semester	Theory	Lab	Credit
Tech R 128, Principles of Radio Tubes and Circuits	5	9	8
Tech R 122, Code	0	6	2
Tech 122, Employment Relations	2	0	2
Tech R 125, Instruments and Measurements	3	6	5
I. B. 212, Practical Business English and Report Writing	2	0	2
			19

Summer Session	Theory	Lab	Credit
Radio Repair Option			
Tech R 154, Radio Construction and Repair	0	24	4
License Option			
Tech R 144, Elective (License Study and Advanced Code) (Business Option)	4	12	4

Second Year

First Semester	Theory	Lab	Credit
Tech R 215, Commercial Circuit Analysis and Design	3	6	5
Tech R 261, Radio Theory and Operation	3	9	6
I. B. 222, Motion and Time Study	1	3	2
Tech E 212, Circuit Tracing	1	3	2
Eng'g. 431, Safety Engineering	1	0	1
I. B. Business Organization and Operation	4	0	4
			20

APPENDIX B (continued)

Second Semester			
Tech R 225, Special Circuits (VHF, FM, etc.) . . .	3	6	5
Tech R 226, Electronic Equipment Control	3	9	6
Tech R 236, Radio Broadcast Theory and Operation .	3	9	6
Tech 283, Industrial Labor Management	3	0	0
			20

ELECTRONICS TECHNOLOGY - 1959

First Year

First Semester	Theory	Lab	Credit
Tec 131, Personal and Occupational Guidance . .	1	0	1
Tec E 115, Electrical Mathematics	5	0	5
Tec R 105, Fundamentals of Electricity	3	6	5
Tec R 115, Principles of Radio and Tubes	3	6	5
			16

Second Semester			
Engl 1T3, Basic Writing Skills	3	0	3
Tec MT 122, Machine Shop Practice	1	3	2
Tec R 127, Radio Circuits	5	6	7
Tec R 125, Instruments and Measurements	3	6	5
			18

Second Year

First Semester			
Tec R 215, Communication Circuit Analysis and Design	3	6	5
Tec R 216, Radio Broadcast Theory and Operation .	4	6	6
Tec 113, Technical Drawing	1	6	3
SoSc 114, Challenges in American Democratic Life	4	0	4
			18

Second Semester			
Tec 242, American Industrial Development	2	0	2
Tec R 225, Special Circuits	3	6	5
Tec R 235, Electronic Equipment Controls	4	3	5
Tec R 245, Television Circuits	3	6	5
			17

APPENDIX B (continued)

ELECTRONICS TECHNOLOGY - 1963

First Year

First Semester	Theory	Lab	Credit
Tec 125, Algebra and Trigonometry	5	0	5
Tec 131, Personal and Occupational Guidance . .	1	0	1
Engl 1T3, Basic Writing Skills	3	0	3
Tec E 104, Fundamentals of Electricity	3	4	4
Tec ET 114, Introduction to Electronics	3	3	4
			17

Second Semester			
Tec 135, Applied Calculus	5	0	5
Tec 124, Applied Physics	3	3	4
Tec E 144, Circuit Analysis	3	4	4
Tec ET 124, Electronic Amplifiers	3	3	4
			17

Summer Semester			
Tec 154, Technological Practice	0	0	4

Second Year

Third Semester			
SocSc 114, Challenges in American Democratic Life	4	0	4
Tec 113, Technical Drawing	1	6	3
Tec ET 204, Instruments and Measurements	3	3	4
Tec ET 214, Communication Circuits	3	3	4
Tec ET 213, Automatic Control Systems	2	3	3
			18

Fourth Semester			
Tec ET 254, Electronic Computers*	3	3	4
Tec ET 244, Electronic Design	2	6	4
Tec ET 253, Microwave Systems	2	3	3
Tec ET 263, Transmission and Radiation	2	3	3
Tec 242, American Instustrial Development . . .	2	0	2
Tec ET 224, Television Systems*	3	3	4
			16

*Students select one of these courses.
(Courses offered as demand allows)

ELECTRONICS TECHNOLOGY - 1967

First Year

First Semester	Theory	Lab	Credit
Tec 1525, Algebra and Trigonometry	5	0	5
Tec 1031, Personal and Occupational Guidance . .	1	0	1
Tec ET 1104, Fundamentals of Electricity	3	4	4
Tec ET 1114, Introduction to Electronics	3	4	4
Engl 1113, Freshman Composition	3	0	3
			17

Second Semester	Theory	Lab	Credit
Tec 1424, Applied Physics	3	3	4
Tec 1735, Applied Calculus	5	0	5
Tec ET 1244, Circuit Analysis	3	4	4
Tec ET 1224, Electronic Amplifiers	3	4	4
			17

Summer Session	Theory	Lab	Credit
Tec 1954, Technological Practice . . . . (Optional)			4

Second Year

Third Semester	Theory	Lab	Credit
Tec 2542, American Industrial Development	2	0	2
Tec ET 2104, Instruments and Measurements	3	3	4
Tec ET 2213, Automatic Control Systems	2	3	3
Tec ET 2314, Communication Systems I	3	3	4
SocSc 1114, Challenges in American Democratic Life	4	0	4
			17

Fourth Semester	Theory	Lab	Credit
Tec 1153, Technical Drawing	1	6	3
Tec ET 2454, Electronic Computers	3	3	4
Tec ET 2543, Electronic Design	1	6	3
Tec ET 2653, Microwave Systems	2	3	3
Tec ET 2764, Communication Systems II	3	3	4
			17

VITA

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Candidate for the Degree of

Master of Science

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