Completing the Circuit: A Century of Electrical Education at MSM/UMR
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By Jack B. Ridley
Acknowledgments

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Jack B. Ridley
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To the alumni, faculty, staff, and students of electrical engineering at MSM/UMR, and especially to the first two department chairmen, Floyd H. Frame and Israel H. Lovett.
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Preface

This history records the highlights of the development of electrical engineering education on the Rolla campus, known first as the University of Missouri School of Mines and Metallurgy, and, now as the University of Missouri-Rolla.

There is a remarkable continuity of purpose and mission in electrical engineering education at UM-Rolla. The early leaders of the department developed a program that provided a strong emphasis on the basics of the science and practice of electrical engineering while offering an opportunity for specialization. This philosophy of a broad-based, in-depth, rigorous curriculum in electrical engineering exists today. The philosophy of quality undergraduate education is a hallmark of this department’s program, past and present.

The department has met the challenges of the growth of electrical engineering, adding new areas of teaching and research as the discipline evolved.

Today the electrical engineering department at UM-Rolla is one of the largest in the United States. It has approximately 1,300 full- and part-time students. The department offers degree programs which include the bachelor of science, master of science, doctor of philosophy, and doctor of engineering. These programs are approved by the Accreditation Board for Engineering and Technology (formerly the Engineers’ Council for Professional Development) and the North Central Association of Colleges and Secondary Schools.

Today electrical engineering at UM-Rolla can be characterized as a department with:

- High-quality undergraduate and graduate students devoted to the study and learning of electrical engineering;
- A prestigious faculty, devoted to excellence in teaching and quality in research and scholarly activities;
- An outstanding curriculum that provides depth and breadth in the science and practice of electrical engineering;
- Programs that provide study and research opportunities in all areas of electrical engineering, including circuits, communications, control systems, computer engineering, electronics, electromag-
netic fields and waves, electromechanical energy conversion, electro-optics, power systems, and solid state materials;

• Graduates that are sought by industry and governmental agencies throughout the nation.

Research and study in current and advanced areas of electrical engineering applications are directed by 35 faculty, most of whom hold the doctorate, and five teaching fellows who are Ph.D. candidates. This group is assisted by over 40 graduate assistants, supervised by a faculty associate, who teach in the department’s laboratory program. In the past five years, 13 outstanding teaching and research faculty have been added to the department. Many of these new faculty have joined the department with significant experience in industrial research and development laboratories. External research funding and scholarly works of textbooks and professional journal publications by the faculty and students are at an all-time high.

Today the electrical engineering department continues to be recognized worldwide for its undergraduate program and is in the process of gaining recognition as a center of quality graduate and research programs.

Many efforts have been initiated to involve alumni and friends in the continued development of the department. These include an Industry Advisory Council for the power program and the Academy of Electrical Engineers. Industrial, foundation, and alumni giving to the department’s development program has grown steadily and is now the largest in the department’s history. Special scholarships have been established through endowments in the names of Thomas O. English, C. James Grimm, I. H. Lovett, F. H. Frame, and Robert H. Nau. An endowed equipment account has been established and funds given to this account will ensure that the department will continue to be well-equipped, and that an outstanding laboratory program will be maintained. Other endowments include an alumni graduate fellowship, and a recent fellowship, the Fred Finley Endowed Fellowship in Communication Theory, as well as a student loan program. Three professorships have been established—the Emerson Electric, the Schlumberger and the Teledyne MEC.

The electrical engineering department continues to follow the philosophy of a strong undergraduate curriculum established by our founding faculty and chairmen, Frame and Lovett. Roger Nolte led in the establishment of a doctoral program in the ’60s, and Robert Betten brought to Rolla many faculty members with doctoral degrees in
preparation for the development of a research program. Today we are building on the work of these leaders.

Directions for the future of the department are well-established. They continue to be:

- A quality student body in electrical engineering;
- A rigorous, broad undergraduate program with ample opportunity for specialization;
- A quality teaching and research faculty that has depth and breadth in all areas of electrical engineering specialties;
- Growth in research and graduate programs supported by funding from industry and state and federal governments;
- A growing involvement of alumni, industry, and foundations in the support of teaching and research programs of the department.

The future of the department will be built on the strong base established in its history. The student will always be our first concern. The department is entering a new era of research and graduate program development. In this new era it will make many contributions to the electrical technological growth and needs of the nation in a way quite different from the past. The future of the department is bright. With the combined efforts of students, faculty, Dean Davis, Chancellor Marchello, alumni, and industrial friends, the electrical engineering department at UM-Rolla will continue to be one of the nation’s leading programs in undergraduate education and will become one of the nation’s major research departments.

J. Derald Morgan
Department Chairman
Emerson Electric Professor
of Electrical Engineering
CHAPTER I
The Formative Years, 1871-1924

In 1871, the University of Missouri School of Mines and Metallurgy (MSM) was established at Rolla, a town on the crest of the Phelps County Ozark hills. During the same era, James C. Maxwell produced his famous treatise on electricity and magnetism, William Wallace produced the first American dynamo, and Alexander Graham Bell invented the telephone. In the same decade, the wizard of Menlo Park, Thomas Edison, worked his magic and developed an incandescent lamp system and formed, in 1877, the Edison Electric Light Company.¹ On the horizon, other pioneers, including George Westinghouse and Charles P. Steinmetz, demonstrated the potential uses of electrical power. As the electrical industry came into being, the profession of electrical engineering also began to take shape. In 1884, the founding of the American Institute of Electrical Engineers (AIEE) signaled the formal birth of the profession.

The Massachusetts Institute of Technology established the first electrical engineering program in America in 1882.² A degree in electrical engineering at MSM became available in 1915, but an interest in the technical applications of electricity existed virtually from the beginning of the school. Armand Ravold, a student at MSM from 1875 to 1877, remembered that C.P. Williams, the School’s first director, demonstrated an electric arc lamp during Ravold’s tenure as a student:

This is to certify, that in the fall of 1876, I saw Professor Williams,. . .demonstrate and explain an Electric Arc Lamp in the Chemical Laboratory of the School. Professor Williams and his assistant set up a battery of Electric Cells, some 20 or more in number, in the Chemical Laboratory of the School. An electric cell consisted of zinc and carbon elements immersed in a solution of sodium bichromate dissolved in dilute sulphuric acid. The cells were connected together and the current generated by them was allowed to flow through the carbons of the lamp, which produced a brilliant light at the point of contact of the two carbons. Whether the lamp was Hand-regulated or Self-regulated I do not remember, but I think that it was self-regulated by a shunt current. It was the
first electric light that I had ever seen, and needless to say, I was fascinated by it. In fact, it was the talk of the School for weeks afterward. . . .³

Prior to this experiment, the Rolla Herald reported Aug. 1, 1872, that Director Williams had returned from a trip to the East where he purchased “. . . a fine Holtz electrical machine [and] a Duboscq electric lamp with battery of 100 cells. . . .”

A “Course” in Electricity

For those at MSM who wished to pursue the applications of electricity beyond Williams’ demonstration of an arc lamp, physics courses were offered in the 1880s, and late in that decade a B.S. degree in physics and mathematics became available to students. A B.S. degree in general science by the 1890s supplanted the old program.

In the last decade of the 19th century, a “course” in electricity became available to students. The 1894 MSM Catalogue explained the rationale for such a program: “For the benefit of those who may lack the time, the money, or the inclination to spend four years in preparation for professional work, certain special courses. . . are offered.”

Apparatus room, Physical Laboratory.
Included among these courses was a two-year program in electricity, designed to prepare students for "...management of light or power plants and application of electricity to mining operators. . . ." The course, the narrative continued, sought to provide a good foundation for the profession of electrical engineering. This represented the first printed reference to the profession of electrical engineering at MSM. The course included classes in mathematics and physics as well as classes entitled "Special Electricity," "Dynamo Electricity," and "Applied Electricity." These classes were open to students pursuing baccalaureate degrees in other disciplines as well as to special students who did not intend to earn a degree. The 1894 Catalogue also mentioned the availability of special classes in electricity and magnetism. Lectures were to be based on Thompson's Lessons in Electricity and Slingo and Brooke's Electrical Engineering. Finally, a physical lab, which included the application of electrical measurements and care and management of dynamos and motors, was available for three hours per week throughout the academic year.

The 1898 Catalogue indicated that offerings had been expanded to include "Electricity and Magnetism," "Dynamo Electric Machinery," and "Alternating Current Machinery." The 1901 Catalogue listed as additions to the program, "Electrical Transmission" and "Dynamo Design." By the beginning of the 20th century, MSM offered a variety of courses in electrical engineering. During the 1906-07 school year, the course in electricity totaled 89 semester hours. The department of physics offered the electricity program and related electrical engineering courses at MSM as was typical on college campuses throughout the
United States at the time. In spite of the program's lack of formal organization, students at MSM in the early years of the century exhibited considerable interest in electrical engineering as illustrated by the popularity of the electricity course and by an impressive list of senior theses dealing with electrical energy.

Expansion of the Electrical Engineering Curriculum

World War I, beginning for Europeans in 1914 and for Americans in 1917, created a great need for technical expertise, and electrical engineering was high on the priority list. Even though some University of Missouri officials disapproved of the expansion of engineering at Rolla beyond the parameters of mining and metallurgy and others advocated moving the school to Columbia, support for the development of degree programs in areas such as electrical engineering increased in the early years of the 20th century. Before MSM could offer a degree in electrical engineering, however, an act of the legislature and a ruling by the state's highest court were necessary.

In 1915 the Missouri General Assembly passed the Buford Act, enabling MSM to offer "...the bachelor of science and professional
degrees in mining engineering, in metallurgy, in mechanical engineering, in electrical engineering, in chemical engineering, in civil engineering, and the degree of bachelor and master of science in general science."

The University of Missouri Board of Curators voted 5-3 to ignore the Buford Act, the majority maintaining that it was the Curators’ prerogative, rather than the legislature’s, to establish University curriculum.10

MSM supporters took their case to the Supreme Court of Missouri. Harry Tobias Heimberger of Rolla, the student who would be the School’s first degree recipient in electrical engineering, served as the plaintiff. The court found the Buford Act to be just and proper and ordered its implementation.11 The court decision assured a future for electrical engineering at MSM although funding such programs continued to plague MSM officials for another generation.12

Passage of the Buford Act did not result in an immediate surge of enrollment in electrical engineering. In 1917, Heimberger became the first person to graduate from MSM with a B.S. in electrical engineering. No electrical engineers graduated between 1918 and 1920 although three students had listed electrical engineering as their major in 1918, and six students had chosen the discipline by 1920.13 In 1921, three Miners earned degrees in electrical engineering and every year since

Harry Tobias Heimberger.
then, the graduating class has included electrical engineers. In 1924, the year of departmentalization, the first professional degree of electrical engineer was awarded to Israel H. Lovett. Professional degrees were available to those who had completed a thesis based upon a minimum of three years of professional experience.\textsuperscript{14}

The Faculty

The physics department served as the cradle of electrical engineering during these formative years. Prior to World War I, the task of developing and teaching the initial courses fell to the physicists and, in particular, to Austin Lee McRae. McRae held an Sc.D. in physics from Harvard. He joined the faculty at MSM in 1891, departed in 1894 and returned in 1899. In 1915, he became the institution’s 10th director. When McRae departed in 1894, Arthur H. Timmerman succeeded him and served as head of the department until McRae returned. McRae

![Austin Lee McRae](image)

continued as the lone faculty representative of physics and electrical engineering until 1914. During this time, he also developed the campus’s first physical laboratory. Floyd H. Frame joined the depart-
ment in 1914 as an instructor in physics and electricity. Frame held an A.B. degree in electrical engineering from Clark University and the professional degree of electrical engineer from Worcester Polytechnic Institute. In 1919, Leon E. Woodman, a physicist with a Ph.D. from Columbia University, succeeded McRae as department head. For a brief period during World War I, R.S. Wallis and Ralph E. Duffy assisted in teaching electrical engineering courses.

George R. Dean, who held an academic appointment in mathematics, also could be added to the electrical engineering faculty of this period. His legendary exploits in calculus classes captivated over a generation of Miners. Dean’s research interests belonged to electrical engineering as well as to mathematics. Over the years, Dean published in the *General Electric Review*, the *London Electrician*, and the *Transactions of the American Institute of Electrical Engineers*. The 1915-16 volume of the *Transactions* contains an article by Dean entitled “Calculation of Long Distance Transmission Lines for Electrical Engineering.” Occasionally, Dean spent his summers at the General Electric Laboratory in Schenectady, N.Y., where the great Steinmetz presided. Dean’s research at the G.E. Laboratory related to the sphere gap voltmeter and magnetic flux densities.
In 1916, electrical engineering gained in status by virtue of the Buford Act. In the 1916-17 school year, the department of physics became the department of physics and electrical engineering. By 1923, the year before physics and electrical engineering became separate departments, the staff included Professor Woodman, Associate Professor Frame, Assistant Professor Ryland F. Ratliff (who held an M.S. in electrical engineering from Indiana University and joined the MSM faculty in 1920), and Israel H. Lovett, a graduate of MIT’s electrical engineering program, who joined the staff in 1921. Joseph Worley, an MSM alumnus, served as an instructor during the 1923-24 school year.\(^7\)

During these years, the department was fortunate to have men with impressive academic credentials such as McRae and Woodman, for professors with earned doctorates prior to the 1920s were rare. Dedicated men such as Frame and Lovett with solid academic backgrounds in electrical engineering laid the foundation for the discipline.
Physical Facilities

Until completion of the Electrical Engineering Building in 1959, classes, labs, and offices were housed first in the Rolla Building and, after 1902, Norwood Hall. Even in the 1890s MSM personnel expressed pride in their physical laboratory which, as the MSM portion of the University of Missouri Catalogue for 1893-94 pointed out, was "...especially strong on the side of electricity and comprises two dynamos, with which a small electric lighting plant is maintained."¹⁸

Norwood Hall.

By 1914 the physics laboratory in Norwood Hall could just as well have been called an electrical engineering lab for it contained a variety of generators, motors, rotary and stationary transformers, voltmeters, ammeters, fluxmeters, coils, and condensers.¹⁹ In the early 1920s, with an electrical engineering degree program in hand, Professors Frame and Lovett expanded the laboratory in Norwood Hall’s basement. The facilities on the eve of departmentalization are described in the 1923 MSM Catalogue:

The Department of Physics and Electrical Engineering is located in Norwood Hall. The lecture room is in the southeast corner of the building on the first floor. On the same floor are found the office and recitation room used by the department. All of the laboratories are located in the basement of the building. The Physical Laboratory is a large, well-lighted room, and is well equipped with water and gas and suitable tables for carrying on nearly one hundred experiments especially chosen for engineering students.

The department is well equipped with apparatus for carrying on the work as it is outlined for engineering students. As the
demand for courses in pure science increases, it is intended to increase the equipment so as to meet the needs and interests of these students.

Curriculum

Prior to authorization of a degree program in electrical engineering, it would have been logical to expect few courses in electrical engineering, but the electricity course made available a variety of classes in the subject. Once a degree had been authorized, a full-fledged curriculum appeared for the first time in the Catalogue of the 1916-17 school year. According to Israel Lovett, MIT’s program served as a model for the electrical engineering curriculum at MSM as it did for most schools in America.

The curricular description in the 1923 MSM Catalogue reads:

The curriculum in Electrical Engineering is intended to give a foundation in the general principles upon which the development of electrical engineering practice depends. Co-ordinated with this instruction in general principles are courses of a more professional nature. A close relationship exists between classroom and laboratory work. The latter consists of a study of methods of electrical measurements and tests of instruments and machines of the usual types found in practice. Two laboratories are equipped with modern apparatus for this work—the Electrical Machinery Laboratory and the Electrical Measurements Laboratory. In the Electrical Machinery Laboratory are two large test benches provided with transfer panels so that connections may be readily made with any machine which is to be tested. The Electrical Measurements Laboratory is equipped with high grade apparatus for making standard electrical measurements. Transfer panels in these laboratories make it possible to connect any kind of power available with any circuit in either laboratory.

Another laboratory is being equipped for work in radio communication.

The philosophy of the electrical engineering undergraduate program at MSM/UMR was established early. MSM’s electrical engineering curriculum has adhered to the spirit of that early program. The intent from the beginning has been to provide the student with a broad foundation in the discipline while offering him or her ample experience in practical applications. The early day program and the curricula of the 1980s reflect the technological transformation of society. While the curricula prior to departmentalization emphasized electrical power
and anticipated the communications revolution, the curriculum of the 80s had been modified to accommodate the computer age.

**Students**

Thousands of students over the years have elected to major in electrical engineering at MSM/UMR, but prior to 1924, the number was small. Before authorization of a degree in electrical engineering, it was impossible to distinguish between the student who preferred electrical engineering or one who leaned toward physics. In the absence of a separate electrical engineering department or degree, physics may justifiably claim the early graduates. Nevertheless, the classroom and work experiences of many of those graduates suggest that electrical engineering was their chosen vocation. Such students included Mervin J. Kelly, a 1914 graduate who pioneered in trans-Atlantic communications and served as president of the Bell Telephone Laboratories. Kelly returned in 1936 to receive an honorary doctor of engineering degree. Albert G. Wishon, a student at MSM in 1875-76, was a pioneer in California's power and light industry. His son, A. Emory Wishon, earned a B.S. in general science at MSM in 1909 and followed in his father's footsteps in the California power and light utilities. Zentaro Iijima took the electricity course in the 1895-96 school year and returned to Japan to become a noted electrical engineer and manufacturer.

In the years between the founding of MSM in 1871 and 1924 when electrical engineering achieved departmental status, the young discipline hardly occupied center stage at the technological school in the Ozarks. In spite of somewhat modest origins, however, electrical engineering served as a part of MSM virtually from the beginning. It became apparent in the generation after 1924 that the discipline would play a significant role at the institution.
Footnotes, Chapter I


4 Missouri School of Mines and Metallurgy *Catalogue*, 1894, pp. 35-36.


6 *MSM Catalogue*, 1898, p. 34.

7 Terman “Brief History of Electrical Engineering.”

8 Phelps County Historical Society, *MSM History*, p. 560.


12 See Chapter Two for a discussion of the separation issue.


15 Phelps County Historical Society, *MSM History*, p. 653.

16 Missouri Miner, Sept. 22, 1937.


19 Phelps County Historical Society, *MSM History*, p. 609.


21 Phelps County Historical Society, *MSM History*, pp. 28-29.

CHAPTER II
Years of Growth and Rationalization, 1924-1959

A separate department for electrical engineering at MSM became a reality in 1924. Departmentalization symbolized the administration’s recognition that the youthful profession was beginning to play an important role in American society. For that matter, in the year of departmentalization the Missouri School of Mines and Metallurgy was relatively young by institutional standards. Between 1924 and 1959, the institution and the department of electrical engineering grew and matured. In 1959 as the department prepared to move into the new Electrical Engineering Building, MSM and electrical engineering approached a new era in higher education.

In spite of its youth, electrical engineering during the 1920s bore little resemblance to the foundling profession that appeared in the 1880s with the creation of the AIEE. In 1924, the World Power
Conference conducted its first meeting. Closer to home, a 50,000-kilowatt transmitter was installed in Chicago. Both the conference and the powerful transmitter reflected the tremendous growth and expansion of electricity since World War I. A communications revolution was helping to transform society as the telephone, the vacuum tube, and the radio became available to the masses. Such changes brought exciting new challenges in electrical engineering education to schools of technology across the nation, including MSM.

Between the world wars, MSM experienced some growth in enrollment but expansion was gradual and nothing like the explosion that would take place after World War II. In the fall of 1924, the students numbered 399 and by the fall of 1945, the student population had increased to 905. In 1924, 38 students declared electrical engineering as their major; in 1945, 126 students majored in electrical engineering.¹

**Director Fulton’s View of Electrical Engineering at MSM**

Charles H. Fulton became director of MSM in 1920 and continued in that capacity until 1937. As a metallurgist, Fulton’s educational priorities were in favor of mining and metallurgy. He viewed electrical engineering as “...in the one case...a special branch of metallurgy, and in the other...a great and important branch of power engineering.”² However, Fulton did not prevent the expansion of courses in electrical engineering during his tenure as director.

**The New Department—Faculty**

From 1924 until near the conclusion of World War II, the electrical engineering faculty changed little. Professors Frame and Lovett made up the faculty of the new department in 1924. Frame, who had just earned the professional degree of electrical engineer from Worcester Polytechnic Institute, became the department head. Lovett upgraded his credentials in 1924 when he earned MSM’s first professional degree of electrical engineer and again in 1928 when he earned a master’s degree from the University of Michigan. It also should be mentioned that Professor Woodman of the physics department assisted his colleagues by teaching a sophomore course, “Principles of Electrical...
Engineers,” and a junior course, "Principles of Alternating Currents.”

In 1925, George O. Ranes joined the faculty. Ranes held a B.S. in electrical engineering from the University of Oklahoma. In 1937, J. Stuart Johnson was appointed an instructor in electrical engineering. Johnson had earned a Ph.D. in electrical engineering from Iowa State University and was the first electrical engineer at MSM to possess such credentials. Frame, Lovett, Ranes and Johnson made up the staff through 1943 until the necessities of war prompted some expansion of the faculty. Joseph Worley served as an instructor for one year in 1923-24 and Charles A. Van Doeren was instructor in 1927-28.

The typical electrical engineering professor of this era in American higher education had a bachelor’s degree combined with some practical on-the-job experience. By these standards, MSM’s electrical engineering faculty possessed impressive academic credentials.

The New Department—Students, 1924-1945

When the new department was created, 38 students had declared electrical engineering as their major. That number gradually increased
to 79 in the 1931-32 school year but dropped to 47 the next year as the Great Depression deepened and enrollment at MSM plummeted. Young Americans apparently recognized the need for electrical engineers on the horizon, however, and by 1939, the year World War II began in Europe, 105 of the 897 Miners were aspiring electrical engineers. Through the war years, the proportion of electrical engineering majors to the total student population remained approximately the same as in 1939.4

George O. Ranes. Israel H. Lovett.

The majority of electrical engineering students and, for that matter, the majority of students at MSM were Missourians. In the 1920s, 53 to 61 percent of the student body listed Missouri as their permanent residence. The Great Depression of the 1930s increased the percentage of native sons in the enrollment. In the 1934-35 school year, 79 percent of the student body hailed from Missouri. By 1937, 80 percent of the students were Missourians although 23 other states and a few foreign countries were represented.5

Because engineering was mostly a profession for males at this time, the majority of students were men. In 1927, the student newspaper, the Missouri Miner, listed 15 coeds in the student body of 505.6 Of the handful of women who attended MSM during the period, electrical
engineering could claim its share. The graduating class of 1944 included Jean McCaw Lloyd, daughter of long-time faculty member Sam Lloyd. Jean, the first female electrical engineering graduate of MSM, graduated 10th in a class of 77, but she only could be an honorary member of Tau Beta Pi, for membership in the engineering honorary society was open only to men. In 1945, Amy Goodhue West, daughter of mathematics professor E. A. Goodhue, became the second coed to complete the undergraduate curriculum in electrical engineering. Lloyd and West served as pioneers for their sister engineering counterparts in the second half of the century for they illustrated that women could successfully complete requirements for engineering degrees and could enter the work force.

Included among the students of this period were young men whose careers would become entwined with electrical engineering at MSM, C. James Grimm of the class of 1930 and Gabriel G. Skitek of the class of 1943. Grimm and Skitek returned to their alma mater after World War II and served a generation of electrical engineering students at MSM/UMR.
Student Organizations—1924-1945

For more than a half century, electrical engineering faculty members at Rolla have encouraged student involvement in professional organizations. On Dec. 15, 1924, the Missouri Miner announced that a student chapter of the American Institute of Electrical Engineers (AIEE) would be established at MSM. The first formal meeting took place in 1925, and Israel Lovett served as the first faculty adviser.

General honor societies such as Tau Beta Pi (organized in 1906) and Phi Kappa Phi (organized in 1916) were open to outstanding electrical engineering majors as was Theta Tau, a professional engineering fraternity. During the 1930s, a Radio Club was developed for those interested in communications.

These organizations, particularly AIEE, served to encourage professional activities for undergraduates. In fact, the faculty expected students in electrical engineering with sophomore or higher standing to belong to the student branch of AIEE. Jim Grimm, for instance, became MSM’s first contestant in the AIEE’s District Seven Best Paper Contest. A student chapter of the Institute of Radio Engineers and the Theta Mu Chapter of Eta Kappa Nu, honor society for electrical
engineering students, would be established in 1948 and 1950, respectively.\textsuperscript{11}

Physical Facilities, 1924-1945

Throughout this period, Norwood Hall served as the home of electrical engineering as well as other academic disciplines. Electrical engineers found that, prior to departmentalization, Norwood Hall was a more-than-adequate facility given the minimal laboratory equipment that was required. As the years passed, however, the number of majors and classes as well as the amount of lab equipment increased and space was a major problem until the completion of the Electrical Engineering Building in 1959. Actually, a building to house electrical engineering, mechanical engineering, and physics reached the planning stages in 1930, but the Great Depression and World War II interrupted those plans. A generation later each of the three disciplines could claim a building as its own.\textsuperscript{12}

C. James Grimm with students testing the power output of an electric motor.
The laboratory space with which the staff made do until 1959 is described in the following excerpt from the March-April 1954 issue of the MSM Alumnus:

In 1921 the north machinery laboratory in the basement of Norwood Hall was rewired in conduit, test benches and a panel board were installed, thus, giving this room modern laboratory facilities. During 1922 the southwest machinery laboratory room was similarly equipped.

The two rooms described above...provided the space allotted for electrical machinery laboratories in the early 1920s. This same space in 1954 is still the only space allotted to electrical machinery laboratories. During the past thirty years there have been many revisions and alterations in power supply facilities, obsolete machines have been replaced by modern units and...many new units have been added but with no increase in available space.

By the late '30s, the faculty had benefited from a good relationship with industrial firms, resulting in the acquisition of valuable lab equipment from companies such as American Telephone and Telegraph, Emerson Electric, General Electric, Southwestern Bell, and Westinghouse.

Curriculum, 1924-1945

For engineering education in America, the interwar years represented a time for introspection and change. The technological requirements of World War I coupled with the features characteristic of a mature industrial society demanded that educators take stock of engineering curricula. The Mann Report of 1918, sponsored by the Carnegie Foundation, presented the first comprehensive study of engineering education. The Mann Report was followed by the Wickenden Report, which was compiled by a team led by educator William E. Wickenden under the auspices of the Society for the Promotion of Engineering Education. In addition to the presentation of statistical information regarding curricula, faculty academic qualifications, and the like, the Wickenden Report recommended the creation of an agency with the authority to accredit engineering curricula. In 1932, the Engineers’ Council for Professional Development (ECPD) was created. With the advent of ECPD, American engineering education in the 1930s moved toward more uniform curricula.
In general, these trends affected electrical engineering education especially technological breakthroughs in areas such as communication. Vacuum tube technology, for instance, became increasingly important and sufficiently complex to require some graduate work for those who wanted to remain truly competent in the field of communications.\textsuperscript{15}

At MSM, curricular revision began prior to the 1930s. Director Fulton arrived on campus in 1920, and curricular reform began soon after. Curricula at MSM lacked uniformity at that time as degree programs varied from 185 to 197 credit hours.\textsuperscript{16} On the eve of departmentalization of electrical engineering, a revised curriculum went into effect with the 1922-23 school year. Thereafter, each engineering curriculum required 172 hours for graduation, including 164 hours of specific requirements and eight hours of electives.\textsuperscript{17} All engineering curricula shared a common first year.

The objectives of the electrical engineering curriculum are summarized in the following excerpt from the \textit{MSM Bulletin} for 1925:
Electrical Engineering

Professor Frame, Associate Professor Lovett.

The purpose of the curriculum in Electrical Engineering is to provide a thorough training in the fundamental principles upon which the development of electrical engineering practice depends. Rather than giving a specialized course in any branch of the profession opportunity is given to identify these fundamental principles in their numerous applications. Also the student is given opportunity to pursue studies of a humanistic type, and subjects devoted to the business aspects of engineering, thus making possible a broad education.

The electrical engineering work proper begins in the second semester of the sophomore year with an elementary course designed to acquaint the student with the various parts of electrical machines and circuits and with the various terms used in electrical engineering. In the junior and senior years more advanced courses are given in the principles of alternating currents, electrical machines, generation and distribution of energy, and the various applications of electricity. An important feature of these courses is the solution of numerous practical problems.

Particular attention is given to the proper correlation of laboratory work to class room study. Laboratory courses include a study of methods of electrical measurements and tests of practically all types of electrical instruments and machines used in practice.

The extensive equipment of the Electrical Engineering Laboratories makes possible an experimental study of the various types of electrical apparatus. Two laboratories are equipped with modern apparatus for this work—the Electrical Machinery Laboratory and the Electrical Measurements Laboratory. In the Electrical Machinery Laboratory are two large test benches provided with transfer panels so that removable connections may be readily made with any machine which is to be tested. Instruments and other auxiliary laboratory equipment are provided for this experimental study of electrical machines. The Electrical Measurements Laboratory is equipped with high grade apparatus for making standard electrical measurements of current, voltage, resistance, inductance, capacitance, magnetic properties of iron, and the calibration of instruments.

A student who has received the degree of Bachelor of Science in any engineering curriculum may also receive the degree of Bachelor of Science in Electrical Engineering upon the satisfactory completion, under the supervision of this department, of at least forty hours of work in excess of that required for the first degree, provided that the student already has credit for 1050, 1051, 1052, 1053, 1055, 1056, 1057 and 1058.
The Department of Electrical Engineering is located in Norwood Hall with the laboratories in the basement and the lecture rooms on the first floor.

Aerial view of the campus, 1925.

Electrical engineering courses included lectures and labs in “Elements of Electrical Engineering,” “Electrical Machinery,” “Electrical Measurements,” “Principles of Electrical Engineering,” and “Electrical Engineering Design.” Additional courses included “Radio Communication,” “Power Stations,” and “Electric Railways.” As the prospective graduate approached the senior year, three requirements represented the capstone of the undergraduate program. The faculty encouraged each student to gain on-the-job experience in an electrical engineering plant or industry during the summer break prior to the senior year. At the very least, they expected four weeks of “observation, note-taking and sketching at some electrical plant.” During the final semester, each degree candidate wrote a senior thesis requiring original thought and investigation. The faculty also led the graduates on a senior trip to power stations, telephone companies, electrical manufacturing firms, and the like.  

In 1924, MSM officials revised the curricula again. All undergraduate degree programs were to consist of 158 semester hours. As in the
earlier revision, all engineering students shared a freshman-year curriculum which consisted of the following:

**Freshman Year. All Curricula.**

*First Semester.*—General Chemistry, 4-6; General Engineering Drawing, 0-9; Rhetoric and Composition, 3-0; Trigonometry and College Algebra, 5-0; Military Science and Tactics, 1-2; Physical Training, 0-1 (no credit); Special Lectures, 1-0 (no credit).  
*Second Semester.*—General Chemistry, 4-6; Descriptive Geometry, 0-9; Rhetoric and Composition, 3-0; Analytical Geometry, 5-0; Military Science and Tactics, 1-2; Physical Training, 0-2 (no credit); Special Lectures, 1-0 (no credit). **Summer School.**—Plane Surveying, 4. (Lect.-Lab.)

The remainder of the electrical engineering program constituted “Curriculum VI” in the *Catalogue:*

**Curriculum VI. Electrical Engineering.**

*Second Year: First Semester.*—Mechanical Computations, 1-0; Machine Drawing, 0-3; English, 3-0; Calculus, 4-0; Physics, 4-6;  
*First Semester.*—English, 3-0; Calculus, 4-0; Machine Shop, 0-3;  
*Second Semester.*—English, 3-0; Calculus, 4-0; Machine Shop, 0-3; Physics, 4-6; Elementary Electrical Practice, 0-6; Fundamentals of Alternating Currents, 2-0; Military Science & Tactics, 2-1.  
*Third Year: First Semester.*—Economics, 3-0; Theoretical Mechanics, 3-0; Mechanisms, 0-3; Metals in Engineering, 2-0; Electrical Machinery, 3-0; Electrical Measurements, 0-6; Alternating Currents, 3-0; Electives, 3-0.  
*Second Semester.*—Hydraulics & Water Power, 3-3; Economics, 3-0; Mechanics of Materials, 3-0; Physical Metallurgy, 0-3; Electrical Power Transmission, 3-0; Experimental Electrical Engineering, 0-6. **Summer:** Work in Practice.  
*Fourth Year: First Semester.*—Power Plants, 3-3; Radio Communication, 3-0; Electric Power Stations, 3-0; Experimental Electrical Engineering, 0-6; Electric Railways, 3-0; Electrical Engineering Seminar, 1-0; Electives, 3-0.  
*Second Semester.*—Power Plants, 3-3; Telephone Communication Systems, 3-0; Electrical Engineering Design, 0-6; Radio Communication Lab, 0-3; Economics of Power System Design, 3-0; Electrical Engineering Applications, 3-0; Senior Trip; Non-Technical Electives, 2-0.

After these revisions, the MSM curricula in engineering changed little until the 1950s although some temporary changes were instituted during the 1940s to meet the demands of World War II. Consequently, for the next two decades the curriculum in electrical engineering essentially remained intact although there were course or laboratory revisions and additions. By the late ‘30s, for example, a 150-watt shortwave transmitter for telephone or telegraph transmission had
been added to the list of electrical engineering equipment. The station was located in a soundproof room in Jackling Gymnasium.\textsuperscript{21} The 1938 Catalogue indicated that new courses had been added, including "Communication Engineering," "Electronics," and "Vacuum Tubes."\textsuperscript{22}

**ECPD Accreditation**

After 1936, ECPD accreditation became a benchmark of excellence in engineering education. Although the accreditation process was voluntary, a favorable report from an ECPD inspection team was beneficial. Rules and bases for ECPD accreditation included evaluation of the qualifications, achievements, and productivity of the faculty of the department being reviewed. The ECPD accrediting team also considered the quality of instruction in service departments, admissions requirements for students, overall student quality, and the achievements of graduates as well as the curricula, physical plant, and finances.

In 1936, an ECPD team visited MSM's campus and appraised all degree-granting engineering disciplines. The team found the electrical engineering curriculum and facilities adequate but advised school officials to employ an additional faculty member, preferably one with

J. Stuart Johnson.
an earned doctorate. Dr. J. Stuart Johnson was subsequently employed, and in its report of Oct. 1, 1937, the ECPD approved MSM curricula in electrical as well as ceramic, civil, metallurgical, and mining engineering. Of the accredited disciplines, only civil and electrical engineering were outside mines and metallurgy and civil engineering’s program had been on campus from the beginning. The electrical engineering staff deserved credit for acquiring accredited status for this new discipline. MSM’s electrical engineering program was the first in ECPD Region V (Arkansas, Kansas, Louisiana, Missouri, Oklahoma, and part of Texas), to receive approval. ECPD, after reorganization, is now the Accreditation Board for Engineering and Technology (ABET).

MSM During World War II

On Dec. 7, 1941, Japanese aircraft attacked America’s naval base at Pearl Harbor, and the United States entered World War II. Probably more than in any other war, civilization looked to science and technology to provide solutions so critically needed to win the war. An unprecedented acceleration of technological accomplishment resulted. The electrical engineering profession would bear its share of the challenge.

At MSM, Fulton had resigned as director in 1937 and William R. Chedsey replaced him. Chedsey and some faculty members and townspeople became embroiled in a controversy over whether MSM should separate from the University of Missouri. In addition, insufficient funds and inadequate facilities and the like contributed to a general state of gloom. In August 1941, Chedsey stepped down. He was replaced by Curtis Laws Wilson, a metallurgist with a Ph.D. from Goettingen. Wilson, whose title was dean rather than director, would serve until 1963, longer than any of his predecessors. But the problems which plagued the campus had to be placed on hold in deference to the priorities of war. More than ever, the nation would need engineers.

Regular registration increased through the 1942-43 school year and then declined. To illustrate, 112 students declared themselves to be electrical engineering majors in 1942-43. The following year, the number had plummeted to 68. In recognition of national needs, the faculty reduced graduation requirements to 144 hours. University officials also added a 12-week summer session which enabled students to complete their degree programs more rapidly.
Several special federal programs also were introduced to the campus including the Engineering, Science and Management War Training Program, a Signal Corps Program, and the Army Specialized Training Program. Hundreds of men participated in these programs. The electrical engineering faculty cooperated with all programs and supervised the Signal Corps Program. Beginning in September 1942, 56 men began a pre-radar course which included non-credit instruction in circuit theory, electronics, and radio communications. By the spring of 1943, 159 soldiers had received certificates verifying that they had completed the program.\textsuperscript{25}

Before the war concluded, the electrical engineering faculty anticipated the post-war expansion of the electrical industry. In addition to serving candidates for degrees, the department instituted one- and two-year courses of technical training preparing veterans for positions as technicians in areas such as power, radio, television, and control.\textsuperscript{26}

\textbf{Post World War II}

An expansion of the electrical industry resulted from the war. Perhaps "explosion" would be a more appropriate term. The war had accelerated the development of things such as radar, microwaves, and electronic instrumentation. On the horizon, an avalanche of electronic technology awaited the electrical engineer. The new technology would include transistors, integrated circuits, computers, and calculators. In addition, television gradually joined the radio and then black-and-white television gave way to color television.

As the world war concluded, officials at MSM braced themselves for huge enrollment increases as almost seven million men were about to be released from the armed forces. Presumably, a good many of them would take advantage of the Servicemen's Readjustment Act of 1944 (the GI Bill of Rights) which would assist them as they pursued goals in higher education. The electrical engineering faculty remained the same in number as before the war. Stuart Johnson was on leave in 1944-46, (Johnson, in fact, would not return to Rolla until the 1960s) but Carl T.A. Johnk had joined the staff as an instructor. Johnk had a B.S. degree from Shurtleff College and a B.S. degree in electrical engineering from MSM.\textsuperscript{27}

Enrollment increased from 905 the year before to a record 2,565 in the 1946-47 school year. Four hundred of these elected to major in electrical
28 / Completing the Circuit: A Century of Electrical Education at MSM/UMR

engineering, making the department the largest on campus. If there were any doubts about the future of electrical engineering at MSM, they were washed away by the tide of new students.

Overcoming Stepchild Status

As officials of MSM attempted to cope with the huge post-war student body, the issue of separation was raised again. Its resolution could be postponed no longer. Since the 1870s the most persistent and divisive issue facing supporters of MSM had been whether the campus would be better served as an integral part of the University of Missouri or separate from it. Over the years, various groups, including faculty, administrators, students, alumni, and townspeople debated the issue of whether engineering education at Rolla should be limited to mining and metallurgical engineering.

It required an act of the legislature, the Buford Act of 1915, and a state supreme court ruling before degrees in chemical, electrical, and mechanical engineering could be offered at MSM. In 1941, Director Chedseyan resigned under duress, as he stated, because he had encouraged the growth of disciplines beyond the scope of mines and metallurgy.28 Chedsey’s successor, Curtis Laws Wilson, received a mandate from University President Frederick Middlebush to end the controversy, but America’s entry into World War II took precedence over all other matters.

After the war, the separation issue intensified because of a clash between the administration and certain faculty members including Floyd H. Frame, head of the electrical engineering department. Frame and other separationists accused President Middlebush and other officials, including Dean Wilson, of “victimizing” the Rolla campus. The charges included allegations of discrimination against engineering programs at Rolla beyond the scope of mines and metallurgy. The separationists also charged University of Missouri officials with refusing to allocate a fair share of state funds for MSM.

The issue reached a peak in 1948 when the University of Missouri administration decided to discipline some of the more outspoken separationists on the faculty. Frame and four other tenured professors were to be transferred to the University at Columbia. In his 34th year at MSM, Frame was to be demoted to the rank of assistant professor of electrical engineering at the University of Missouri. One-third of his time was to be devoted to electrical engineering, two-thirds to the
University buildings department. Frame and his colleagues resigned rather than accept the transfer, but this action rendered separation an emotional issue that divided all those interested in MSM.

Mervin J. Kelly publicly supported the transfer and opposed separation. Another alumnus, W.O. Keeling, and Phelps County Representative Booker H. Rucker thought the administration had gone too far when it transferred the professors. In 1949, Rucker introduced House Bill 82 in the Missouri House of Representatives. The bill would make MSM’s top administrator directly responsible to the Board of Curators thus bypassing the University administration in Columbia. The bill was defeated. It represented the final serious attempt to achieve separation.

After 1949, for a variety of reasons, University officials became more receptive to development at MSM, and in 1964, the creation of the University of Missouri at Rolla essentially laid the issue to rest.29

Faculty—1946-1959

The expansion of the faculty was a distinct feature of the post-war years. While the number of faculty had remained constant between

![Image of Israel H. Lovett]
the world wars, the vast number of majors in electrical engineering made additional faculty essential.


Most of those, at the time of employment, had B.S. degrees in the discipline and on-the-job experience. Only John Zaborszky had a doctorate (a science doctorate from Hungarian Technical University). The increasingly complex electrical engineering profession dictated that virtually all of those who remained on the faculty return to graduate school for a master’s degree or beyond.

In 1948, Israel Lovett succeeded Floyd Frame as department chairman. Lovett, who served as chairman until his retirement in 1960, presided over a much larger department than his predecessor. The
1949-50 bulletin shows that the faculty had increased in size to 16, four times larger than the departmental faculty of the 1930s. The size of the faculty decreased in 1950 as did student enrollment for most veterans had completed graduation requirements by that time. Following a slump in the early 1950s the faculty slowly expanded until the end of the decade when it totaled 19.

This post-war faculty, like their counterparts of the interwar years, emphasized teaching. In 1946-47, classes and labs ran from 7 a.m.-10 p.m. Mondays through Saturdays. C. James Grimm was always there to advise students. He was, as one student recalled, “the kind of guy who would pat you on the back or kick you in the pants depending on what you needed at the time.” Through the years, Grimm advised thousands of students and had the uncanny knack of remembering them years later. Students of that period also would remember Gabriel Skitek, “the human dynamo,” who was always on the move attending committee meetings, teaching classes, or contacting a government agency or an industrial firm in search of laboratory equipment.

The faculty of this generation emphasized teaching but did not ignore research. Many faculty began to publish by the late 1940s and early 1950s. In the 1960s the department developed major research and graduate programs.

Sliderule-toting students of the mid-'50s might recall the grading practices of Professor Freeman T. Tingley. In particular, students might remember the stars, diamonds, and other coded marks that mystified students and kept them guessing about their fate in Tingley’s classes until the end of the semester. Tom Herrick recalled waiting with fellow students outside Tingley’s office to discuss his grade on an examination and overhearing a discussion that took place between the usually gruff professor and a student. On that occasion, Tingley was especially gracious and encouraged the student to argue for more points on the exam. The student and the eavesdropping Herrick became more incredulous when the professor continued adding points to each problem. At last the student completed his arguments and asked triumphantly, “Do you want to record my new grade?” “No,” Tingley replied, “I have already recorded your grade. This was merely for your benefit.” Needless to say, Herrick and friends did not stay to argue for points that day.

The relationship between faculty and students in this period was formal, though cordial. Most students recalled spending pleasant evenings in the homes of their professors, and most students felt
comfortable approaching one or more of their professors for help in solving academic as well as personal problems.

Students, 1946-1959

The large number of students was a distinguishing feature of MSM from 1946 to 1959. As mentioned previously, 2,565 students enrolled at MSM in 1946-47 and 515 declared electrical engineering as their major. Of the 1,262 freshmen that year, roughly 75 percent were veterans. These former GI's represented a new breed of student for they were older, more experienced, and more mature. Many had wives and children and they pursued their educational goals in a serious manner. These war veterans were on the Rolla campus to acquire an education so they could get on with the life plans that had been interrupted by war. Because they refused to participate in student activities so characteristic of the campus prior to World War II, dress codes, freshmen beanies, the freshman fight, and hazing disappeared thus concluding a chapter of student life at MSM.

Between 1946 and 1959, total enrollment varied from a low of 1,210 students in the 1951-52 year to a record high of 3,039 students in 1959. Electrical engineering claimed a substantial number of students. Electrical engineering majors increased and declined with the ebb and flow of general enrollment. Electrical engineering experienced a peak in 1950 when 123 earned the B.S. degree in electrical engineering. In the following year, placement officials proudly announced that starting salaries of MSM graduates in 1951-52 averaged $334 per month.

By the early 1950s, enrollment declined as veterans of World War II completed their degrees, but Korean War veterans soon replaced them. Enrollment gradually increased through 1959 when the department could claim 632 majors.

As before the war, the great majority of students at MSM came from Missouri but more states were represented. For example, during the 1949-50 school year, the Missouri Miner recounted that 1,450 students listed Missouri as their state residence, 368 listed Illinois, 171 listed New York, and 78 listed Wisconsin. The student population that year included 50 international students with India, China, and Turkey having the largest representation.

Another distinguishing feature of this era is the increased number of graduate students. Research and development, with federal grant
support, became a more important feature of higher education. The most dramatic increases in research efforts and graduate education in electrical engineering at Rolla came after 1964, as will be discussed later. Although MSM remained essentially an undergraduate institution which emphasized teaching, the graduate program expanded. In 1946, campus-wide enrollment included 86 graduate students. In 1950-51, graduate enrollment peaked at 187. It dropped to 68 in 1953-54 but increased to 143 by 1959.

Prior to 1946, students could earn graduate credit in electrical engineering at Rolla, but graduate degrees had to be granted through the Graduate School at the University of Missouri at Columbia. In 1946, MSM initiated a master’s degree program and H.L. Seneff earned the first M.S. degree in electrical engineering in 1947. For the remainder of the period, the graduate program remained small and work was restricted to the master’s level.

**Student Organizations**

After 1948, the student branch of AIEE had to share the limelight with the Institute of Radio Engineers (IRE). The joint student branch of the AIEE and IRE was among the first of its kind. The Radio Club remained active, and the Theta Mu chapter was established in 1950 and received recognition by the electrical engineering honorary society, Eta Kappa Nu, in 1951. Theta Mu’s duties included preparation and distribution of a departmental newsletter for alumni, selection of the outstanding senior electrical engineering student each year, and provision of cash awards for the best AIEE-IRE student paper. During its first decade of existence, Theta Mu consistently ranked among the top chapters of Eta Kappa Nu in the nation in activities, membership records, and paper contests.

**Curriculum, 1946-1959**

From 1946 through 1952, the curriculum remained essentially the same as before World War II although new courses with accompanying labs included “Communications Networks” and “Ultra-High Frequency.” Students enjoyed considerable latitude during their final years; seniors selected 15 credit hours in elective subjects. As the requirements in electrical engineering broadened during the 1950s, the
number of electives diminished to a minimum of six credit hours.\textsuperscript{36}

The 1952-53 school bulletin reflected the first major curricular revision in many years, as requirements for graduation changed from 150 credit hours to 148. The difference was a reduction in credit hours for chemistry during the freshman year.\textsuperscript{37} By the late '50s, the “work-in-practice” summer requirement prior to the senior year and the senior trip had been eliminated from Curriculum VI. Moreover, the 148 hours for graduation no longer included credit for freshman-sophomore military science or freshman physical education.

In the 1958-59 school year, the department anticipated its move into a new building and into a new era. It is interesting to examine Curriculum VI:

Curriculum VI, Electrical Engineering

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**Freshman Year**

**First Semester:**

Chem. 1 and 2 General Chemistry .................. 4 3 5

Draw. 11 General Engineering Drawing I .... 0 6 2

Engl. 1 Rhetoric and Composition................. 3 0 3

Math. 5 Algebra and Trignometry ........... 5 0 5

C.E. 1 *Elementary Plane Surveying ...... 1 3 2

M. 10 Military Fundamentals .................. 2 1 2

P.E. 1 Physical Education ...................... ... ... 0

15 13 19

**Second Semester:**

Chem. 3 General Chemistry ...................... 3 0 3

Draw. 12 Descriptive Geometry ................. 0 6 2

Engl. 2 Rhetoric and Composition ................ 3 0 3

Math. 8 Analytic Geometry and Calculus II ................. 5 0 5

Hist. 160 American Civilization ................ 3 0 3

M. 20 Military Fundamentals .................. 2 1 2

16 7 18

**Sophomore Year**

**First Semester:**

E.E. 51 Principles of Electrical Engineering ...................... 3 0 3

Engl. See footnote** ............................................. 3 0 3
### Years of Growth and Rationalization / 35

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*Students presenting credit in Trigonometry will schedule Elementary Plane Surveying in the first semester. Those without credit in Trigonometry will schedule Elementary Plane Surveying in the second semester.

**Requirements fulfilled by successful completion of any one of courses Engl. 51, 75, 100, 102, 110, 125, 170, provided at least one three credit hour course in literature is included.

### Curriculum VI, Electrical Engineering

#### Junior Year

#### First Semester:

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### Senior Year

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<td>Elementary Fluid Mechanics</td>
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*Econ. 314 or Econ. 356 may be taken in place of Econ. 201.
**Electives for both the first and second semester senior year are to be chosen in conference with the department chairman and are subject to his approval. Six credit hours of electives must be chosen from E.E. electives.

### Physical Facilities, 1946-59

Electrical engineering kept its old quarters, Norwood Hall, from 1946 to 1959. Record enrollments caused a serious shortage of space for classrooms, labs, and offices, particularly from 1946 to 1950, and electrical engineering spilled out of its headquarters in Norwood
Hall to occupy three temporary buildings and two rooms in the Old Metallurgy Building. By 1954, the department had sufficient equipment for an industrial electronics laboratory, but there was no space for it. A classroom doubled as a radiation lab. All of the equipment in the radio lab made it difficult to walk about, and the electrical machinery lab bulged at the seams with equipment.39

Electrical engineering at MSM required new physical facilities, and the University of Missouri Board of Curators recognized the need. The problem related to funding. As to physical facilities, on the eve of completion of the new building, the following description for the 1958-59 school year provides a nice summary:

Electrical Engineering: The laboratories of the Electrical Engineering Department are located on the ground floor and on the first floor of Norwood Hall. Their power requirements are supplied by 220-volt, 110-volt, and 32-volt, d-c generators of approximately 125 kw combined capacity, 10 portable lead-acid and nickel-iron-alkali batteries providing voltages from 1.2 volts to 6.0 volts, and a 3-phase transformer bank of 45 kva capacity making 3-phase and single-phase a-c power available at 220 and 110 volts. The electronics and communication laboratories are
equipped with a variety of vacuum-tube regulated d-c power supply units as well as numerous types of constant voltage transformers with which to augment the main power supply.

The electrical machinery laboratories contain standard types of a-c and d-c rotating machinery, ranging from a fraction of a horse power to 35 horse power. The d-c machines are of the shunt, series, and compound type. The a-c machines are represented by single and polyphase alternators and motors. The polyphase a-c motor group includes various types of squirrel cage and wound rotor induction motors, and commutator motors representing the adjustable speed type. A wide variety of single-phase power transformers is also provided in this laboratory.

Prony brakes and electrical dynamometers, both a-c and d-c, are available for loading purposes together with resistance loads of the water barrel, carbon, and resistance wire type.

Measuring instruments of high accuracy are available in sufficient quantity and of proper range to insure obtaining the maximum amount of information from each laboratory experiment. The types of instruments available represent, insofar as possible, the types found in industry.

For advanced work in power and machinery, various special types of equipment are available, such as amplidynes, thymotrol control systems, motortrol system, d-c calculating board, and magnetic oscillograph.

The electronics and communications laboratories contain adequate high quality audio oscillators, radio frequency oscillators, vacuum tube voltmeters, cathode-ray oscillographs, square wave generators, electronic switches, frequency meters, Tektronic oscillograph, Q-meter, d-c amplifiers, radio frequency bridges, R-L-C bridges, television receivers, F.M. receivers, ohmmeters, optical pyrometers, dielectric heating equipment, precision condensers, precision inductors, artificial transmission lines, and the usual D’Arsonval, and thermo-couple types of meters.

An analog computer with capacity to seventh order differential equations is used in demonstrations of principles and circuits involved in computer work. Graduate students are allowed the use of the computer.

The ultra-high frequency laboratory contains a wide variety of equipment such as U.H.F. oscillators, antennas, coaxial wave meters, cavity frequency meters, slotted lines, horns, parabolas, wave guides, wave guide attenuators, wave guide crystal mounts, wave guide slotted sections, wave guide tuners, bolometer bridges, klystrons, magnetrons, and an adequate supply of coaxial cable and wave guide fittings.

The measurement laboratory test equipment consists of potentiometers for voltage and current measurements, R-L-C bridges, audio oscillators, ohmmeters, Micromax and Esterline Angus
recording meters, standard cells, decade condensers, decade resistors, variable inductors, watt meters, watt-hour meters, dynamometer instruments, iron vane instruments, thermo-couple instruments, and D’Arsonval instruments.

Plans are being prepared for a new Electrical Engineering laboratories building which will provide improved housing for the excellent equipment of the department. Funds for this building are to be provided by the seventy-five million dollar bond issue approved by the people of Missouri in 1956. It is expected that construction will start early in 1958.40

In 1956 passage of a $75 million bond issue included $4.9 million in requests from the Rolla campus. With public approval, officials allocated $1 million of this amount for the construction of an Electrical Engineering Building. The completion of this building by the 1959 fall semester inaugurated a new era in electrical engineering at the University of Missouri School of Mines and Metallurgy. The dream that began with building plans in 1930 was at last fulfilled.
Footnotes, Chapter II

1Roberts, 1871-1946 MSM History, pp. 100, 118.
2Phelps County Historical Society, MSM History, p. 878.
3Terman, "Brief History of EE," p. 1404.
4Roberts, 1871-1946 MSM History, pp. 100, 118.
5Missouri Miner, March 31, 1937.
6Christensen and Ridley, UM-Rolla pp. 104-5.
7MSM Alumnus, Spring 1944.
8Missouri Miner, Feb. 23, 1925; Phelps County Historical Society, MSM History, p. 955; and Roberts, 1871-1946 MSM History, p. 96.
9Phelps County Historical Society, MSM History, p. 960.
10MSM Catalogue, 1938-39, p. 117.
11I.H. Lovett, MSM Alumnus, October 1951, p. 12.
12Missouri Miner, Jan. 7, 1930.
15Terman, "Brief History of EE," p. 1403.
16Phelps County Historical Society, MSM History, p. 891.
17Ibid.
18MSM Bulletin, 1925.
19Phelps County Historical Society, MSM History, p. 896.
20Ibid., p. 899.
21Ibid., 1938-39, pp. 116-117.
22Ibid., pp. 40-41.
24Christensen and Ridley, UM-Rolla, pp. 111-12.
25Ibid., p. 115; Roberts, 1871-1946 MSM History, pp. 106, 118.
26See University of Missouri School of Mines and Metallurgy Bulletin "1 and 2 year Courses of Technical Training at College Level for Veterans," pp. 22-23.
27MSM Alumnus October-November 1945, p. 5; Roberts, 1871-1946 MSM History, p. 108.
28Missouri Miner, April 1, 1941.
29Christensen and Ridley, UM-Rolla, pp. 135-44.
33MSM Alumnus, September-October 1952, p. 10.
34MSM Alumnus, September-October 1951, p. 12.
36Ibid.
CHAPTER III
The Maturation of Electrical Engineering at MSM/UMR, 1959-Present

The launching of Sputnik in 1957 was a significant date in the annals of engineering education for it signaled the beginning of the race for technological leadership between the United States and the Soviet Union. The American public provided a mandate for winning this race, and funds became available from private and government agencies for scientific and technological research. For instance, the National Defense Education Act of 1958 placed higher education within the grasp of any student with the intellectual capacity to earn a college degree. In the early 1960s President Kennedy announced his hopes for landing an American on the moon before the end of the decade. All these factors made scientific training and research a desirable commodity. Technological institutions possessed the greatest potential to profit from these societal priorities.

American universities increased spending for research and development from $334 million in 1953 to $2.6 billion in 1968. In order to obtain these funds, universities, more than ever, came to rely upon federal agencies.

By the 1970s, national priorities expanded to areas such as energy conservation. Along with the shift in interest, the more farsighted engineering educators anticipated a decline in government-sponsored research and anticipated a greater need for a closer working relationship between universities and industry.

Electrical engineering education reflected the national interests of the 1960s and 1970s for electrical engineers would increasingly be involved in meeting the nation's objectives whether they were the space race, defense contracts, or energy conservation. These new societal requirements, along with the new high technology of the 1970s and 1980s (very high-speed integrated circuits, fiber optics, super
computers, stealth missiles, laser communications, and direct digital satellites), made the profession more complex than ever. High-tech features were integrated into traditional specialties such as power and communications as well as into newer areas such as medical electronics and digital techniques. The most successful electrical engineering departments on America’s campuses would be able to combine the traditional areas with the new. Given these complexities, the Ph.D. became the advanced degree required for those electrical engineers who planned careers in higher education and/or research.²

A New Building at MSM

In the fall of 1959, the electrical engineering faculty could call a new three-story building home. Of reinforced concrete column and beam construction, the new building emphasized functional use. The ground floor included machinery laboratories, computation rooms, a photography lab, a network analyzer room, workshop, instrument room, and several other research rooms. The middle floor included space for eight large classrooms, a conference room, and offices for faculty and staff. The upper floor included a variety of electronics labs (circuits, measurements, radiation, and antennas, digital and analog
computers, and advanced networks), three spacious classrooms, an instrument room and repair shop, and a half dozen rooms that could serve as offices or research rooms.  

The Development of a Modern Faculty

It was appropriate that Lovett served as department chairman at the time of the move to the new building, for the soft-spoken department chairman personified the continuity and tradition of electrical engineering at MSM. Lovett had been one of the two original members of the electrical engineering department at its inception in 1924. Lovett would step down as chairman in 1960 when he reached mandatory retirement age. He became the first professor emeritus of electrical engineering at MSM.

Ahead lay a series of exciting transformations in engineering education. At Rolla, the Missouri School of Mines and Metallurgy would soon become the University of Missouri at Rolla and, in 1968, the University of Missouri-Rolla.

As the new chairman, Roger E. Nolte would be responsible for directing the department during the transformation. Nolte had joined

Roger E. Nolte.
the faculty during the post-war expansion in 1949. During the mid-’50s he took a leave of absence to complete his Ph.D. at Iowa State. In the previous decade, the men who bore the burden of responsibility in the department included Lovett, Grimm, Skitek, Rittenhouse, and Nolte. Between 1956 and 1961, men like George McPherson (1956), Robert Nau (1957), Robert Chenoweth (1960), and Richard Harden (1960) joined the faculty. Each in his own way added to the professional stature of the department. For instance, McPherson developed the modern power program at Rolla. Nau was a prolific publishing scholar, and Chenoweth and Harden had Ph.Ds.

When Nolte became department chairman in 1960, he inherited a department with a sound undergraduate program. Students, facilities, and the curriculum were firmly established and recognized. These accomplishments resulted from the work of the faculty of the past generation. For MSM’s electrical engineering department of the 1960s, research was the area which required expansion. Those electrical engineering programs nationwide which would experience success would combine a good undergraduate teaching program with research complete with graduate degrees, good laboratory equipment, and federally supported research endeavors.
Top priorities under Nolte’s leadership included recruiting faculty with the proper credentials for research in the 1960s and developing a Ph.D. graduate program in electrical engineering. The School administration cooperated with the department in achieving these objectives. In the early 1960s, several electrical engineers with doctorates joined the faculty, including J. Robert Betten (1962), Ralph Carson (1964), Edward Bertolli (1965), and James Tracey (1965). Their research interests enabled the department to broaden its specialties beyond the traditional areas of power and communications to include computer systems, advanced electronics, and the like.

In 1962, the University approved electrical engineering’s proposal to offer work leading to the Ph.D. Electrical engineering became the seventh department on campus to gain such approval. Prior to this, electrical engineers who sought doctoral degrees at MSM earned them in a related area like engineering physics. In 1962, electrical engineering enjoyed the distinction of having the largest number of majors on campus (783) and 22 full-time faculty. As in the past, electrical engineers at MSM had responded to needs in a positive manner. After 1962, the tempo of change on the Rolla campus accelerated, and the
electrical engineering department would be called upon to meet new challenges.

From MSM to UMR

The school year 1962-63 represented the realization of an important objective for electrical engineering when the Ph.D. program gained approval. That year also represented the end of an era as Curtis L. Wilson, dean of MSM since 1941, prepared for retirement. He would be succeeded by Merl Baker, a mechanical engineer from Kentucky. As the campus adjusted to a new dean in 1963-64, faculty, staff, and friends also looked to the future and to an unprecedented period of growth and expansion. The state of Missouri acquired the University of Kansas City, converted the University of Missouri Normandy Residence Center into a two-year college, and combined these two with the Columbia and Rolla campuses to create the University of Missouri system.\(^5\)

In 1964, the Missouri School of Mines and Metallurgy became the University of Missouri at Rolla. MSM had become a part of history. The
electrical engineering faculty at Rolla received the announcement of the name change with mixed emotions. Some preferred to keep the old name out of respect for tradition while others had advocated a name that more accurately reflected the modern thrusts of the campus such as the "University of Missouri School of Engineering and Sciences." 

The reorganization did not stop with a name change. Merl Baker, now Chancellor Baker, reorganized the campus into a School of Mines and Metallurgy, a School of Engineering, a School of Science, and a Graduate School. Electrical engineering became a department in the School of Engineering, and before the decade was out, an engineer whose early career had been entwined with electrical engineering at MSM, J. Stuart Johnson, returned to Rolla to serve as dean of the School of Engineering. Johnson returned to a campus that had changed since his departure in 1944. In 1967, Johnson said, "the electrical engineering department had more faculty members and students than the entire school had when I left." Expansion in the 1960s included an enrollment increase from 3,091 in the fall of 1960 to 5,285 in 1970. The faculty at Rolla increased from 243 in 1963-64 to 389 in 1970-71.
J. Stuart Johnson, Israel Lovett, George Ranes, and Floyd Frame.

Department Chairmen—1959-1983

The electrical engineering faculty would have four of its five department chairmen during this modern period: Lovett (until 1960), Nolte, Betten, and Morgan. Nolte resigned his position in 1967 when he accepted an administrative post at the University of Miami (Florida).  

J. Robert Betten succeeded Nolte as the department’s fourth chairman in its then 43-year history. Betten, with a Ph.D. from Iowa State, had come to Rolla during the 1962-63 school year. It would be Betten’s task to lead the department through a dramatic period of expansion as well as a period of constriction.

In 1978, J. Derald Morgan succeeded Betten. Although Morgan received his undergraduate degree from Louisiana Polytechnic Institute, he also was a product of MSM for he had earned an M.S. in electrical engineering from the School in 1965. Subsequently, he received a Ph.D. from Arizona State University before returning to Rolla. In 1976, Morgan became the first electrical engineer at Rolla to be
named the Emerson Electric Professor of Electrical Engineering. He and the faculty would face the challenge of coping with unprecedented enrollment increases at a time when funding made it virtually impossible to expand the size of the faculty.\textsuperscript{11}

Under Nolte's leadership the faculty increased in size from 19 in 1960 to 37 in 1967. During the Betten years, faculty size ranged from 38 in 1968-69 to a high of 51 in 1970-71 (figures are from MSM or UMR catalogues and numbers represent total faculty). Thereafter, enrollment decreased dramatically at UMR and faculty size diminished. The number of faculty in electrical engineering stabilized in 1977-78 and 1978-79 at 28 and increased slowly to the 1983 figure of 39 (including those with joint appointments and emeritus status). Of the faculty in the fall of 1983, all but three have earned doctorates.

While specialties in 1959 emphasized traditional areas like power, electronics, and communication, those in 1983 included the traditional areas plus digital systems, solar energy, computer applications, and robotics.

After 1959, the electrical engineering faculty members also expanded their role beyond the structure of the department. In 1983, electrical engineering faculty served in UMR's Graduate Engineering Center
(Edward Bertnolli was director), the Electronics Research Center (J. Robert Betten was director), the Graduate Center for Cloud Physics Research (D. Ronald Fannin was an associate), and the Renewable Resources Research Center (Jack L. Boone and Thomas Van Doren were associates). In addition, William H. Tranter was assistant dean of engineering for graduate affairs and research and D. Ronald Fannin was assistant dean of engineering for undergraduate affairs.

A Dynamic Department

In the past decade, electrical engineering at Rolla expanded its activities far beyond the traditional roles of teaching and research. Workshops, conferences, development and scholarship endeavors, and special relationships with industry had been characteristic of electrical engineers from UM-Rolla.

In 1970, a UMR-Mervin J. Kelly Communications Conference set the tone for conference activities for the decade. In 1974, the department, in cooperation with the IEEE, sponsored the Midwest Power Symposium. The Rolla campus also hosted the first conference
on energy in 1974. The annual energy conference provided a useful international forum for all professionals in energy-related fields. In 1977, a consortium of universities and industries including UMR developed an electrical engineering institute in Algeria.

An Industrial Advisory Council was created in 1973. Made up of company officials who supported UMR's power programs, the council provided a critical bridge between the university and industries such as A.B. Chance, Aluminum Co. of America, Emerson Electric, Illinois Power Co., and Union Electric.

The Visiting Industrial Scholar Assistance (VISA) program involved the acquisition of an industrial sponsor who financed a student to pursue graduate work. In turn, the graduate student spent three to four months each year working for the sponsor. The student benefited from the financial support, and, the sponsor, in turn, benefited from a researcher fresh from the academy's research laboratory.

Those blessed with insight in the 1970s anticipated that state and federal funds would not be so readily available in the 1980s. This meant that private funding and support would, more than ever, be essential. In 1979, electrical engineering at UM-Rolla inaugurated a development program called BOLD THRUST to seek funds from
private sources for scholarships and fellowships, the purchase of laboratory equipment, and faculty enrichment. The most successful outgrowth of this project was the Lovett-Grimm Tribute, a scholarship fund.

**Students—1959-1983**

Since 1959, enrollment showed considerable growth, tempered slightly by a decline in the early 1970s. This was followed by a period of such expansion that overcrowded classrooms and laboratories in recent years were reminiscent of the period after World War II.

In the fall semester of 1959, a total of 3,039 students registered at MSM. That number included 143 graduate students, 32 women, and 632 electrical engineers. By the late 1960s, electrical engineering was the first UMR academic department to have over 1,000 majors.

In the fall of 1983, more than 7,000 students attended UM-Rolla. Nineteen percent of them were women, nine percent were graduate students, and some 1,300 were prospective electrical engineers. Many electrical engineering students were involved in the Minority Engineering Program and the Women in Engineering Program.

The Emerson Electric Co. Machines and Drives Laboratory, dedicated in 1984, shows Professor George McPherson with students.
During this period, graduates of the program made contributions to the state and nation, and the offspring of former students enrolled at their parent’s alma mater. For example, Dr. George E. Mueller, an electrical engineer from the class of 1939, became deputy associate administrator for manned space flight of NASA in 1963.

The Academy of Electrical Engineers is a significant organization sponsored by the electrical engineering department. Founded in 1980 to honor outstanding electrical engineers, most of whom are graduates of MSM/UMR, the academy’s members, in turn, serve as ambassadors for and advisers to electrical engineering at UM-Rolla. As of the fall of 1983 the Academy of Electrical Engineers had inducted the following persons into the organization:

**Academy of Electrical Engineers**

**Charter Members**

Wayne J. Bennetse
Thomas O. English
Fred W. Finley
C. James Grimm
R. C. Hansen
Edwin W. Logan
Israel H. Lovett
Joseph W. Rittenhouse
William A. Rutledge
Hueston Smith
Leroy E. Smith
P. Gene Smith
Lawrence A. Spanier
James W. Stephens

**Members**

Ren Beatty
Charles E. Boulson
Charles E. Brinkmann
Phillip O. Brown
Fredrick B. Burns
W. James Carr, Jr.
Donald G. DeBolt
Richard H. Duncan
Chandrakant Gandhi
Robert L. Hanna
Edwin L. Hughes
J. Stuart Johnson
Vernon R. Lawson
Elmer L. Luehring
Dennis E. Mason
Robert L. Mayse
Fred M. Mueller
William F. Oberschelp
James J. Skiles
Gabriel G. Skitek
Harry B. Smith
James A. Smith
Hal A. Steinbruegge
Robert A. Strain
Jerry D. Swearingen
Edward F. Tuck
E. Harold Vannoy
William D. Walker
William A. Wundrack

**Student Organizations**

Electrical engineering students continued to be active in professional organizations. In 1962 the joint student branch of AIEE-IRE was the largest of its type in the United States. In 1963, these two prominent national professional organizations merged to form the Institute of Electrical and Electronics Engineers (IEEE). In 1963, these two prominent national professional organizations merged to form the Institute of Electrical and Electronics Engineers (IEEE). In 1963, these two prominent national professional organizations merged to form the Institute of Electrical and Electronics Engineers (IEEE). In 1963, these two prominent national professional organizations merged to form the Institute of Electrical and Electronics Engineers (IEEE).
chapter won the national outstanding activities award for 1980-81, the highest award available. Eta Kappa Nu activities include participation in the annual departmental phone-a-thon for development, assisting in Electrical Engineering Career Day, providing guides for Parents' Day and University Day, and helping with the Phelps County Junior Miss Pageant.\textsuperscript{18}

**Curriculum, 1959-1983**

The undergraduate curriculum established in 1952-53 remained intact until the mid-'60s. The 1965-66 Catalogue for UMR illustrated the first major change for the period when credit hours for graduation were reduced from 148 hours to 143, excluding required courses in physical education, basic military science, algebra, and trigonometry. Basic military had been dropped as a requirement in the fall of 1964.
The catalogue for 1970-71 revealed more curricular alterations. By that time, 132 credit hours were required for graduation, excluding algebra, trigonometry, and basic military science. The curriculum of the 1980s remained at 132 credit hours. That included an "Introduction to EE," created by C. James Grimm, and a "Senior Seminar."

As in the past, the curriculum emphasized breadth although 1983 majors also could elect to emphasize one of the following areas: Circuits, Communications-Signal Processing, Computer Engineering, Control, Electromagnetics, Electronics, Power, and Solar Energy. The following degrees were offered in electrical engineering in the fall of 1983: bachelor of science, master of science, doctor of philosophy, doctor of engineering, and professional development degree.

The complete curriculum in electrical engineering as of the fall of 1983 was as follows:

### FRESHMAN YEAR

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<td>EE 271—Fields &amp; Waves I</td>
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SENIOR YEAR

First Semester  Credit
EE 230—EE Lab III  ........................................ 2
EE 231—Control Systems ................................. 3
EE 251—Prin of Semicond ............................. 3
EE 243—Com Systems ................................. 3
EE 207—Power Systems ................................. 3
Elective (EE 300-level Tech) ............................ 3
17

Second Semester  Credit
EE 240—EE Lab IV .......................................... 2
ME 227—Thermal Anal .................................... 3
Elective (Hum/Soc Sci) ................................. 3
Elective (Free or Tech) ................................. 3
Elective (Free or Tech) ................................. 3
Elective (Free or Tech) ................................. 3
EE 210—Seminar ........................................... 1/2
17 1/2

Note: All electives must be chosen in conference with the student’s adviser.
1 Selected from Pol. Sci. 90 or Hist. 112 or Hist. 175 or Hist. 176.
2 A total of 6 hours credit of Mil. Sci. may be used as free elective credit.
3 Communications skills elective selected from E.T. 10, Sp. & M. 85, Engl. 160, or Engl. 181.
4 12 hours of humanities/social sciences electives are required from approved list of humanities/social sciences. 6 hours must be chosen from humanities courses. The balance may be humanities or social sciences.
5 9 hours of technical electives must be chosen from approved courses in schools of science or engineering, of which 3 hours must be chosen from E.E. 300-level courses, exclusive of E.E. 300 (special problems).
6 EE 231, E.E. 243 or E.E. 251 may be delayed until the second semester senior year to allow earlier registration in technical electives.
7 Minimum grade of “C” required by department before registering in subsequent courses.
8 Students emphasizing power should take E.E. 207 earlier.

Emphasis Areas for Electrical Engineering

Note: The following emphasis areas identify courses from which a student may opt to develop an emphasis area. It is not required that students obtain an emphasis specialty in electrical engineering.

Circuits:
E.E. 313—Microcomputer System Design
E.E. 343—Communications Systems II
E.E.351—Advanced Electronic Circuits
E.E. 355—High-Frequency Amplifiers
E.E. 361—Computer-Aided Network Design
E.E. 363—Introduction to Circuit Synthesis
E.E. 367—Power Electronics
Math./Stat. 309—Advanced Calculus I
Math./Stat. 351—Introduction to Complex Variables

Communications-Signal Processing:
E.E. 313—Microcomputer System Design
E.E. 341—Digital Signal Processing
E.E. 343—Communications Systems II
E.E. 379—Microwave Theory & Techniques
Math./Stat. 309—Advanced Calculus I

Computer Engineering:
E.E. 312—Digital Systems Design Laboratory
E.E. 313—Microcomputer System Design
E.E. 315—Digital Computer Design
E.E. 341—Digital Signal Processing
E.E. 351—Advanced Electronic Circuits
C.Sc. 303—Software Systems Survey
Math./Stat. 305—Modern Algebra I
Electrical engineering graduate students, as of 1983, could specialize in one or more of the following areas: circuits-electronics, communications-signal processing, computer engineering, control, electromagnetics, physical electronics, power, and solar engineering. Master of science degree candidates could take courses on campus or at the UMR Graduate Engineering Center, UMSL Campus. In addition, a Professional Development Degree, a post-baccalaureate degree, was available for those who wished to update their electrical engineering education without entering a traditional graduate program.

Conclusion

If you walked into the Electrical Engineering Building at UM-Rolla in 1983, you would see the first- and third-floor laboratories equipped with facilities of which C.P. Williams could not have dreamed when he
demonstrated the electric arc lamp on campus over 100 years ago. The program of 1983 was infinitely more complex than the course in electricity of the late 19th century, or, for that matter, it was more intricate than the curriculum that existed when Harry T. Heimberger became electrical engineering’s first degree recipient at MSM.

Yet, the visitor also would find those important links to the past that provide continuity and stability. If you walked down the hallway of the middle floor, you would see that continuity in evidence on the doors of certain offices. Those included name plates of active and retired professors who were still important in the life of the department, extending back a generation, a half-century and more. The names included Johnson, Lovett, Grimm, Skitek, Nau, and McPherson.

The philosophy of the curriculum of 1983 remained essentially the same as that of 1917. Both Harry T. Heimberger, class of 1917 and the graduates of 1983 had been provided with a broad foundation in the discipline along with ample experience in practical applications. For Heimberger, these practical applications might have included vacuum tubes. For the 1983 graduate it included computers and lasers.
Footnotes, Chapter III

2 Terman, "Brief History of EE," p. 1405.
3 MSM Alumnus, January-February 1959, p. 3.
5 Christensen and Ridley, UM-Rolla, pp. 186-88.
6 Ibid., and Nolte Oral Interview.
7 Ibid.
9 Christensen and Ridley, UM-Rolla, p. 192.
10 MSM Alumnus, April 1967, p. 5.
12 Christensen and Ridley, UM-Rolla, p. 204.
16 Ibid., V, No. 3, July 1979.
17 Current Transmissions, VI, No. 3, April-May 1982.
19 University of Missouri-Rolla Undergraduate Bulletin, April 1982.
Appendix

Academy of Electrical Engineers

Charter Members

Wayne J. Bennetseen
Thomas O. English
Fred W. Finley
C. James Grimm
R. C. Hansen

Edwin W. Logan
Israel H. Lovett
Joseph W. Rittenhouse
William A. Rutledge
Hueston Smith

Leroy E. Smith
P. Gene Smith
Lawrence A. Spanier
James W. Stephens

Members

Ren Beatty
Charles E. Boulson
Charles E. Brinkmann
Phillip O. Brown
Fredrick B. Burns
W. James Carr, Jr.
Donald G. DeBolt
Richard H. Duncan
Chandrakant Gandhi
Robert L. Hanna

Edwin L. Hughes
J. Stuart Johnson
Vernon R. Lawson
Elmer L. Luehring
Dennis E. Mason
Robert L. Mayse
Fred M. Mueller
William F. Oberschelp
James J. Skiles
Gabriel G. Skitek

Harry B. Smith
James A. Smith
Hal A. Steinbruegge
Robert A. Strain
Jerry D. Swearingen
Edward F. Tuck
E. Harold Vannoy
William D. Walker
William A. Wundrack

Alumni Awardees

Wayne J. Bennetseen
J. Robert Betten
Donald G. DeBolt
Thomas O. English
Fred W. Finley
Edward S. Fris

C. James Grimm
Billy R. Jones
Israel H. Lovett
Sylvester J. Pagano
Joseph W. Rittenhouse
William A. Rutledge

Leonard L. Schuler, Jr.
Gabriel G. Skitek
Harry B. Smith
James W. Stephens

Eta Kappa Nu Association Membership
Gamma-Theta Chapter

1952

Donald G. Bardon
Paul H. Breazeale
Homer E. CQUENCE
William Crawley
John N. Davidson

John H. Dickerman
Rodney E. Gilbreath
Vernon E. Hackman
David L. Hillhouse
Kenneth Jenner

Mervin J. Kelly
William P. Kimker, Jr.
Ernest Peter Langerich
Israel H. Lovett
John G. Macke
George F. McCormick
Charles M. McDowell
William G. Meyers
Fred Mullersman
Joseph J. Murphy
Claude J. Osbourne
Robert J. Owens
William A. Paar
Charles C. Poe
Robert E. Rasche
Gene Reynolds
Joseph W. Rittenhouse
Michael C. Robel
James F. Ruhl
Wiley T. Ruhl
Gerald F. Sinnamon
Gabriel G. Skitek
Jerry Swearingen
Frederick R. Wagner
Joseph Watkins
Ronald R. Watson
John Zaborszky

1953
Campbell Craig Barnds III
Martin Walter Barylski
William C. Blackwell
Earl Bunney
Frederick Brandt Burns
Donald Gessley
Harvey A. Hollingsheed
Richard Kaiser
Miklos E. Nagy
Richard L. Reeg
Henry F. Streigl

1954
Clarence Lee Alburtis
E. L. Crandell
F. M. Drummond
George J. Fiedler
David J. Freeman
Paul F. Gramlich
C. James Grimm
Robert L. Hanna
William E. Hugh
Edwin W. Logan
James F. Longshore
Elmer L. Luehring

Myron C. Lytle
Conrad L. Neal
M. Duane Sanner
Gerald D. Spann
Kenneth F. Steffan
Maurice E. Suhre, Jr.
E. F. Tuck
Spyros G. Varsos
Norman L. Walker

1955
James L. Abernathy
Ronald G. Alberter
William Alexander
Leslie S. Allen
Kjell Arneson
Bill Ashworth
Clyde W. Baxter
Robert L. Blount
Sam Bowman
Phillip O. Brown
Lowell G. Campbell
Gene C. Clodfelter
Ralph David
Frederick J. Dietrich
Carl W. Glaser
Dennis Gooding
L. D. Harrison
Eugene L. Hough
Albert F. Huters, Jr.
Myron J. Johnson
Leonard J. Linde
Robert L. Mayse
Morton L. Mullins
Liston E. Neely
James J. Ridinger
John H. Schmedl
Dale Schrumpf
Kenneth W. Shriver
Hueston M. Smith
James G. Smith
Harold A. Steinbruegge
James W. Stephens
Jack D. Stewart
John R. Troutner
Edgar D. Walton
Paul E. Zahn

1956
Wayne J. Bennetsen
Thomas A. Bertorello
Charles Boulson
Ronald D. Brennan
John P. Dever
Thomas W. Eaker
William R. Field
Paul D. Gerlach
Richard J. Konrad
Elliot Kurzman
David Lambert
Jerry D. Long
Bobby J. McConnell
James E. McNabb
Carl J. Meyer
David M. Morrison
Richard C. O'Dell
Craig G. Roberts
Orville L. Schaefer
Donald F. Sncek
Mack J. Stanton
David A. Sutton
James L. Taylor
Norval D. Wallace
Jack T. Wilson
Eugene N. Zesch

1957
Earl E. Anspach
William J. Barlow
Norris J. Bassett
Frank L. Baum, Jr.
William W. Beydler
Fred Borgini
Robert T. DeWoody*
Melvin J. Dull
Albert J. Dusin, Jr.
William J. Ebert, Jr.
Thomas K. Garlich
John R. Giboney
Carl D. Griffith
James H. Hahn
William E. Hord
Donald D. Humphrey
James T. Jones**
John C. Jones
James I. Latham
Leland L. Long
Robert L. Lukefahr
Richard L. Mason
Charles R. McGehee
William L. Metcalf, Jr.*
Henry J. Mingo
Don E. Mitchell
Marquis B. Robinson
Harry K. Riggs
Lynn A. Rockwell
John J. Schiermeier
Donald F. Schwarz
Giles Sinkewiz
Roy F. Sloan
Homer D. Smith
Jimmie L. Smyth
Julius C. Strasbourger**
James G. Taylor
Freeman T. Tingley**
Sadeq M. Vakil
Robert E. Van Meter
William D. Walker
Charles A. Watts
James E. Weinholt
Albert W. Weinrich

1958
John C. Adams, Jr.
Wayne T. Andreas
T. E. Barfield**
Lloyd W. Carpenter
Earl J. Charlson
Gary N. Denney
Gerald D. Dunigan
Larry L. Ferguson
Douglas Froemsdorf
Richard W. Grinder
Palmer H. Hadler
Wayne K. Hammond
Carl L. Henslee
Gilbert L. Hermann
Henry J. Holley
Joallan Hootman
Kenneth F. Hornkamp
James H. Johnson*
Paul R. Jordan
Jimmie J. Justus
James F. Kauffman
Jerry C. Kendrick
Harold E. Lobaugh
Frederick W. Lynch
Albert L. Maisak
Jack E. McElroy
Paul B. Medley II
Robert G. Melvin
Jimmy D. Moses
Ronnie Northcutt
Marcellinus A. Orf
Daniel A. Pelhank
Paul E. Pemiller
Oscar J. Potty**
Tehuda A. Rachovitsky*
Louis C. Rephol
James L. Risner
Edwin G. Schmitt
Robert K. Schuler
Ellis E. Shafer
Otis H. Smith
Anthony V. Steinman
Leo D. Stephens
Chester W. Sturgeon
Charles F. Swettich
Roy L. Teeterson
William J. Wheeler
David F. Winter**
Paul R. Zacheis

1959
Donald Annis
Larry C. Amsler
Thomas Kent Bohley
Dwayne Brixey
Richard P. Brueggemann
Lloyd E. Brunkhorst
Donald W. Burlage
Stephen T. Chuck
Charles L. Coats
Emil L. Coffey
James D. Coffman
David L. Cook
Duane E. Cowan
John W. Crocker
Morrell C. Diebold
Vernon Dunn
Thaddeus F. Flood
Rex E. Fritts
George W. Fze**
Robert Glaser
F. L. Grismore, Jr.*
Gary F. Hoech
John T. Holman
Naomichi Ito
Robert G. Jones
Richard R. Kapfer
Robert L. Kelley
Walter F. Kern
Donald R. Killian
John A. Kuntz
Willis D. Lawler
Kasem Malek
Thomas J. Martens
Billy W. Marshall
William McGovern
Robert C. McIntyre*
Gary K. McNees
Wilbur F. Metcalf
Henry N. Peterson
Don J. Popp
Emmett A. Reynolds
Earl F. Richards*
Ben E. Roseberry
Wayne Ruck
Joseph G. Sargent
Don Sharon
Martha Shultz
Peter E. Simko
Gary E. Spencer
Franklin Standley
Larry Lee Stephens
Robert A. Strain
Jake R. Tims
Joseph F. Urekar
Donald E. Waldecker
William John Wolf, Jr.
John W. Woodward
Edward C. Wright, Jr.
Cecil G. Young, Jr.**

1960
Ren Beatty**
Leslie Blumberg
Harold F. Brady
Raymond C. Breithauer, Jr.
Marvin Camp
Charles T. Ervin
Bill L. Gerhart
Appendix

Paul Gitchos
William Gladney
John Grivdon
Thomas Hertel
Kenneth W. Henry
R. C. Horn**
Barry House
Gerald E. Huck
Frank Edward Jacks
Benjamin W. H. Jaeger
James D. Kallmeyer
Burton H. Kinsworthy, Jr.
Warren Lawrence
Raymond W. Limbert
Alan L. McDonald
Larry S. Nanney
James T. Odum
Russell M. Ousley
John Peatman*
Donald Z. Pierce
Paul D. Plaunik
Richard Reeves
Gerald Rencehausen
Blair A. Rowley
William H. Slacum
James A. Smith**
Ellis Speicher
Paul D. Stigall
Thomas Van Doren
James A. Zychinski

1961
George D. Alexander
George J. Brenner, Jr.
Jose Briceno
Charles A. Byers
John L. Clements
Fred M. Dickey
Charles E. Diemer
Curtis W. Dodd
Paul W. Droll
David N. Everswick
Hugh B. Gardner
Gary Kent Glover
Byron W. Gordon
James M. Gormley
Louis W. Grespan
Harold D. Haertling
Lee Roy Haertling

1962
James J. Baremore
John F. Curtin*
Michael Devaney
Walter Ronald Koenig
Palmer A. Lawson
Lowell D. Moore
Dewey F. Noles
Richard Pohl
Vincent P. Pusateni*
David Seymour
Clifford O. Skouby
Billy T. K. Swift
Robert A. Taylor, Jr.
William J. Tito, Jr.
Gary Voorhis
Arthur Winter
Kei Yamane

1963
Wayne F. Balsman
Thomas D. Beckmann

1964
Gary Andrews
Carl G. Ashly
Thomas E. Austin
Robert K. Baldwin
David E. Bergt
Maurice E. Brubaker
Gary D. Brunner
Frank A. Buchmeier, Jr.
James L. Butler
Appendix

Fred W. Kuchenig
George L. Long
Tim Luce
Benjamin A. Mason
Bill McCarty
Jim McGinnis
Robert McLain
Steven Miltenberger
Laird Moffett
Steven R. Musterman
D. M. Neal*
Wendell D. Neumeier
John Oelge
Richard G. Olsen
Wilford Pomeroy
David Rause
Robert W. Roos, Jr.
Lester C. Roth
Larry Rushing
Richard I. Schoeffel
Faramarz Semnani
Kenneth Shuey
Ronald Sipes
David R. Slagle
Billy Smithson
James J. Spence
Kent Ulrich
Kirby C. Watson
David Weinrich
Van Weissflug
James Wiseman
John P. Wolf

1967

Steven Barr
John Barnes
Gordon Bell
Daniel E. Besterfeldt
Gene D. Biggerstaff
William J. Budt
Walter Collins
Thomas J. Dougherty
Ronald Engelbrecht
Kenneth W. Ervin
Richard W. Fowler
James M. Gill
J. C. Gilmore
Warren Dean Graham
Michael E. Gravitz
David L. Gray
Michael H. Harting
Allen Heaberlin
Alan T. Horn
Noel C. Hyde, Jr.
Donald I. Jiggerst
Ronald A. Karger
William C. K. Karr
Samuel R. Law
Merlin Lindsey
Robert J. Livengood
Darrel A. Mank
Jimmy C. Massey
Robert F. McCrae
Joseph L. Mueller
Paul D. Mullenix
Larry E. Munn
David C. Nagy
Terry Nixon
William B. Olsen
Clayton G. Porter
Larry R. Reagan
Michael R. Reed
T. L. Roach
Harry Salomon, Jr.
John Schultz
Markus W. Smashey
David R. Spence
William A. Suszko
Robert G. Towne
Denny R. Townson
David Uricland
Stan F. Vaninger
Thomas R. Vass
Ronald J. Verhoff
Kenneth B. Wise

1968

William E. Abernathie
Harold R. Alexander
Michael E. Anderson
Don M. Ascoli
Jack T. Bourquin**
Clark Brinker
Jerry K. Brown
Ronald D. Brown
Paul F. Cretin
William H. Curd, Jr.
William Doerf

Surin Dunnvatnanachit
Robert W. Duston
Daryl Enke
Royce Fessenden
James L. Fullbright
Ronald G. Gerdes
James W. Graham III
Randle D. Hall
Timothy C. Hartmann
Jerry G. Hatfield
R. Dale Hensley
William Herzog
Charles E. Huebner
Ronald Jochum
Daniel H. Kruvand
Charles A. Leni
Kenneth W. Littek
Carl H. McCormick
James B. McKelvey
Michael E. Mechlin
H. Edward Midden III
Gary Miller
Gary W. Neal
Frederick L. Newton
Thomas A. Niemeier
Steven G. Nigus
Wayne E. Omohundro
Donald R. Paul
Michael L. Renden
Michael W. Riley
William F. Rootz
James A. Ross
Marcus J. Schaefner
Eugene A. Schill
Donald W. Shaw
Richard E. Stewart
James R. Stigall
Vincent J. Sunderdick
Thomas E. Sweeney
E. Don Thalhammer
George M. Vernon
Bruce A. Warren
David A. Wayne
Thomas J. Wille
Allen H. Williams
Donald Willis
Robert Wilmesher
Michael Yount
Bobby G. Zoll
1969
Don W. Aldridge
J. Fred Archer
Donald Beach
Jeffrey Bednar
Robert Bentzinger
Stephen Bohnemeyer
James O. Bondi
Joseph G. Borcherdt
Robert Brown
James L. Cambier
Ralph Carroll, Jr.
Mark Carron
Donald Cobb
Lawrence J. Colona
Michael Cook
Robert Cook
Allan Cowgill
Donald C. Denham
Patrick M. Dulatt
Joseph O. Elliott
Bruce Fenney
Bruce Harting
Howard Hoffman
Bradford B. Horky
William C. Howell
Constantine Jenkins
Steve Jolly
Ronald Kelley
Kenton D. Kelly
Rex E. Kenyon
Robert Klump
David Massey
William W. McCommis
Chester A. Meeker
Leo W. Midden
Daniel D. Moline
Larry D. Morris
Michael J. Mueller
Richard C. Mues
Gregory M. Murray
John W. Olson
Gary Pieper
H. Dale Puls
Harold Rossman
W. Alan Schuppan
Ralph Steudner
Thomas Steury

Thomas M. Stoll
Arlan Taylor
Robert D. Teter
William M. Thomasson
James W. Turentine
Robert L. Varnon, Jr.
Steven Vaughan
Charles A. White III
Bruce R. Winsor
Donald R. Wolf
Kerry Wolfington
John A. Woltjen
Terry Wormington

1970
Dennis T. Abernathie
Dennis G. Anson
Richard Bartlett
Dana Basel
David G. Baxter
Donald Bene
Harry A. Benhardt
Stephen W. Berghaus
James V. Bertoglio
Jeffrey Boevengloh
David Bondurant
David Bryant
Craig Bubble
David Callanon
Robert S. Davis
Orrin J. Dieckmeyer
Carl D. Dufner
Robert L. Egbert
Richard W. Eimer, Jr.
John D. Elliott
Leland W. Ford
Randall James Fry
James Fuhrmann
Randy F. Gamble
George W. Hauenstein
Roger A. Hayes
Wendell Heady
Jane E. Heineman
Thomas Hentz
Mike Herron
Chung-Lin Ho
Carl Eugene Intag
Bruce S. Kessler
Ben Kiehl, Jr.
Paul C. Kriegshauser
David Lee
James Lobsinger
Daniel W. Long
David G. Lynch
Ajay M. Mehta
Bob R. Meiners
Larry Merry
Charles Mitchell
Robert Mitchell
Robert W. Morrow, Jr.
Gary S. Oleksiw
Gary J. Potter
Charles Raiff
D. S. Raj-Karne
Gary Robertson
Michael S. Routburg
Jerry Sewell
Richard Sidelnik
Gary Smith
LeRoy W. Stahl
Oramel D. Stevens
Alan Sumater
Robert J. Talir
James W. Varwig
David Vogelpohl
Robert Volkmar
Robert Weidner
Alvin Wendt
Terry Wilson
Milton Zlatic

1971
Charles E. Audrain
Wesley Breeden Argo, Jr.
Raymond Joseph Blattel
Chau-Chih Chang
Robert E. Clark
James J. Cobble
Harold Leon Crawford
R. Dean Delker
Charles W. Ervin
Ronald J. Fadler
Randy Hasselfeld
James Jeffries
Leonard F. Laskowski III
Cecil Michael McDonald
Gordon McFerron
John McInerney
1972
Steven M. Akers
Anthony J. Artman
George Bair
Angelo Bellassai
Stephan J. Bengtholdt
Charles W. Bethards
Ronnie E. Blaha
Lyndell R. Brown
William H. Coalson
John H. Dodge
Richard L. Emanuel
Richard H. Gloff
Thomas E. Graves
Jeffrey L. Hartenberger
David W. Head
Wilfred E. Hegg
Robert W. Hoech
James C. Hunsicker
Rolf Kaf
Michael F. Kavanaugh
Hermes Lee
Robert T. Lindsey
Ronald D. Lutes
James W. Marolf
Bruce S. Mitchell
Larry L. Montgomery
Ronald J. Muffler
James A. Fautler
Keith A. Petty
Ronald M. Pollman
Gregory A. Ritter
E. Wayne Rothermich
John J. Sallos
Jerry L. Sanduos
Richard A. Smith
Ken M. Suetterlin
Lloyd N. Wallace
Ronald D. Willoughby
Dennis R. Wilson

1973
Nicholas Barrack
Jeffrey D. Barton
Gary Bich
John D. Bowlin
Michael R. Campbell
Michael E. Cerulo
Paul L. Cites
Jerome P. Dahl
George M. Dolson
Michael P. Edwards
Alan Erickson
Maria H. Gibson
David Greco
Kirk Hayden
David Hollocher
Anton J. Horn**
James R. Kauterr
Gilmore W. Kremer, Jr.
James H. Knehans
Larry D. Lancaster
Dennis W. Leitterman
Roger W. McCloud
Marquis David McMillian
Larry E. Mueller
Robert E. Perrey
Steven Polinsky
Michael A. Post
H.R.S. Raghauan
Jerry L. Rich
Steven Riley
John G. Rosenfeld
Marion Stan Sanders
Vincent Saporita
Robert L. Schaefer
David J. Schepers
John L. Schoenecker
Steven R. Short
Randall E. Staponski
James Straka
John Suchan
Donald D. Taylor
Tery L. Taylor
Viner Tren
David Warfield
Daniel R. Williams
Terry A. Witthaus
Richard T. Wurtt
John R. Zugel

1974
Paul Austin Abney
Michael J. Barnett
Steven D. Bodenhamm
Scott T. Christian
David Stewart Durand
Dennis G. Garrison
Carl R. Goecckler
William O. Gooch
Lonnie G. Heldenbrand
Douglas J. Henry
Robert C. Hill
Roger E. Holmes
Charles W. Hyman
Jack E. Keller
Kenneth E. King
Bill Kolze
Dave Kutilek
Steve G. Matalone
Richard H. McLean
Richard J. Mullin
James S. Pruitt
Jean Roberts
William G. Robertson
John S. Signorino
John L. Smith
Kent L. Tallyn
Gale L. Towery
William L. VanHorn
Martin E. White
David M. Young

1975
Dennis C. Appel
David L. Begley*
Gregory L. Beitz
David E. Brandon
Mark G. Call
Philippe Chicoineau
Pham Quy Chot
James Detry
James A. Godar
Sherman L. Griffith*
Victoria K. Headrick
Daniel Hughes
Ross D. Livengood
Bruce A. Lowe
Jerrel W. Maples, Jr.
Paul R. Martin
Appendix

Scott A. Coleman
Ken Copeland
Jon Cook
Blaine Dinwiddie
Ed Ellibracht
Rosemary Emhoff
Margaret M. Fraser
Jeanne Garrett
Gary Green
Steve Hanmann
John Humphreys
John Jones
David C. King
David J. Klein
Paul Kreter
Ming K. Lau
Jim Lueckenhoff
Robert J. Lyle
Mark Nealon
Bob M. Novak
William A. Reagan
David E. Reed
John David Rotramel
Randall J. Schmitt
Steven C. Strouse
Hal S. Tharp
Steve Westerhouse
Garry Wilber
Gene E. Wisner

FS 1980
Peter Berglar
Andrew W. Bonnot
Debbie Brown
Scott Freiberger
Brenda Garman
Jim Haberstock
Elizabeth Lenhart
Duc Nguyen
Robert J. Tragesser
Cecilia Wempe
Craig A. Wohlers
Edward H. Wooldridge

1981
Timothy R. Adrian
Mike Amelss
Robert E. Armstrong
Ron Blankenhorn
Bruce C. Bowden
James C. Brohe
Renee Rigsley Busiek
Michael W. Coleman
Azita Dadmarz
Diann Johnson Dow
Stephen Dow
Timothy R. Ein
Russell L. Gillenwater
Sam Hammond
Donald Hand
James R. Hanf
Janice Hierholzer
Jeanne Hilker
Jeff Holland
Kevin Klug
David W. Kroeger
Robert A. Kruse, Jr.
C. Fred Kummer III
David Langenberg
William R. Lee
Kurt A. Liebel
Jim Marting
Steven McCallough
William McKinzie
Mark Michel
R. Christopher Noonan
Steve Peecher
Joseph A. Puhl
Kermit A. Ross
Dave Siegel
Ron Sifuentes
R. Craig Simpson
David Lynn Smith
John Stuller
David Sumpter
Thien Xuan Tran
Kiwon S. Yoon

1982
David M. Anderson
Mike Brown
James C. Bullard
Richard S. Casebolt
Chris Cooper
Thomas J. Dalton
Dro Darbadian
Ronald W. Davidson
Mike Duello
Daniel Dziedzic
William Ebel
Mohammed Fotouhi
David A. Gaskill
Jalee Gill
Timothy Hagan
Derek Hannah
Craig Hendricks
Duane Highly
Moira Horton
Brent Jenkins
Thomas P. Jolly
David Kerfer
Dan Kietzer
Robert Kressig
Peter F. Lichtenwalner
Ray Luechtefeld
Mike Matthews
Steven McMogg
James C. Moore II
Garry W. Orf
Terry Pautler
Melinda Pauter
Ron Prenger
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Terry Riley
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Ken Roberts
David Saunders
Bill Schulze
Jim R. Stahlman
Wendell Stavig
Suzanne M. Thomas
Kenneth K. Tinsley
Robert Tower
Timothy Troupe
Stephen R. Veit
Kathy A. Von Rump
Steve E. Watkins
Gaston R. Williams
Jay P. Wilshire
Bradley C. Zikes

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Charles F. Abell
Daniel J. Bicket
Ann L. Brandel
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Nguyen Quoc Chinh
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John D. Jabusch
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Christopher Kurtz
William Latham
Matthew Lemke
Russel Long
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Mark Mattes
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Kerry Rhea
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Dale Schwent
Nicholas R. Simpson
Heraleen Sprenger
Marvin Taylor
G. Mark Terhune
Vijay Varma
Susanne Voda
Kevin Wempe
Bonnie Wiess

* Graduate Level
** Professional Level

Honorary Degree Recipients
Thomas O. English
Robert C. Hansen
George E. Mueller
James W. Stephens

MSM/UMR Faculty in Electrical Engineering

*1991 Austin Lee McRae
*1995 Arthur H. Timmerman
1914 Floyd Hill Frame
1917 Ralph E. Duffy
1918 Rolland S. Wallis
*1919 Leon E. Woodman
1920 Ryland F. Ratliff
1921 Israel H. Lovett
1923 Joseph Worley
1925 George O. Ranes
1927 Charles A. Van Doeren
1937 J. Stuart Johnson
1943 Carl T. A. Johnk
1946 Fred Beaty
1947 William A. Ford
1948 John W. Cappeck
William Feist
Paul Gray
John W. Hammann
Robert M. Montgomery
John W. Rittenhouse
Richard D. Wheat
Palmer L. Anthony, Jr.
John Barcroft
Herbert Crosby
C. James Grimm
Arthur W. Grove
Horace R. Horton
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John Zaborsky
Edward Erdelyi
Walter Graham
Roger Nolte
G. G. Sunnman
J. J. Skiles
1949
1953 David J. Freeman
Bienvenido C. Peralta
1954 Floyd M. Drummond
Conrad L. Neal
Jerry D. Swearingen
Freeman T. Tingley
Robert T. DeWoody
1955
1956 Donald G. Bardan
William L. Metcalf
George McPherson
Ferdinand H. Mullersman
Bill W. Ashworth
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James H. Johnson
Robert H. Nau
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1958 Lowell G. Campbell
Fred L. Grismore
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Leland L. Long
1961 Robert D. Chenoweth
Richard C. Harden
Thomas J. Herrick
William E. Hord
Arne M. Nystuen
John B. Peatman
Lloyd E. Brunkhorst
1962 J. Robert Betten
Edward J. Brueggemann
John F. Curtin
Charles A. Gross
Ronald McNally
Jack F. Morris
Russell M. Ousley
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* Professors with appointments in physics who taught courses in electrical engineering
† Date refers to initial appointment at MSM/UMR
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Amoco Professorship
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Clyde E. Vandivort
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Jack L. Boone
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Kenneth H. Carpenter
Glenn W. Bills
Hardy J. Pottinger
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Jerome Knopp
Arturo Miles
N. R. Cox
R. H. Moss
S. V. Rao
E. Strangas
C. H. Wu
Silver and Gold Club
C. James Grimm

St. Pat through the Years
1927—Gerald A. Robert
1945—Harold C. Brehe
1949—Donald E. Spackler
1965—Clyde A. Vandivort

Professional Degree Recipients
Wayne J. Bennetisen
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Charles E. Boulson
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Phillip O. Brown
Delbert R. Cox
Donald G. DeBolt
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Harry B. Smith
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P. Gene Smith
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James W. Stephens
Robert A. Strain
George D. Tomazi
Edward F. Tuck
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Eugene H. Woodman
Joseph Worley
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C. James Grimm
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Mr. and Mrs. George E. Mueller
Mr. and Mrs. Robert H. Nau
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Blankmeister, Irwin C. BS 1949 fl
3310 Princess Ln; Dallas TX 752290000

Burdick Corp; 3301 Gardenbrook; Dallas TX 752340000 Sr Sales Exec

Blankenship, James D. BS 1989 fl
3080 Colony Crossing Dr; Charlotte NC 282170000


Blankenship, William J. BS 1971 fl
3130 Dawn Dr; Jonesboro GA 309460000

Owners-Corning Fiberglas;

Blanton, Larry Glenn BS 1981 fl
1409 N Argonaut #C; Griffin IN 461190000

Northern Indiana Pub Serv Co; 5265
Holman Ave; Hammond IN 463200000

Substation Engr

Blaha, Russell W. BS 1962 fl
9275 Sherborne; St Louis MO 631260000
Celtco Industries; 2801 Hamilton; St Louis MO 631100000 Engr & Sales Mgr

Blattel, Raymond BS 1971 fl
7300 Jardine Dr; Oxford CA 930300000
U S Navy; Code N53-Missle Ctr; Pt Magu CA 930320000

Bledsoe, Jeffrey P. MS 1982 fl
115 Old Brock Rd; Weatherford TX 760860000

Blizewski, Brent BS 1972 fl, BS 1973 M
E 8 Chambers Ln; Mt Vernon IL 628660000

W "S" Ave; Mt Vernon IL 628660000 Sr Elec Engr

Block, Duncan G. BS 1957 fl
8310 Hale Rd; Hiscox FL 337600000

Voyager Enterprises; Inc; President

Block, Harold S. BS 1944 fl
6412 Ruffin Road; Chevy Chase MD 200150000

U S Army;
Asst Chief of Staff for Intel
Block, Martyn J. BS 1942 fl
6412 Ruffin Road; Chevy Chase MD 208150000

Retired

Blount, Robert L. BS 1957 fl
1124 Saxony; Houston TX 770800000

NASA Johnson Space Ctr;
Asst Mgr-PayLoad Safety

Blumberg, Leslie BS 1962 fl, MS 1966 fl
11 Oak Meadow Tr; Pittsford NY 145300000

Itek Corp; 1001 Jefferson Blvd

Rochester NY 146030000

Prod Planning Mgr

Blumfelder, William D. BS 1966 fl
430A Matador Dr; Florissant MO 633360000

Emerson Electric; 8100 W Florissant;
St Louis MO 631500000
Lab Mgr Test Equip Dev

Boaz, L. Richard BS 1980 fl
2819 Redford; Burlington NC 272150000

General Electric; P O Box 489; Mebane NC 272820000

Bodenhammer, Steven D. BS 1975 fl
11 Meadow Crest; Viburnum MO 655660000

St Joe Minerals Corp; P O Box 10;

Viburnum MO 655660000

Maintenance Coordinator
Bodick, Andrew L. BS 1951 Fl
2101 Parkton Way; Barnhart MO
630120000
McDonnell Douglas;
Deceased
Boeifier, Emery L. BS 1948 Fl
Boeing, Jeffrey J. BS 1971 Fl
15135 Appalachian Trail; Chesterfield MO
631700000
McDonnell Douglas; P O Box 516; St Louis MO 631660000
Programmer
Bogates, Marco A. BS 1947 Fl
Current Address Needed
Bogard, Joseph H. BS 1964 Fl
66 B American River Dr; Sacramento CA
958250000


Bogni, Alfred J. Jr. BS 1955 Fl
7600 Ramada Ave SE; Huntsville AL
358020000
New Technology Inc; Engr
Bohley, Thomas K. BS 1961 Fl, MS 1966 Fl
1931 Peyton Cir; Colorado Springs CO
809150000
Howard-Packard; Dev Engr
Bonham, Michael R. BS 1973 Fl
615 St Jovite; St Charles MO 633010000
Emerson Electric; 9707 Reavis Rd; St Louis MO 631200000
Prod Mgr-Gas Prod
Bolhmeeyer, Stephen P. BS 1970 Fl
17 Trabridge Rd IV; Columbia MO
652020000
3M Co; 5400 Rt B; Columbia MO
652090000
Boilot, Charles R. BS 1966 Fl
2798 N Jongkind Park Rd; La Porte IN
463500000
Northern Indiana Pub Serv Co; Franklin Square; Michigan City IN 463600000
Div Supv-Power Applications
Boje, George J. Jr. BS 1950 Fl
9531 Horton; Overland Park KS
662070000
Self Employed; P O Box 1274; Overland Park KS 662070000
Mgr Rop
Bolavichov, Peter BS 1948 Fl
Deceased
Boilting, Harry O. III BS 1964 Fl
2018 Francis; Garland TX 7504020000
L-Systems; Sr Specialist
Bollam, James R. Jr. BS 1972 Fl
6861 Parc Charlene Dr; Florissant MO
630330000
Kenneth Botk & Assoc; Elect Engr
Bollinger, Dwight A. BS 1969 Fl
720 Larn Ct; Mt Zion IL 625490000
PPG Industries; Proj Engr
Boman, Thomas M. BS 1979 Fl
9146 Saddlebrook; St Louis MO
631260000
Bomback, Mark Anthony BS 1981 Fl, MS 1983 Fl
Route 1 Box 166; Cuba MO 65543
Bondel, James O. BS 1971 Fl, MS 1972 Fl, PhD 1974 Fl
10231 Echo Ridge Ct; Dallas TX 752630000
1X Instruments; P O Box 2262025; Dallas TX 752660000
Computer Sys Engr
Bondurant, David W. BS 1971 Fl
9285 Garrison Way Box F; Eden Prairie MN
553440000
Honeywell; 12001 Hwy 55; Plymouth MN
554180000
Mgr Systems Applications
Bonnat, Andrew W. BS 1982 Fl
541 Del Medio #323; Mountain View CA
940400000
Teledyne MEG; P O Box 10007; Palo Alto CA 9430308291 Engineer
Bono, Thomas L. Sr, BS 1968 Fl
P O Box 2945; Alhambra CA 918010000
Bono Inc;
Bock, William T. BS 1935 Fl
335 Fairview; Kirkwood MO 631220000
Boos, Guy H. BS 1949 Fl
310 Collinwood Dr; Oakhill WV
259010000
Retired
Borchardt, Joseph G. BS 1971 Fl
14965 Gateway; Chesterfield MO
630170000
Alfa-Southwestern Bell; In S Atth St, 8m B-10j; St Louis MO 631020000
Staff Manager
Borschardt, Donald A. Jr. BS 1975 Fl
78 Dorchester Rd; Collegrove PA 191260000
Control Data Corp; 10323 W Reno; Oklahoma City OK 731790000
Sr Applications Engr
Borsing, Robert L. BS 1977 Fl
5370 Forest Crk Dr; Hazelwood MO
631420000
McDonnell Douglas; P O Box 516; St Louis MO 631660000
Elec Engr
Borchers, Raymond W. BS 1933 Fl
7095 E IIiff Ave; Denver CO 802240000
Retired
Borger, Robert M. BS 1972 Fl
2171 Warrick; Granite City IL
620400000
Pottor Electric; P O Box 14138; St Louis MO 631300000
Borgman, Charles R. BS 1966 Fl
825 Princess Jeans; NE Albuquerque NM 871170000
Alfa-Sandia Labs; P O Box 5800; Albuquerque NM 871150000
Technical Staff Member
Boring, William D. BS 1969 Fl
980 Saddle; Florissant MO 630330000
McDonnell Douglas; P O Box 426; St Charles MO 633010000
Program Mgr-ESYS
Borowiak, Thomas G. BS 1975 Fl
675 Claymont; Ste Genevieve MO
636700000
Citizens Electric; 150 Merchant St; Ste Genevieve MO 636700000
Suv Elec Engr
Borowicz, John B. BS 1967 Fl
2285 Fairplain Ave; Benton Harbor MI
490220000
Nati Standard Co;
Boschert, Joseph II. BS 1971 Fl
156135 Joe H.; los Gatos CA
950300000
Consultant
Boshears, Johnny H. BS 1982 Fl
3635 Butterfield ln; Joplin MO
648010000
Empire Elec; Engr
Boswell, Paul B. BS 1948 Fl
145 Partridge Rd; Pittsfield MA
012010000
General Electric; 100 Plastics Ave; Pittsfield MA 012010000
Consult Components Engr
Boswell, Robert F. BS 1948 Fl
Current Address Needed
Bott, Max L. MS 1971 Fl
4 Brixworth; Florissant MO 630330000
McDonnell Douglas; P O Box 516; St Louis MO 631660000
Section Chief Electronics
Boulson, Charles L. BS 1939 Fl, ELEC 1971
P O Box 3; Marshfield MO 657060000
Retired
Bounds, Donald R. BS 1963 Fl
1561 Coldish Ln; Chesterfield MO
630170000
Monsanto; Vice Pres & Dir of Engr
Brecht, Alan R. BS 1980 F1
511 Hill Dr; Kirkwood MO 631220000
AI&T-Bell Labs;

Breit, Stephen M. BS 1971 F1
352 Box 167-2; Bartlesville OK
790030000
Tulip Inc; P O Box 1181; Bartlesville OK
790030000 Dev Eng/Advance Eng

Bremer, Terry W. BS 1981 F1
1106 Wrought Iron In; Manchester MO
630110000
McDonnell Douglas; P O Box 516; St Louis MO 631660000 Lead Eng

Bremer, Robert A. BS 1977 D7, BS 1977 F1
1111 NW 11 St; Andrews TX 797140000
Amoco; 801 N Main; Andrews TX
797140000 Engr

Brennan, Ronald D. BS 1957 F1
77th Castlemoor Ave; Fulton MO
652510000

Brennecke, William E. BS 1958 F1
3920 Wilmington; St Louis MO 631660000
Emerson Electric; 8000 W Florissant Bx 4100; St Louis MO 631660000 Engr Spec

Breitbauer, Raymond C. Jr, BS 1962 F1
Current Address Needed

Brevillo, David A. BS 1968 F1
557 Five Fingers Way; Columbia MO
210450000
Newell-Packard; Field Engr

Brewster, Robert W. BS 1961 F1
37th Croswood Dr; Tullahoma TN
373880000

Brennan, Marshall R. BS 1964 F1
P O Box 759; Lebanon TX 750670000
TX Instruments;

Brennan, Marshall R. BS 1964 F1
P O Box 759; Lebanon TX 750670000
Tulip Inc; P O Box 1181; Bartlesville OK
790030000 Dev Eng/Advance Eng

Brenner, George J. Jr. BS 1962 F1
557 NW Woodlawn; St Louis MO 631220000
Emerson Electric; 8000 W Florissant Bx 4100; St Louis MO 631660000 Engr Spec

Breton, William R. BS 1980 F1
1942 Deerpark #12; Fullerton CA
926310000
Chevron Companies; P O Box 3965; San Francisco CA 941190000 Des Engr

Brez, Ray C. Jr. BS 1966 F1
4059 Yamba St; Simi Valley CA 930500000
McDonnell Douglas; Engr

Bridgeburn, William E. BS 1964 F1
625 Carrico Rd; Florissant MO
630340000

LCOMP-St Louis Inc; 2550 Harley Dr;
Maryland Hts MO 630430000 Sales Mgr

Bridge, William F. BS 1972 F1
Current Address Needed

Brigitte, Harry B. BS 1959 F1
6620 Finchler Rd; Indianapolis IN
462500000 Retired

Brigids, Thomas L. BS 1979 F1
25 Dogwood; St Peters MO 633760000
McDonnell Douglas; 2600 N Third St; St Charles MO 633010000 Design Engr

Briemeyer, Paul A. BS 1973 F1
3966 Regalway Dr; St Louis MO
631290000

Union Electric; P O Box 499; St Louis MO 631660000 Elec Engr

Brigg, Paul C. BS 1974 F1
1215 Waterford In; Roselle IL
601720000

Tola Electric Co; Electrical Engr

Brinker, Clark D. BS 1969 F1
3030 Greenridge #17; Houston TX 77027

Dashiel Corp; 1300 Underwood Rd Bx 1300; Deer Park TX 775360000
Proj Engr

Brinckman, John E. BS 1951 F1
Star Rt; Atheistane WI 541100000
Allis-Chalmers; P O Box 512; Milwaukee WI 532010000

Brinckman, Charles E. BS 1950 F1
2101 Cedar Hill Rd; Jefferson City MO
651010000
MO Power & Light; 101 Madison; Jefferson City MO 651010000

Vice Pres-Operations

Briscoe, Robert L. BS 1959 F1
2501 S Ohio; Sedalia MO 653010000
MO Public Serv Co; 600 S Ohio; Sedalia MO 653010000 Meter Engr

Brittingham, Harry H. BS 1928 F1
Deceased

Brixey, Harvey D. BS 1961 F1, MS 1963 F1
3291 Taylor; Bridgeport MO 630440000
McDonnell Douglas; P O Box 516; St Louis MO 631660000 Sr Engr

Brock, Jordan R. BS 1973 F1
2719 Ashby Rd; St Louis MO 631160000

Brockmier, James D. BS 1972 F1
1655A S Pine St; Nethylee AR
725190000

U S Air Force;

Bronson, John L. BS 1959 F1
1605 East Wichita; Mc Alester OK
745100000

Central & SW-Public Ser of OK;

Eastern Div Operations Mgr

Brooks, Howard W. BS 1964 F1
Current Address Needed

Brooks, Thomas W. BS 1979 F1
1095 Detroit; Jacksonville FL
322050000

Brophy, Steven Robert BS 1982 F1
3128 B Alpen Road Ct; St Louis MO
631290000

Union Electric; Assistant Engr

Brooke, Robert L. BS 1972 F1
218 Stony View Ln; St Louis MO
631410000

Technisonic Studios Inc; 1201 S

Brentwood; St Louis MO 631170000
Chief Engr

Brown, Jerry W. BS 1968 F1
1956 E Des Moines St; Mesa AZ
852030000

City of Mesa, AZ; P O Box 1966; Mesa AZ 852010000 Elec Sys Engr

Brown, Alan B. BS 1964 F1
L D Schneider Cheese; 127 W limestone
Bx 557; Carthage MO 648360000

Brown, Bradley A. BS 1980 F1, BS 1980 D5
7716 Grisp; Kansas City MO 641300000
Bondix; P O Box 1199; Kansas City MO
641410000 Engr

Brown, Deborah Diane BS 1981 F1
See Brase, Deborah Diane

Brown, Donald R. BS 1978 F1
408 N Johnson Pl #2; Russellville AR
728010000

Air Power & Light; P O Box 551; Little

Rock AR 722030000 Elec Engr

Brown, Douglas A. BS 1971 F1
367 Drummond Dr; Bourbonnais IL
609140000

Commonwealth Edison; 1 First Natl

Plaza; Chicago IL 606700000

Brown, Gary S. BS 1967 F1
3700 Camino DeLaSierra NE; Albuquerque NM 871100000

AT&T-Sandia Labs; P O Box 5800; Albuquerque NM 871150000 Supv

Brown, James L. BS 1963 F1
R R 1; Toddville IA 523410000
Brown, Jerry B. BS 1969 fl
RT 1 Box 7; Callao IA 63534000
Rochwell Int-Collins Radio; 400
Collins Rd NE; Cedar Rapids IA
524020000 Tel Engr Scientist
Brown, Joe R. BS 1968 fl
1127 S Garrison Box 552; Carthage MO
648360000
Motor Rentals Inc; P 0 Box 756;
Carthage MO 648360000 Vice Pres
Brown, Lyndell R. BS 1973 fl
1720 Nearbrook St; Canyon Country CA
913510000
Hughes Aircraft; Sr Staff Engr
Brown, Phillip O. BS 1957 fl, MS 1960 fl,
ELEC Eng 1974
13005 New Hallis Ferry Rd; Florissant
MO 631300000
McDonnell Douglas; P 0 Box 516; St
Louis MO 631400000 Chief Ingr-Electronics
Brown, Richard Alan BS 1983 fl
1729 McKnight Rd; Rock Hill MO 63119
Brown, Richard R. BS 1961 fl
515 Silver Springs Cir; Colorado Springs CO 809210000
Newlett-Packard; Elec Ingr
Brown, Ricky J. BS 1975 fl
RT 1 Box 2968; Ellis Grove IL
622160000
Core Coat; RPI 1; Cora II; Elec Ingr
Brown, Robert A. BS 1970 fl, MS 1975 fl RT 5 Box 100V; Joplin MO 648010000
Engle-Fisher Industries Inc; C &
Porter St; Joplin MO 648010000
Brown, Robert C. Jr. BS 1970 fl
819; Naum; Florissant MO 630310000
Brown, Robert I. BS 1956 fl
3625 S Spring; St Louis MO 631160000
Brown & Assoc; 715 S 2nd; St Louis
MO 631100000 Assoc
Brown, Robert L. BS 1970 fl
3625 S Spring; St Louis MO 631160000
U S Navy; U S Naval Reserve; LtJg
Brown, Robert S. BS 1965 fl
1095 Rockwood Dr; St Charles MO
633010000
Brown, Ronald D. BS 1970 fl
caterpillar Tractor Co; 100 NE Adams;
Peoria IL 616020000
Brown, Thomas F. BS 1968 fl RT 1 Box 115A; Callao VA 224350000
U S Navy; Air Test facilities; Pax
River MD
Brown, William R. BS 1948 fl
730 E Elm; 1; Springfield MO 658060000
Brownard, Billy R. BS 1950 fl 30 Wauenta PI; Hannibal MO 634010000
Northeast MO Elec Power Coop; Box 191;
Palmyra MO 634610000 Elec Ingr
Brownning, Phil A. BS 1988 fl RT 2 Box 300; Loganport IA 710900000
Shell Oil; P 0 Box 61129; New Orleans
LA 701600000
Operations Superintendent
Brubaker, Maurice L BS 1965 fl 23 Crown Manor Dr; Chesterfield MO
630170000
Drazen-Brubaker & Assoc; P 0 Box
11866; St Louis MO 631050000
President
Bruce, Joe J. BS 1981 fl
7017 Greenview Circle N; Ft Worth TX
761120000
Motorola; Engr Eleet
Bruce, Randy D. BS 1978 fl
Current Address Required
Brueggemann, Richard P. BS 1961 fl,
MS 1964 fl, PhD 1972 fl 6787 Blossom View Dr; Florissant MO
630330000
McDonnell Aircraft Co; Sr Staff Engr
Brummeier, David M. BS 1980 fl
4507 Wabash; St Louis MO 631090000
IL Power Co; 500 S 27th St; Decatur IL
625250000 Engr
Brumback, Brian D. BS 1978 fl, MS 1979 fl
4425 Augusta; Ft Worth TX 761260000
General Dynamics; P 0 Box 708;
Ft Worth TX 761010000 Sr Arou Engr
Brune, Peter A. BS 1965 fl
1131 Bluebird Terr; Brentwood MO
631440000
Malcolm A Miller Inc; P 0 Box 7207;
St Llmen Mission KS 662070000
Elec Designer
Brummitt, Lloyd E. BS 1961 fl, MS 1963 fl
1571 Mason Knoll Rd; St Louis MO
631310000
Brown Group Inc; 8000 Maryland Ave;
Clayton MO 631050000
Bir-Research & Engineering
Brunnenmeyer, Lester R. BS 1950 fl 1900 E Loyola; Tempe AZ 852830000
The Garrett Corp; 462 S 36th St;
Phoenix AZ 850180000 Assi Proj Engr
Brunner, Gary D. BS 1965 fl, MS 1967 fl 7116 W Pensietta Dr; Glendale AZ
853080000
Goodyear; Box 85; Litchfield Park AZ
853400000 Sr Ingr Spec
Bruns, Gregory A. BS 1961 fl
6412 Bruce Ave; Minneapolis MN
554210000
Honeywell; Marketing Mgr
Bruns, Martin F. BS 1963 fl
1265 Bunny St; Hiawatha IA 522330000
Rockwell Int-Collins Radio; 5200 C
Ave NE; Cedar Rapids IA 524020000
Prod Mgr
Brunston, Vernon L. BS 1950 fl
P O Box AA; Baldwin Park CA 910060000
Rockwell Int; 2170 E Garson; Lakewood
CA 902350000 Sr Research Engr
Brunt, Randall F. BS 1951 fl
3030 Berkeley; Kokomo IN 469020000
General Motors-Defoe; Highway 31;
Kokomo IN 460200000 Engr
Bryan, David O. BS 1971 fl
8546 Melrose; Overland Park KS
662100000
General Motors; Plant Engr Dept Assem
Div; Kansas City KS Assoc Engr
Bryan, Daniel J BS 1980 fl
952 Lombardy Dr; Plano TX 750230000
1X Instruments; 11500 N Central Expwy;
Dallas TX 752200000 Elec Engr
Bryan, David A. BS 1970 fl
6709 Tower Dr #208; Alexandria VA
223060000
U S Navy; U S Naval Sea Sys Comm;
Arlington VA Proj Engr
Bryant, James R. BS 1947 fl
1602 Via Media; San Lorenzo CA
945800000
Pacific Gas & Elec; 245 Market St;
San Francisco CA
Bryant, Richard O. BS 1970 fl
27 Bartlett; Lebanon MA 010530000
Simpkin Time Recorder Co; 35 S
Lincoln; Gardner MA 014400000
Systems Support Engr
Buback, Craig K. BS 1972 fl
1480 Gettysburg Landing; St Charles MO
633010000
McDonnell Douglas; P 0 Box 516; St
Louis MO 631160000 Elec Engr
Buchhammer, Donald F. BS 1962 fl
10711 forest Path; St Louis MO
631260000
Emerson Electric; Elec Engr
Buchhammer, Raymond J. BS 1976 fl
1125 W 1st; Wichita KS 672120000
Bowling; 3901 S Oliver; Wichita KS
672100000 Sr Specialist Engr

Alphabetical Listing / 87
Cope!lard, Gregory C. BS 1977 Fl, MS 1979 Fl
1825 Charmeran; San Jose CA 9512900000
ESU Inc.; 495 Java Dr; Sunnyvale CA
940860000 Mbr Tech Staff
Copeland, Kenneth W. BS 1980 Fl, MS 1981 Fl
508 Williams; Eureka MO 6305200000
Coping, James W. BS 1984 Fl
1919 Hurstbourne Circle; Louisville KY 4022000000
Westinghouse; 919 Bishop Lane; Louisville KY 4021100000
Industrial Rep
Corbett, John E. BS 1968 Fl
60 Citysdale Dr; Pittsfield MA 0120100000
General Electric; 100 Plastics Ave; Pittsfield MA 0120100000
Electro magnetic Eng
Corbin, Gary A. BS 1978 Fl
419 W Lincoln #2; Kokomo IN 4690100000
General Motors-Delco; 700 E Firmin; kokomo IN 4690100000 Mfg Engr
Cordes, Robert F. BS 1965 Fl
Current Address Needed
Corryg; John D. BS 1965 Fl, MS 1966 Fl, PhD 1970 Fl
4401 Claremont Ct; Bridgeport MO 6304400000
McDonald Douglass; P O Box 516; St Louis MO 631660000 Sr Staff Engr
Costley, Leon J. Jr. BS 1949 Fl
Current Address Needed
Cox, Amy S. (Nei Mc Daniel, Amy S.) BS 1946 Fl
9361 Vance Ct; Brookfield CO 8042000000
IBM; Assoc Engr
Coxan, Stephen A. BS 1968 Fl
8647 Poplar Ridge Ct; Florence KY 4104200000
Instrumentation Serv; P O Box 563; Florence KY 4104200000
Process Control Spec
Co!ter, Gary D. BS 1969 Fl
22N4 C Renault Dr; St Louis MO 6314100000
McDonald Douglass; P O Box 516; St Louis MO Radar Engr
CoUlter, Gene G. BS 1968 Fl
Current Address Needed
CoUter, John C. BS 1970 Fl
11080 W 7th St; Shawnee Mission KS 6620300000
Shaw Elec; Vice Pres of Eng
Cowl, Joseph A. BS 1976 Fl
Box 4071; Woodland Park CO 8086300000
KAMAN; Research Scientist
Couture, Daniel G. BS 1970 Fl
7801 W 96th Terrace; Overland Park KS 6621200000
Black & Veatch; P O Box 8405; Kansas City MO 6411400000 Control Engr
Cowan, Duane L. BS 1960 Fl
Rd 1 Box 1437; Bethel PA 1950700000
AL&I-Western Electric; 2525 N 11th St; Reading PA 1905000000
Development Engr
Cowan, William L. BS 1972 Fl
12 Ivey Ct; Bloomington IN 4740100000
General Electric
Czogill, Allan R. BS 1971 Fl
706 Lester St; kennett MO 6385700000
Federal-Mogul; Maiden Plant; Maiden MO 6385700000 Mfg Engr
Cox, Bethel R. BS 1949 Fl, MS 1951 Fl,
MECH F 1951
7705 Oakridge Dr SE; Huntsville AL 3580200000
McDonnell Douglass-Tech Service; P O Box 1181; Huntsville AL 3580700000
Dir-Engr
Cox, John M. BS 1979 Fl
10370 Granite Crk In; Oakton VA
2212400000
E-Systems, Inc.; 7700 Arlington Blvd; Falls Church VA 2204600000
Des/Dev Elec Engr
Cox, William E. IV BS 1967 Fl
5168 Whipple Lake Rd; Clarkson MI 4906100000
E-Systems, Inc.; 7700 Arlington Blvd; Falls Church VA 2204600000
Industrial Mkt Supvr
Crawford, Richard L. BS 1966 Fl
17 Carolyn Dr; Edwardsville IL 6202500000
Laclede Steel Co; P O Box 266; Alton IL 6200400000 Plant Engr
Cradic, Curtis Ray BS 1981 Fl
56% E Yosemite; Columbia MO 6520100000
CGS; Plant Mgr
Craig, Charles M. BS 1969 Fl
1512 S 13th; Blue Springs MO 6401500000
AL&I-Southwestern Bell; 500 E 8th; Kansas City MO 6410600000 Staff Supervisor
Craig, Richard F. MS 1967 Fl, PhD 1970 Fl
10955 SW Wasco Way; Tualatin OR 9706200000
Cramer, Gary R. BS 1971 Fl
Current Address Needed
Cramer, Roy R. BS 1949 Fl
70 Bell Drive; Excelsior Springs MO 6402400000
Mtr Power & Light; Dist Mgr
Crandell, Elga L. BS 1955 Fl
11300 North Central Dr; Dallas TX 7523000000
Maigon; Assoc Exec Dir
Cranes, Greg R. BS 1970 Fl
4707 El Monte; Rockland Park KS 6620500000
Black & Veatch; 1900 Meadowlake; Kansas City MO 6411400000 Elec Engr
Crawford, David M. BS 1974 Fl
Requests No Mail
Crawford, Harold L. BS 1972 Fl
9511 Middleton R3 Box 192A; loes Summit
MO 6506300000
Arco; 7000 Roberts; Kansas City MO 6412500000 Process Engr
Crawford, Jack L. BS 1963 Fl, MS 1964 Fl
6960 N Solaz Primero; Tucson AZ 8571800000
IBM; Advisory Engr
Crawford, Samuel K. BS 1971 Fl
1751 W Indian School; Apt 2038; Phoenix AZ 8503100000
Western Geophysical; Elec Engr
Crawley, William L. BS 1953 Fl
860 Lindeman Rd; St Louis MO 6312200000
McDonald Douglass; P O Box 516; St Louis MO 6316600000
Creen, Ray C. BS 1969 Fl
5859 Lorain; St Louis MO 6310900000
MO Pacific R R; 210 13th-Electronic Systems; St Louis MO 6310300000
Advisory Systems Analyst
Creelius, Percy H. Jr. BS 1958 Fl
11950 Olalla Valley Rd SE; Olalla WA 9835900000
US Navy; Naval Yard-Puget Sound; Bremerton WA 9831400000 Elec Engr
Creer, Harry L. BS 1965 Fl
1609 9th St; Charleston IL 6192000000
Eastern Ill Univ; Mgmt Analyst Programmer II
Cremer, Adolph F. BS 1968 Fl
P O Box N3811; Houston TX 7721000000
Amoco; Production Superintendent
Crenshaw, Reuben L. BS 1963 Fl
6910 Winchester; St Louis MO 6312100000
R & L Realty; 6726 Nat Bridge; St Louis MO 6312100000
Real Estate Broker
Devey, George C. BS 1964 fl
9837 Coltech Ln; St Louis MO 631230000
Wagner Electric; 6000 Plymouth; St Louis MO 631360000
DeWoody, Robert I. BS 1955 fl, MS 1958 fl
P O Box 769; Fairhope AL 365320000
Engls Shipbuilding;
Dey, William E. BS 1964 fl
Current Address Needed
Diamant, Ronald Alan BS 1981 fl
716 Arcadia Dr Apt 9; Bloomington IL
617010000
Gilt: 1311 E Empire; Bloomington IL
617010000
Dianas, Charles S. BS 1939 fl
Deceased
Dickens, Richard L. BS 1951 fl
10413 Remington Ln; Dallas TX
752900000
Westinghouse; 8600 Carpenter Frwy;
Dallas TX 752670000; Fellow Dist Engr
Dickman, John H. BS 1953 fl
15723 Labelle; La Puente CA 917460000
Dickoy, Daniel I. BS 1964 fl
Current Address Needed
Dickey, Fred M. BS 1964 fl, MS 1965 fl
17 N Baltimore; Derby KS 670370000
Bowen; 3801 S Oliver; Wichita KS
672100000; Research Engr
Dickinson, Ronald L. BS 1962 fl
Rt 3 Box 47; Augusta KS 670100000
Bowen; 3801 S Oliver; Wichita KS
672100000
Sr Spec Eng-Avionics Des Engr
Dietz, Joseph A. BS 1972 fl
Deceased
Diedrich, Melrose C. BS 1959 fl
1118 Patricia; Cape Girardeau MO
637010000
Consumer Benefit Serv Inc; B2H
Independence; Cape Girardeau MO
637010000; Dir-Agencies
Dieland, Stephen W. BS 1979 fl, MS 1981 fl
3918 Harbaugh; Independence MO
640500000
Armco-Burns & McDonnell; P O Box 173;
Kansas City MO 641100000
Ass't Elec Engr
Diecker, John T. BS 1978 fl
308 Park Charles Blvd N; St Peters MO
633760000
Lemco Engr; 11933 Westline Ind Dr; St
Louis MO 631410000; Des Engr
Dielkemper, Ursula J. Jr. BS 1972 fl
2630 Park Ave; St Louis MO 631040000
Homsanto; W G Kremmrich Plant; Sauget
IL 622010000; Elec/Instr Engr
Dielkemper, Edwin V. BS 1983 fl
Rt 1 Box 77; Carlyle IL 62231
Farmer
Dieker, Charles E. BS 1963 fl
2915 C S Fairview; Santa Ana CA
927050000
McDonnell Douglas; 5301 Bolsa;
Huntington Beach CA 926460000
Consultant
Dieringer, Donald R. BS 1950 fl
69 Prospect St; Danvers NJ 077260000
L & K Comstock & Co Inc; 155 E 44th St;
New York NY 100170000; Vice Pres
Dietrich, Frederick J. BS 1957 fl
3878 Corina Way; Palo Alto CA
943030000
Ford Aerospace & Communication; 3939
Fabian Way; Palo Alto CA 943030000
Sys Engr/Satellite Terminals
Dietrich, Randall G. BS 1970 fl
3918 S Elm; Tempe AZ 852800000
Salt River Project; P O Box 1980;
Phoenix AZ 850010000; Lead Engr
Diller, Homer E. Jr. BS 1956 fl
12667 Lonsdale; Bridgeton MO 630440000
McDonnell Douglas; Section Chief
Diller, Kirby L. BS 1980 fl
1149 Cargill Dr; St Louis MO 631360000
Emerson Electric; 8000 W Florissant Bx
63190; St Louis MO 631360000
Dirwiddie, Blaine R. BS 1982 fl
1153 Grove St; Fl Canton CA 902020000
Dippel, Henry C. BS 1976 fl
4318 Bar Lang; St Louis MO 631230000
Schmeckes Market; 7651 Clayton; St
Louis MO 631170000; Mgr Trainee
Ditton, Vernon R. Jr. BS 1961 fl,
MS 1972 MT
1795 Banstead; Florissant MO 630330000
McDonnell Douglas; P O Box 516; St
Louis MO 631660000; Sr Engr
Ditty, Paul R. BS 1975 fl
6 Weatherly Ct; Valley Center KS
671800000
Beech Aircraft; 9709 E Central;
Wichita KS 672060000
Electronic Test Engr
Dixon, Donald B. BS 1977 fl
12270 Chesepeake Dr; Florissant MO
630330000
McDonnell Douglas; P O Box 516; St
Louis MO 631660000; Elec Engr
Dixon, Michael W. BS 1971 fl
4710 Reavis Brks Rd; St Louis MO
631230000
Union Electric; 14th & Gratiot; St
Louis MO 631660000; Engr
Djehane, Abdellah M S 1979 fl
Cem Abbot Ahmed El-Biar; Agers
Algeria 11
Djirar, Same M. SA 1981 fl
Current Address Needed
Dobrynski, Peter V. BS 1967 fl
Current Address Needed
Dockey, Robert W. BS 1970 fl
11715 Clydesdale Rd; Colorado Springs
CO 809150000
Doweckmyer, John B. BS 1973 fl
4637 E 115th Cir; Denver CO 802330000
IMC; P O Box 1900; Boulder CO
630010000; Staff Engr
Dodson, Richard M. BS 1964 fl
2871 Howorth Ln; Bowie MD 207150000
U S Army; 2050 Powder Mill Rd;
Adelphia NJ 078300000
Secretariat Staff
Doerr, Kenneth J. BS 1979 fl
Sperry Rand-Sperry Flight Sys; P O Box
2111; Phoenix AZ 850360000; Des Engr
Doerr, William F. I I. BS 1970 fl
4140 N Parking Dr; Hoffman Est IL
601190000
Doolittle, Jim A. BS 1968 fl
5647 Bayview Dr; Seminole FL 337720000
U S Navy; P O Box 12748; St Petersburg
FL 337100000; Elec Engr
Donson, George M. BS 1975 fl
5923 Vickijohn; Houston TX 770600000
Univ of Texas-Houston; P O Box 2078;
Houston TX 770050000
Dombsky, Edward BS 1959 fl
5813 Alpine; Indianapolis IN 462240000
Indiana's Water Co; 1220 Waterway
Bld; Indianapolis IN 462020000
Sr Elec Engr
Donahue, James B. BS 1940 fl
P O Box 5586; Sun City Center FL
335700000; Retired
Duggins, Gary H. BS 1969 F1
Davis Crk Rt Box 2C; W Plains MO 657750000
Southwest Truck Body Co; P O Box 196;
W Plains MO 657750000

Dukie, Calvin W. BS 1969 F1
505 Grandin Ave; Severna Park MD 2114600000
Arinc Research Corp; Sr Engr

Duke, Richard A. BS 1973 F1
416 Hughes; Marshalltown IA 5015800000
Monsanto-Fisher Controls; 205 S Center; Marshalltown IA 5015800000

Dulatt, Patrick M. BS 1971 F1, MS 1982 M1
288 Portwine Pl; Ballwin MO 6310100000
AFL-Western Electric; 1111 Woods Mill Rd; Ballwin MO 6311000000

Dulin, Thomas E. BS 1961 F1
5249 King Apt 189; Greenville TX 7540100000
Recognition Equip Inc; P O Box 22307;
Dallas TX 7522000000

Dull, Melvin J. BS 1958 F1
612 Mary Ann; Ridgecrest CA 9355500000
Dulie, Richard G. BS 1980 F1
5470 Town Center; St. Louis MO 6312000000

McDonnell Douglas; P O Box 516; St Louis MO 6316600000

Duncan, Douglas W. BS 1977 F1
770 Riverview Dr; Gladstone OR 9702700000

Raytheon; Elec Engr
Duncan, Kenneth J. BS 1970 F1
1006 W Washington; Harrison AR
7260100000

AR Power & Light; 9th & Louisiana;
Little Rock AR 7220300000 Dist Supv
Duncan, Richard H. BS 1949 F1, MS 1951 D5
2012 Rose Lane; Las Cruces NM
8800100000

V S Army; White Sands Missile Range;
White Sands NM 8800300000
Tech Dir & Chief Scientist
Duncan, Robert C. BS 1967 F1
4702 Baha; Lubbock TX 7941200000
David G Hallie & Co; P O Box 987;
Lubbock TX 7940800000 Sales Rep

Duncan, Thomas I. BS 1969 F1, MS 1970 M1
60401 Eleven M; S Lyon M 4817800000

Duncannon Disposal Serv; Self Employed
Duncil, Glenn K. BS 1950 F1
1361 Elm Ave; Glendale CA 9120100000

Ralph M Parsons Co; 100 W Walnut St;
Pasadena CA 9112400000

Principal Project Elec Engr
Dung, Tran A. BS 1977 F1
Current Address Needed

Dunham, William J. BS 1963 F1
1105 Millikin PI NE; Warrren OH
4488300000

General Motors-Packard Elec;
Mgr of Industrial Engr
Dungan, Gerald D. BS 1960 F1
916A E Chirco Pl; Tucson AZ 8571000000

Rockwell Int-Collins Radio;
Dunkann, Steven W. BS 1972 F1
282010 Highfield Ave; Glendale Hghts IL
6013900000

Rockwell Int-Collins Radio; 400
Collins Rd; Cedar Rapids IA 5220200000

D amusement
Dunn, Vernon D. BS 1960 F1, MS 1972 F1
1200 Sherbrook Rd; St Charles MO 6330100000

McDonnell Douglas; 2600 N 3rd;
St Charles MO 6330100000 Group Engr

Dunnvatanachit, Surin BS 1970 F1
33 Tantano, Surivangkhe; Bangkok Thailand

Bangkok Bank Ltd; 9 Suapa Rd; Bangkok Thailand
Asst Vice President

Dunc, Nguyen Q. MS 1973 F1
9538 Charlotte; Kansas City MO 6413100000

Dupree, James F. BS 1960 F1
34529 Birchwood; Westland MI 4818500000
Ford Motor Co; 20000 Rotunda; Dearborn MI 4812400000 Res Engr A

Durand, David S. BS 1975 F1
506010 Ave CV; Austin TX 7871000000

TX Instruments; 12501 Research Blvd;
Austin TX 7875000000 Elec Engr

Durand, Don K. BS 1968 F1, MS 1979 D7, MS 1981 M1
2059 Parasol Dr; Chesterfield MO 6301700000

Mcdonnall Douglas; P O Box 516; St Louis MO 6316600000 Sr Engr

Durbir, Brian C. BS 1975 F1
1536 Olmstead PI; Dayton OH 4541600000
U S Air Force; Air Force Inst of Technology; MGt Patterson AB OH

N4330000000 Captain

Dusin, Albert J. Jr. BS 1958 F1
741 Lamplight Lane; Hazelwood MO
6304700000

McDonnell Douglas; P O Box 516; St Louis MO 6316600000

Dustin, Robert W. BS 1969 F1
2170 Willow Ridge Ln; Chesterfield MO 6301700000

AFL-Western Electric; 1111 Woods Mill Rd;
Ballwin MO 6310100000

DuVall, Leif A. BS 1976 F1
6038 Hartford; St Louis MO 6313900000
Vetal Labs; Supervisor

Dyorsky, Michael A. BS 1981 F1
Current Address Needed

Dziedzic, Daniel A. BS 1974 F1
P O Box 441; Williamsville NY
6293000000

Mcdonnell Douglas; P O Box 441; Williamsville NY
6293000000

Eagan, Thomas Eugene BS 1951 F1
10500 Swimerset; Detroit MI 4822600000

Eagleton, Rosemary A. BS 1981 F1
Rt 3 1 26 Blue Lockspur; Hollywood MO
2063600000

Mcdonnell Douglas; P O Box 516; St Louis MO 6316600000 Assoc Engr

Eaker, Thomas W. BS 1958 F1
766 Sleeppy Hollow Rd; Briarcliff Manor NY 1051000000

GTF; 730 Third Ave; New York NY
1001700000 Administrator

Eason, Donald L. BS 1949 F1
711 Chippenendale Ct; St Louis MO 6312900000

Mcdonnell Douglas; P O Box 516; St Louis MO 6316600000 Group Engr

Eason, Lillian S. BS 1969 F1
13130 Diamond Ridge Ct; St Louis MO 6313300000

Anheuser-Busch; #1 Busch Place; St Louis MO 6311800000 Sr Project Mgr

East, Douglas R. BS 1966 F1
4221 W Eisenhower Suite II; Loveland CO 8053700000 President

Easterwood, Michael J. BS 1973 F1
RT 1; Russville IN 4797900000

General Motors-Delco; Sr Proj Engr

Eaton, Jerry A. BS 1970 F1
P O Box 5173; Highland Point NC 2726000000
St Louis Diecastng Corp; 201 Rock Ind Pk Rd; Bridgeton MO 6304000000

Elec Engr

Eaton, Larry L. BS 1962 F1
1346 Springhurst; Florissant MO 6301700000

Mcdonnell Douglas; P O Box 516; St Louis MO 6316600000 Sr Design Engr