# COURSES

*IN*

# Radio

AND

# Commercial Radio Engineering

SCHOOL of ENGINEERING of Milwaukee

BULLETIN RA

1932 - 1933

## This Bulletin Describes Courses Offered in

**Radio Reception**

**Commercial Radio Engineering**

In addition to the six months course offered in Radio and the one year course in Radio Engineering, certain vocational courses may also be arranged to meet the needs of individual students; for example: A student familiar with the principles of Radio Reception may pursue a course in Radio Transmission, which is of three months duration, or for a student having had sufficient radio experience he may pursue a three months course in Speech Amplification, Talking Motion Picture Operation, and the Principles of Television. For such students who wish advanced work in Radio, it is recommended that a statement of all radio work accomplished in school or in practice should be sent to the School of Engineering. Our Educational Department can then give definite advice pertaining to any particular case.

## Bulletins of the School of Engineering of Milwaukee

These publications include:

**Bulletin EE—"Courses in Electrical Engineering"**
Commercial Electrical Engineering, 1 year.
Industrial Electrical Engineering, 2 years.
Electrical Engineering (B. S. Degree), 3 years.

**Supplement to Bulletin EE**
"Commercial Electrical Engineering (for non-high school graduates) 1½ years.

**Bulletin E—"Practical Electrical Education"**
Six months Master Electrician Course.

**Bulletin RA—"Radio Technician,** 6 months and **Commercial Radio Engineering,** 1 year."

**Bulletin RE—"Electrical Refrigeration."**

**Bulletin S—"Photo Story."**
Illustrated booklet showing scenes of the School of Engineering of Milwaukee.

**Catalog—"Practical Electricity."**—Home Study Division.
Copies of the bulletins may be secured by addressing
School of Engineering of Milwaukee, Milwaukee, Wisconsin.

BULLETIN RA

General Information Concerning Courses in

# Radio Reception
(SIX MONTHS)

# Commercial Radio Engineering
(ONE YEAR)

# Radio Transmission
(THREE MONTHS)

Speech Amplification, Talking Motion Picture Operation, Principles of Television
(THREE MONTHS)

1932 - 1933

SCHOOL *of* ENGINEERING *of* MILWAUKEE
MILWAUKEE, WISCONSIN

INDEX



# ADMINISTRATION

The School of Engineering of Milwaukee is incorporated under the laws of the State of Wisconsin as an educational institution, whose purpose is to give courses in Engineering subjects with the authority of conferring appropriate degrees.

## OFFICERS

of the

## SCHOOL OF ENGINEERING OF MILWAUKEE

1931

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## HISTORY

The School of Engineering was founded in 1903 by Oscar Werwath who has been its president since its inception. The original purpose of its founder was to give a short course in practical electricity to a few ambitious young men connected with a local electrical organization. Its president, a practicing engineer, gave instruction evenings. The progress made by the first students, the growing importance of the electrical industry, and the need of trained men induced Mr. Werwath to abandon his engineering practice and devote his full time to organizing the school on a larger scale. The enterprise has grown steadily since that time, until today its annual enrollment is considerably over a thousand students, specializing in Practical Electricity and Electrical Engineering; and the institution is recognized in the United States and abroad as one of the foremost electrical engineering schools of the country.

# CALENDAR

## 1932-1933

**WINTER TERM, 1932:**

| | | |
|---|---|---|
| January | 2-4 | Registration. |
| January | 5 | Instruction begins. |
| January | 29 | Examinations for removal of conditions. |
| February | 15 | Enrollment of new students for pre-spring term |
| March | 18 | Final examinations begin. |
| March | 24 | Winter term ends. |

**SPRING TERM:**

| | | |
|---|---|---|
| March | 26-28 | Registration. |
| March | 29 | Instruction begins. |
| April | 29 | Examinations for removal of conditions. |
| May | 9 | Enrollment of new students for pre-summer term. |
| June | 13 | Final examinations begin. |
| June | 17 | Spring term ends. |

**SUMMER TERM:**

| | | |
|---|---|---|
| June | 18-20 | Registration. |
| June | 21 | Instruction begins. |
| June | 29 | Examinations for removal of conditions. |
| July | 4 | Independence Day. |
| August | 19 | Summer recess begins. |
| September | 5 | Instruction resumed. |
| September | 19 | Final examinations begin. |
| September | 23 | Summer term ends. |

**PRE-FALL TERM:**

| | | |
|---|---|---|
| Sept. | 3-5 | Registration. |
| September | 6 | Instruction begins. |

**FALL TERM:**

| | | |
|---|---|---|
| Sept. | 23-24-26 | Registration. |
| September | 27 | Instruction begins. |
| October | 28 | Examinations for removal of conditions. |
| November | 7 | Enrollment of new students for mid-winter term. |
| November | 24 | Thanksgiving recess begins. |
| November | 28 | Instruction resumed. |
| December | 15 | Final examinations begin. |
| December | 21 | Fall term ends. |

**WINTER TERM, 1933:**

| | | |
|---|---|---|
| January | 3 | Registration. |
| January | 4 | Instruction begins. |
| January | 27 | Examinations for removal of conditions. |
| February | 20 | Enrollment of new students for pre-spring term. |
| March | 27 | Final examinations begin. |
| March | 31 | Winter term ends. |

**SPRING TERM:**

| | | |
|---|---|---|
| April | 1-3 | Registration. |
| April | 4 | Instruction begins. |
| April | 28 | Examinations for removal of conditions. |
| May | 15 | Enrollment of new students for pre-summer term. |
| June | 19 | Final examinations begin. |
| June | 23 | Spring term ends. |



# FACULTY

of the

## SCHOOL OF ENGINEERING OF MILWAUKEE

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JOHN D. BALL, B. S., E. E., Ph. D., Educational Director, and Professor of Commercial Electrical Engineering

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Assistant Professor of Mathematics

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Instructor in Electrical Laboratory

MORRIS W. THOMAS,
Chief Radio Operator WISN



# A Great New Profession
# Commercial Radio Engineering
## Offers the Ambitious, Industrious Trained Man Boundless Opportunity for Rapid Advancement

### THE COMMERCIAL RADIO ENGINEER

The Commercial Radio Engineer is a man who combines the practical application of sound business training with skillful technical knowledge of radio. He is a technically trained business man—definitely, intensively fitted to deal with the problems arising in the progress of this great industry. He is at once an engineer-salesman, a consulting radio engineer, a technical expert and a super-emergency man. He is both a professional man and an executive. He is always a key man in a radio organization. Upon his judgment rest weighty decisions. He handles problems of designing, planning, organizing, purchasing. He negotiates big propositions. Today he may be directing the efforts of his laboratory staff in the creation of new radio products. Tomorrow, he may be making recommendations for expansion of operations or directing the formation of new advertising and selling campaigns. Again, he may be consulted by financiers regarding reorganization or expansion of an enterprise. He occupies a high position among his fellows, is looked up to and respected in his community. He is the man who handles big problems with the sure success that comes of the use of proven knowledge in his line of endeavor. He is, of course, well paid—often drawing a high salary or sharing liberally in the profits his superior direction creates.

### WORLD-WIDE OPPORTUNITY

Such a calling challenges the efforts of the most intelligent, ambitious and industrious young man. It will vie with all the other professions in attracting young men of this type. It offers him opportunity for service, fame and fortune that is unexcelled. It offers him chances for contact with the leaders of the radio and related industries.

There is a great and definite demand on the part of the business and industrial world for engineers of broad capacity—for business men with technical knowledge—for technical men with business knowledge. Business is rapidly becoming an exact science—divorced from gamble and guess-work. Capital is cautious. New standards of efficiency are being brought to bear. Operations are becoming so large that often millions are involved in only a slight change in the policy of a large concern. To formulate plans for such changes,

to make decisions upon them, calls for the very highest type of engineer-trained business men . . . Men who know values . . . Men who can take a mass of facts, dug out in research, and cast them into a practical campaign of action . . . Men who know not only the manifold ramifications of merchandising and selling, but the principles upon which such successful operations rest . . . Men who know the inter-relation of industry and finance . . . Men who know the principles of economical mass production . . . Men who, by virtue of their engineering training, are not staggered with figures but approach mathematics as a handmaiden to sound economics.

When the history of radio is written years hence, it will show that the Commercial Radio Engineers have played a large part in controlling and developing it into a lasting place in the annals of civilization. A highly technical subject, it will have naturally drawn to its operation and expansion these technically trained men.

## WHO MAY QUALIFY FOR THIS CALLING?

Any young man of normal intelligence may qualify himself as a Commercial Radio Engineer. The prime requirements are a sincere and earnest determination to master the training required and industry enough to match the opportunities open to him. Thousands of young men who have been graduated from School of Engineering of Milwaukee have stepped out into industry and are holding responsible positions, having passed with flying colors many men who lacked vision enough to provide themselves with a technical education.

It is not to be expected that a student will be sought out for the presidency of a concern the minute he leaves school. But, there are countless opportunities to enter well-paid jobs which are stepping-stones to higher executive positions.

## A FASCINATING LIFE'S WORK

You young man who are struggling along, trying to get a footing with nothing to recommend you but ambition and energy—you who are conscientiously trying to select the right life's work—give serious consideration to making yourself a Commercial Radio Engineer. Enter a profession yet young and uncrowded with able men. Take up a fascinating career that reaches into the homes of the millions. Embrace a calling that may take you to the farthermost reaches of civilization. Fit yourself for a vocation that may bring you the richest rewards in money, fame and enjoyable activity.

If you hesitate, if you are uncertain, if you do not fully understand the duties and opportunities of this big new profession, write to the School of Engineering of Milwaukee. It is the business of this school to help men get started on the right track and stay there. You are under no obligations if you ask advice. Your success is our SUCCESS.



IN ONE SHORT YEAR YOU CAN BECOME A

# Commercial Radio Engineer

## QUICK, THOROUGH, PRACTICAL TRAINING THROWS WIDE OPEN THE DOOR OF OPPORTUNITY IN THIS FASCINATING FIELD

It seems fitting that it should be possible to obtain a thorough, practical training for this great new profession in a remarkably short time. The keynote of radio is speed—annihilation of distance! In one short year, here, you may completely master the courses in Commercial Radio Engineering.

When you consider that most professions require from two to six years to complete the training, and then contemplate all that Radio offers, the urge to enter this great calling in this way should become irresistible. You are not to confuse this training with the so-called courses in radio offered for completion in a few months.

## AIM AT THE BIG THINGS!

If you expect to rise to any height in the world, aim high! Shoot at the big things and even if you fall short, you are bound to carry off a good prize. If you aspire only to modest estate, you will never reach the high peaks of success. If you are going into radio, make up your mind that you are going to get into it right and rise to the biggest position your native ability, training, health and determination will let you. That means set your goal to become a Commercal Radio Engineer.

When you have so prepared yourself, you will find the door of opportunity in this fascinating field of endeavor swung wide open to you. You will be able to side-step the long apprenticeship faced by untrained men. While you will likely not be immediately welcomed to a high executive position when you have graduated, you can command a better than average starting point. Your training will then make itself felt and your rise will be as rapid as your ingenuity, application to duty and determination can make it.

## YOU BECOME AN EXPERT

The distinguishing feature of School of Engineering of Milwaukee training is thoroughness. First, you will be intensively grounded in the theory of reception, metering and testing and D-c and A-c theory as applied to radio. In the meantime, you will be drilled in mathematics. Following this, you will be given a comprehensive laboratory training in these subjects, working with the same type of equipment you will meet with in practical work in the field. You will then study transmission, and direct and alternating current motors and generators as well. And, you will not only get the theory of broadcasting, but by virtue of the school ownership of broadcasting stations WISN and W9SO, you will get real and actual observation of application of theory in practice.

## A VERY INTENSIVE TRAINING

Upon this groundwork, you proceed to speech amplification and synchronized pictures. Next, you enter radio layout and design. You will also cover Radio Telegraphy and Code Instruction, if you desire it. Here you will

have exceptional facilities for practice through the Amateur Station W9SO, one of the most famed "ham" stations in the world.

You will be given a short, interesting course of instruction in Commercial English. This will give you a good grounding for proper speech and effective expression in composition. Many brilliant men have fallen far short of their possibilities because of their inability to express themselves in clear, convincing diction. This instruction is the result of years of experience in the engineering field and treats the subject from the angle of an engineers' needs. The Commercial Radio Engineer comes in contact with other high grade men and he must be fitted with the proper speech and presence to find his proper place. Last, but by no means least, you are given commercial training. This reaches from sound principles of business organization to merchandising and selling.

## BE READY FOR A REAL JOB

With such a background, you will know the radio industry. During your training, you will enjoy the seminar sessions given over to roundtable discussion of the radio art and the developments in the industry.

On completion of this fascinating, intensive training, you will step forward with full confidence of your understanding and knowledge of the radio business in all its branches. You will be able to enter a radio organization from a retail store to a large manufacturing plant and know not only what to do, but how to do it right and why. Your judgments and decisions will be based upon exact technical knowledge and full understanding of the principles involved. You will be fitted to occupy a position of responsibility and have thrown before you a brilliant future in this great billion dollar industry.

Do not think that you can enter business, commerce or industry today with a good rudimentary education and expect to "work up" with any degree of success. Trained men are what are needed today and business has no time any longer for training raw recruits. This is a day of big business, vast, highly departmentalized organizations, each division headed by a trained specialist. Men for these executive positions are selected from men who are trained.

## OPPORTUNITY BEYOND MEASURE

Never in the history of American business was the opportunity so great for the engineering-trained specialist. Men, who have been trained in a technical knowledge of the art or science involved, plus principles of sound business practice; Men of well-rounded judgment; Men who know technicalities and how to apply them in business and commerce. Such a man is the trained Commercial Radio Engineer. He enters a new field, a giant in size already, but one in an embryonic state of development, offering boundless opportunity for expansion.

The greatest entertainment industry in the world is radio . . . No longer a fad, but an acknowledged, demanded comfort of modern living . . . Millions of listeners . . . Millions invested in it . . . What a limitless field for progress, opened wide to the man who has the vision and courage to prepare himself for it!

## RADIO CHAINS PROSPERING

While nearly all other forms of business and industry were suffering a slump in 1930, the National Broadcasting Company received 50 per cent more money than in 1929. Receipts totaled $22,000,000. The company served 263 "clients" or advertising sponsors during last year, an increase of 54 over the previous year. Proof of the old saying that "time" is "money" is impressively demonstrated in radio broadcasting. Radio advertisers now must pay



$20,000 for an hour's broadcast over the coast-to-coast chain of the two big systems.

## THE RIGHT TIME IS NOW!

Will you sacrifice this great opportunity? Will you let the comparatively small cost in money and time stand in your way of reaching a high position in this wonderful calling? Will you be lead aside by immediate promise of some kind and miss the main issue of your life? Or, will you take time and opportunity by the forelock and start immediately upon the highway of a brilliant career in this fascinating field?

Become a Commercial Radio Engineer now! You will never find a better time to enter this great profession.

# Radio of Tomorrow

## THE DREAMS OF TODAY ARE THE REALITIES OF TOMORROW UNDER THE MAGIC TOUCH OF THIS WONDER-WORKER: THE ENGINEER INDUSTRIALIST

### Prepare Yourself Now to Take Advantage of This Unparalleled Opportunity!

What is ahead in radio, exhausts the imagination of the keenest mind. Yet, it is rationally given us now to foresee amazing and revolutionary developments and applications of this new art.

In 1922, broadcasting of voice and music burst forth to startle the world! Public demand for reception equipment knew no bounds. So generous was this wide-spread acceptance that the art grew and prospered with amazing speed.

With this new era of Radio Transmission and Reception has come a demand for more able men in the technical division of the art. Competition in the market between manufacturers is keen. Quality, refinement, development of design and perfection of integral parts are demanded.

This has brought a pressing demand for technical experts who, by virtue of their proficiency in the theory and practice of electricity as it is used in radio, may advance the art to higher standards. The crude practices of yesterday are giving way to scientific methods of design, production and maintenance.

### Some Facts and Figures

Let us look at some figures as they apply to radio today. Reliable authorities estimate the number of sets in use at about 12,000,000. It is estimated that these sets in use employ about 96,000,000 tubes. About 69,000,000 tubes were sold last year and about 84,000,000 are planned for the ensuing year. The total sales for all radio products last year were estimated at $842,548,000! Conservative estimators foresee a billion dollar volume for next year!

About half of the American people today enjoy radio, yet only half of the homes have receiving sets. Many of these sets are already obsolete and will be replaced by modern receivers.

## Watch Radio-Telephony

Observe the vast development in telephony, but also realize that some day there might not be any telephone wires! See the replacement of manual operators with the mechanical automatic switchboard. Witness the perfection of long distance talking and now wait for its economical operation, so that to talk across the continent will be as casual as a two-mile call today!

Dream, if you will, of the vast possible expansion of radio inter-communication in the operation of transportation systems, flying, governmental activities, industrial and commercial enterprises!

## Expert New Radio Design

Observe the radio set of tomorrow. Will it be the complicated, bulky device of yesterday? It is reasonable to expect that it will be greatly simplified and presented in some more attractive form. Radio design today, perhaps, stands in the same position that the automobile did when that machine was made up of a motor installed in a high wheeled buggy. This change in itself will bring a vigorous, far reaching new stimulus to the industry.

## Great Possibilities in Sound Amplification and Public Address Systems

Try to compass the vast possibilities of the application of Sound Amplification or Public Address Systems to industry, commerce and transportation! Already, we see a remarkable activity in this direction, but the start has only been made. Group reception and reproduction of broadcast will be common. Community dissemination of learning and entertainment will be wide spread. Herein lies a great field in itself which will command the efforts of thousands of accomplished, trained radio engineers.

## Television Around the Corner

TELEVISION—What a magic word that is! How it fires us with anticipation of the time when vision in motion is instantly transmitted from a single happening to all the world! Sight and sound together! Television is yet in the laboratory. Just when it will emerge into practical reality is not definitely known. The public wants it and stands ready to pay the price for it. What the public wants it gets. Television will come. When it does come, it will make the sensation of radio pale into a commonplace. Countless thousands of new trained men will be employed in its building, exploitation and service, and countless new fortunes will be created.

## The Light-Sensitive Cell

Consider the application of the "electric eye" to industry, to commerce, to government and domestic life. There has already been much activity in the application of the light-sensitive cell to machinery control in the cigar, textile, metal and other lines, but the surface of the possibilities has not been scratched. "Some day soon," says an eminent engineer, "light switches will be replaced by the light-sensitive cell." Here alone is a field that should inspire the engineer and bring to him thrilling satisfaction and remuneration for his efforts.

## Vacuum Tube Uses in Infancy

The use and extension of application of the vacuum tube is in its infancy. Almost daily, new discoveries are made in the great experiments that are being conducted by engineers the world over. For example, Dr. Tesla has



announced that he has perfected tremendously powerful rays that penetrate for miles through solid substances by means of a new high potential cathode tube.

The press also reports from Dr. Tesla that he has in process of creation a radically new airplane. In place of gas and oil tanks, this plane will carry an antenna, picking its power from directed currents of electricity through the air. This plane will rise and descend in a vertical line. The ship itself is light in weight and may be stored in a garage if desired, like an automobile. Who knows but that will be the air "flivver" of which we hear so much banter and conjecture? Patents on some of the features have already been granted, it is said.

## The End Cannot Be Foreseen

Go on and on, indefinitely, if you will. We cannot vision the vast expansion of the application of radio in the life of the future. It seems a boundless field, staggering our fancy to compass it.

What does this mean to the young man selecting a calling? Just this. Here is a field of endeavor treating with a power that bids fair to revolutionize the habits and life of civilization, yet in an embroyonic state. It awaits the magic hand of the engineer-industrialist—the Commercal Radio Engineer. Opportunities are lying dormant until grasped and developed by these wonder-workers who not only perfect the mechanics, but adapt them to the practical needs of business and commercial life.

# Radio Opportunity

The radio industry in the United States now provides employment for approximately one million persons. Of course, the work of some of these persons requires no further knowledge than how to use a screw-driver or a soldering iron. But the demand for this type of worker is rapidly decreasing, and the better paid positions for radio men increasingly demand a more thorough knowledge of the principles of radio.

## Extensive Openings for Trained Radio Men

Among the positions now requiring technical training are:

In RETAIL organizations—Radio Serviceman (Radiotechnician) radio service manager, salesman, sales manager.

In WHOLESALE distributing organizations—Radio serviceman, radio service manager, repair department manager, traveling sales serviceman, sales manager, radio buyer.

In MANUFACTURING concerns—Assistant in engineering department, radio engineer, chief engineer, inspector, testor, chief of testing department, repair department manager, traveling sales serviceman, sales manager, installation engineer of talking moving picture equipment and public address systems.

There are many hundreds of radio manufacturers, about 1,500 wholesale houses, and 20,000 to 30,000 retail radio stores in the United States.

Since the development of the talking moving picture, a new field for the trained radio specialist has opened. Large manufacturers of talking picture equipment now employs many School of Engineering graduates in the engineering and service departments.

Some of the openings in the radio field are:

### Manufacturing

Engineers needed to develop and perfect new designs, new and better circuits, more efficient methods of production. Thousands of executive jobs here for trained men in creation, design, inspection, testing, etc. Mass production is demanding the direction of trained men in operations. Expansion of plants and markets await men equipped to plan, organize and promote with assured success. Scores of high executive positions going begging right now for the want of trained men to fill them!

### Broadcasting

Hundreds of big stations, already established, but ever vying with one another to excell in the quality of their output electrically and as to entertainment value. Millions being spent in advertising through the air, assuring a secure economic basis for operation and expansion. Engineers needed to direct operation, devise and build new and better instruments and to promote and expand the influence of each station.

### Television

Already bidding fair to enjoy a more sweeping popularity than did audible radio. Yet in the laboratory stage, beckoning for engineering brains to perfect and bring it forward to reality. Millions of capital ready the instant practical methods of broadcast and reception can be perfected.

### Talking Pictures

An established success, yet only in its first stages of development. It has revolutionized the entertainment industry. Later it will be felt in the commercial world in selling and promotion. Under this head, we include the new field of Public Address or Sound Amplification Systems. Group radio installations involving the expenditure of millions of dollars. A budding new field that will bring countless new opportunities to the men who enter it with the proper training behind them.

### Merchandising, Advertising and Selling

So intimate is the relationship between techincal quality and the marketable popularity of radio, that a high type of sales promotion man is needed in its exploitation. The engineering-trained type of salesman, or planner, or merchandiser. A highly technical subject, demanding advertising men who know the art in order to do the right job. Keen competition that requires efficient, sure-fire campaigning to survive. A fascinating field of endeavor for the Commercial Radio Engineer.

### Self-Owned Business

The man who successfully sells today is the man who KNOWS his product and employs sound, proven principles in his operations. There are many opportunities for men in radio retailing who approach their store operation with a definite training for it. They take success by the forelock and side-step the floundering, stumbling methods of the untrained, uneducated store operator. When Television comes, many new fortunes will be made in this field.

### Radio in Aviation

The application of radio to aviation is yet in a primitive stage. Even so, right now there are countless good jobs as operators of beacon stations, operators in weather report stations and so on. All leading airports are fast being equipped with sending and receiving stations for the control of traffic in the air. Here is a fascinating branch of this great industry offering golden opportunities to countless trained men.



### Radio Operators

Great liners keep in touch with the world and the weather by radio. To the fellow who likes adventure and travel, this calling offers a thrilling field. Trans-oceanic radio telephone and telegraph service is established. Great expansion in this service lies directly ahead. Transmission of pictures by radio is fast reaching a state of perfection and is likely some day to revolutionize this angle of industry.

### Service and Repair

A vital part of radio merchandising. Engineer-Executives are needed to direct the efforts of thousands of service men in the field. This division of radio is admittedly not yet upon a properly established basis and awaits the hand of men able to organize it upon a sound basis.

### Remote Control

Remote Control is not a thing of the future alone, but has already been demonstrated. In a recent article in the American magazine, Dr. W. R. Whitney, who is in charge of research for the General Electric Co, stated it would be but a short time when airplanes would be directed in flight by the setting of a delicate instrument on the dash board, and when they had arrived at their destination they would be brought to a safe landing by remote control. The remote control of motors, airplanes, and automobiles has already been accomplished experimently and many possibilities lie in the future. The student thoroughly grounded in the principles of radio and the theory and properties of the photo-electric cell possesses the fundamental knowledge necessary in this important branch of science.

# Course of Instruction in Radio

## AT THE SCHOOL *of* ENGINEERING

Early in the fall of 1925, the School of Engineering of Milwaukee inaugurated its Radio Course. The school had included instruction dealing with science of wireless communication in its courses for many years, having, in fact, been one of the pioneers in this particular phase of Electrical Engineering. In accordance with its policy of constantly adapting its curriculum to the practical needs of the electrical industry, the school immediately included a complete course of instruction in Radio, when it became evident that radio had come to stay, that it had passed the experimental stage and was rapidly becoming a vital factor in the industrial and economic affairs of the entire civilized world.

### The Course Intensive, Complete

The young man taking the Radio course at the School of Engineering learns all that he should learn to become proficient in radio; he learns it thoroughly because completely equipped laboratories allow him to apply all that he acquires in the classroom, and he learns it in the quickest possible time because all unnecessary and irrelevant matters have been left out of the course of study.

### LABORATORY FACILITIES

That the student may have this practice every day, from the time he begins his course of instruction, he not only has access to a special radio laboratory, but, in studying the relation of A-c and D-c circuits to radio, he has the use of the complete electrical laboratory of the school, valued at several hundred thousand dollars.

In this are found a great variety of motors and generators of all types. Specimens of the best known and most highly efficient testing sets known to the world of radio are available to those ready to use them and various elementary testing media are made and their accuracy verified by the students in their laboratory practice.

That the student may not lose sight of any of the essentials as they are placed before him from day to day, he is taught to compile a fully detailed record of his class and laboratory work, and a frequent check is made of these records by the instructors.

Frequent use is made of manufacturers' bulletins in addition to the lesson texts, so that every recognized aid is given the student in acquiring that very desirable combination of theoretical and practical knowledge needed to make him truly a RADIO EXPERT.

### Great Need for Trained Men

As an example of the need of trained men let us study the condition in Wisconsin. There is a great need for Class "B" and Class "C" men. When the 1926 radio business began to develop, not enough trained servicemen were available, and this condition had not greatly improved. The Trade Association office was swamped with requests for men. It is conservatively estimated that 150 more trained men could have found employment in the City of Milwaukee alone. As it was, radio dealers had to be content to hire men and boys who had a smattering of radio knowledge, and trust to luck. Results, as might be expected, were far from satisfactory.

Is this shortage likely to continue? Yes, and it will be greater from year to year unless more men avail themselves of the opportunity to become trained. These are the reasons why the shortage will increase:

FIRST, the radio business is growing, constantly and rapidly, requiring more and more workers.

SECOND, every year a large number of trained radio servicemen are promoted to higher and more lucrative positions. Some become salesmen; some go into business for themselves; some are absorbed into the engineering departments of manufacturing companies.

What is true in Wisconsin is true in every state in the Union and in other countries.

The School of Engineering graduate being thoroughly grounded in the fundamentals of the subject, he will be a progressive member of his industry, because he will have no trouble in following the new development in the field occurring after his graduation.

## AMATEUR AND COMMERCIAL BROADCASTING AT THE SCHOOL OF ENGINEERING

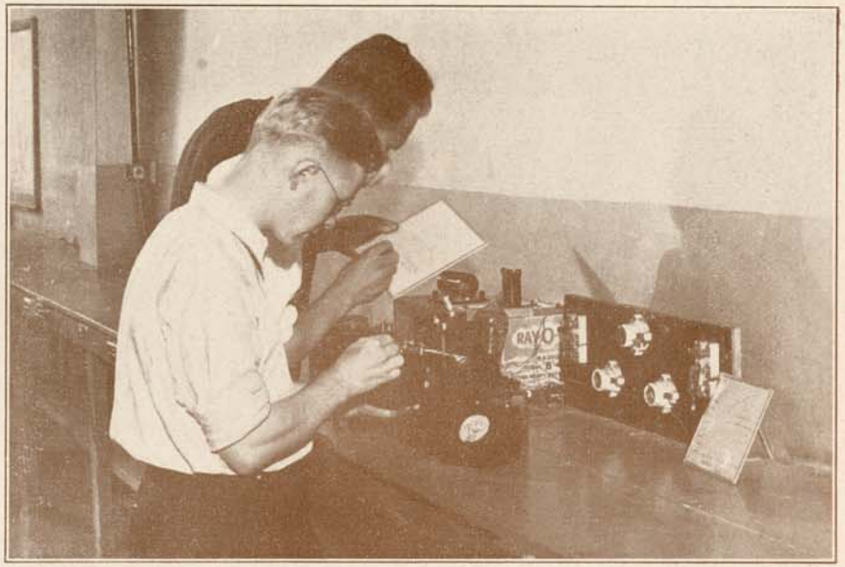
### Students Operate Amateur Station

Licensed Amateur Station, call letters W9SO, is operated exclusively by students who are members of the Radio Club. It not only enables them to put into actual practice their radio knowledge acquired in the classroom and laboratory, but it also keeps them constantly aware of the fascination and romance of the modern subject they are studying.

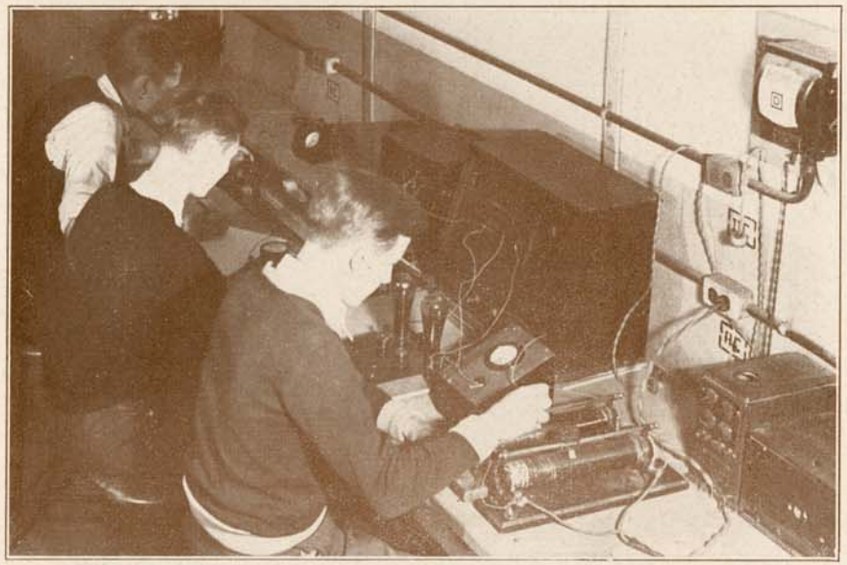
The Station is also a part of the College Radio Union. The purpose of this Union is to promote a closer relation between the college radio clubs of the country, and to broadcast college news, such as results of athletic activities.

Because of its previous wide experience and range, W9SO, the School of Engineering Station, has been chosen as the key station of the Western sec-

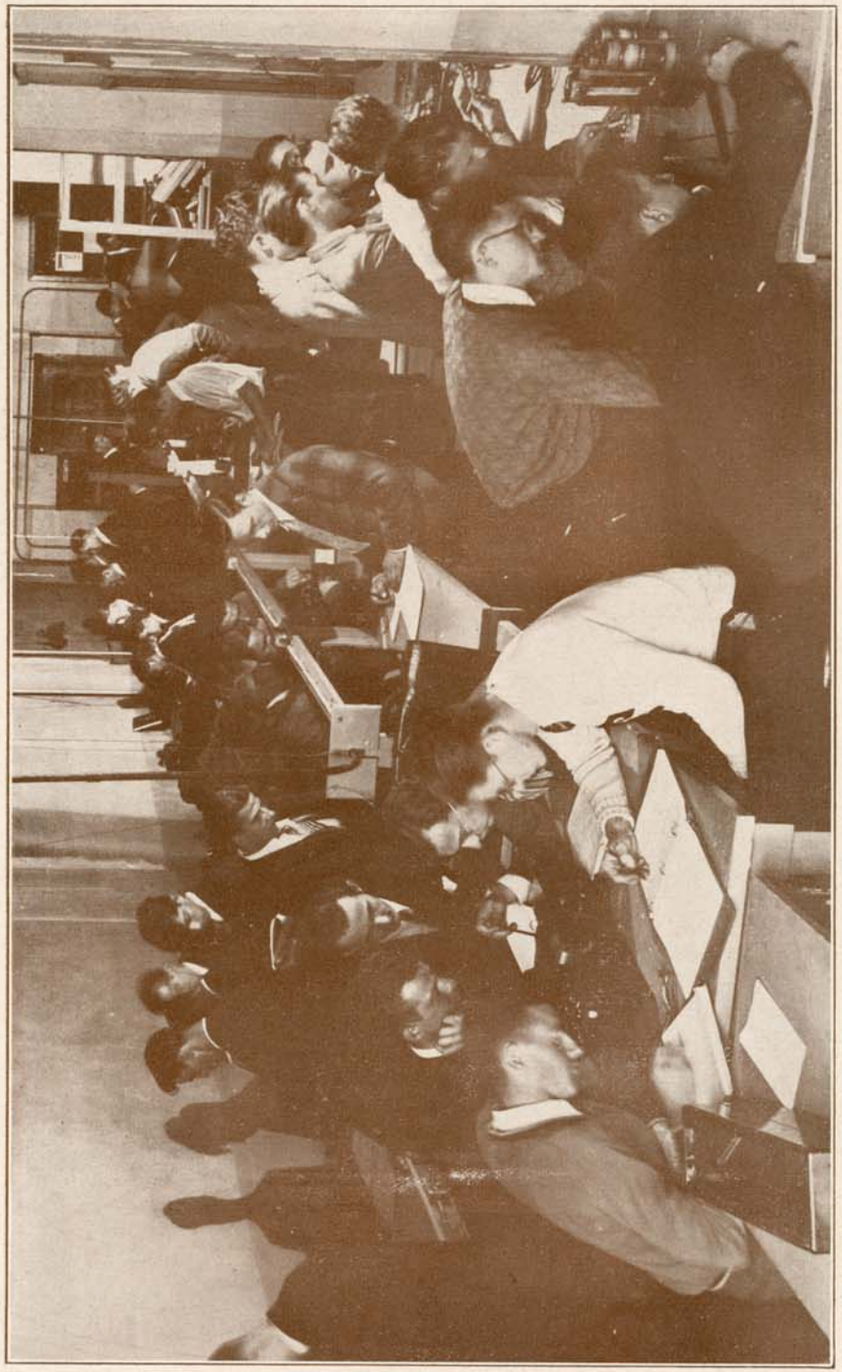




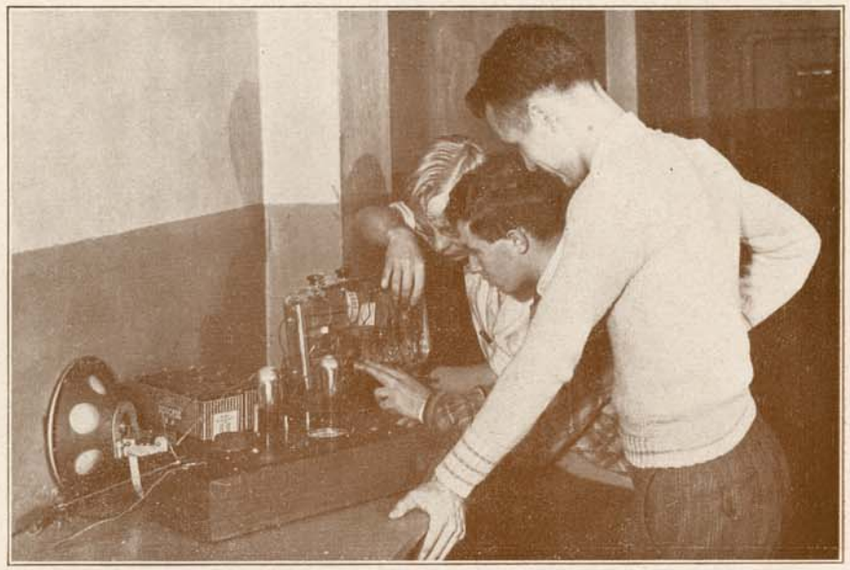
RADIO RECEPTION—AN EXPERIMENT IN RADIO COUPLING



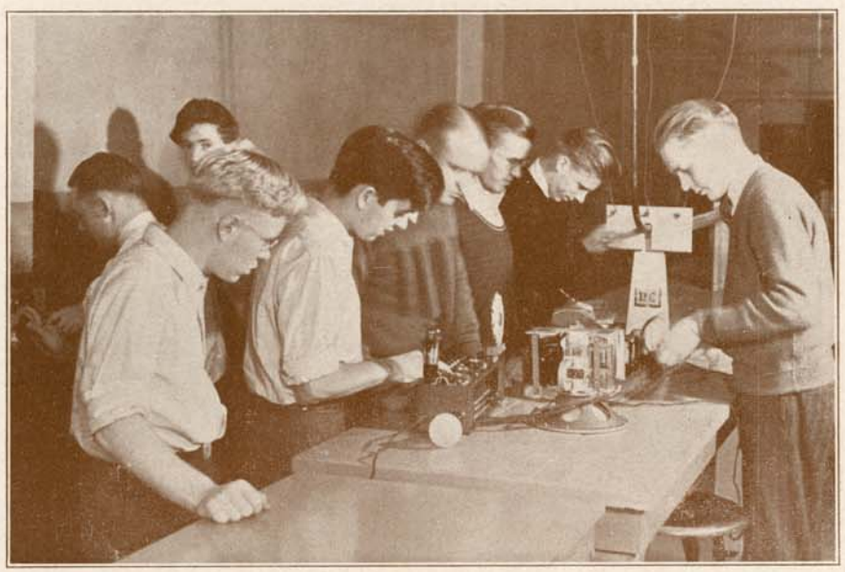
RADIO RECEPTION—TESTING RECTIFIER TUBES FOR POWER PACKS



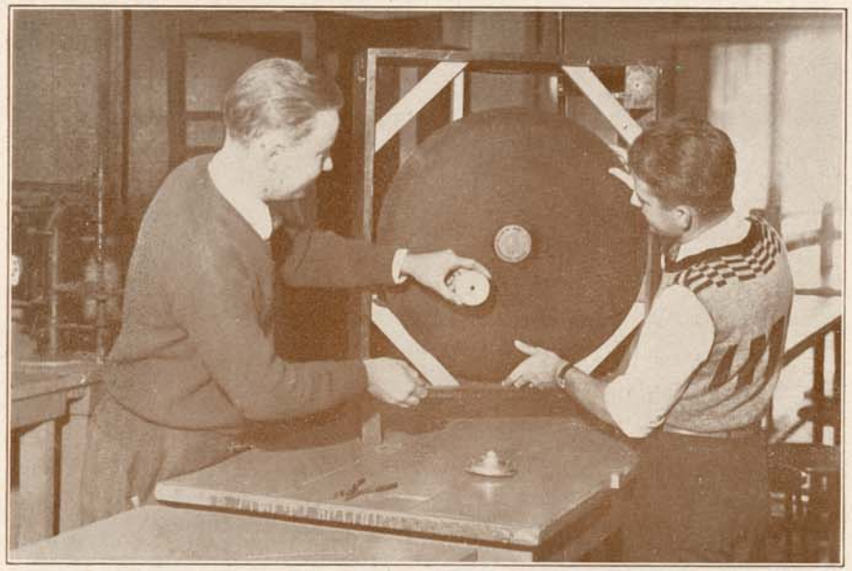
A GENERAL VIEW OF THE RADIO RECEPTION LABORATORY



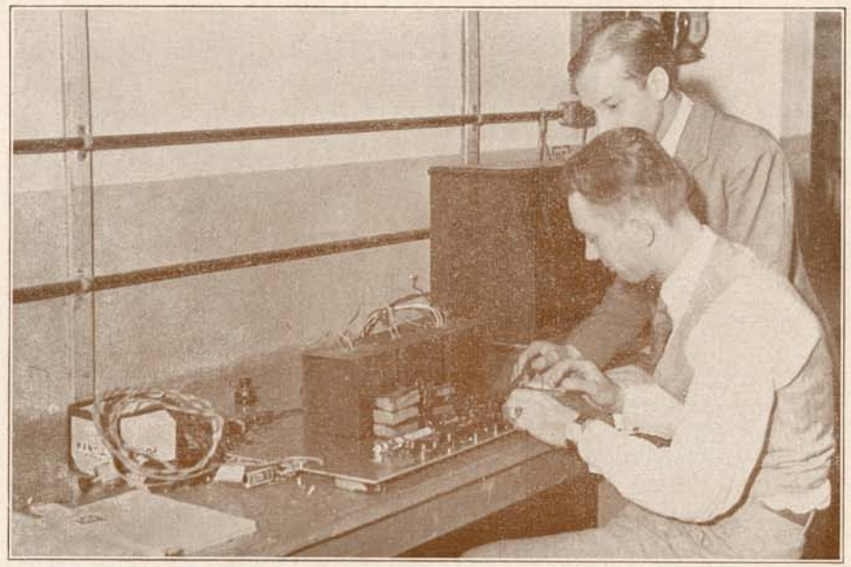
RADIO SERVICING—ALIGNING A TUNED CIRCUIT OR "BALANCING" A RECEIVER



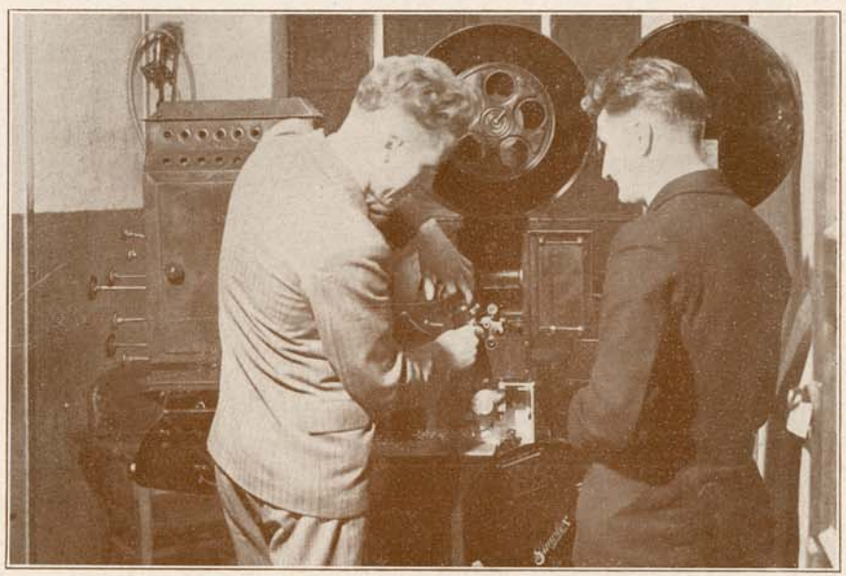
RADIO SERVICING—LOCATING FAULTS IN A RECEIVER BY MEANS OF A TEST KIT



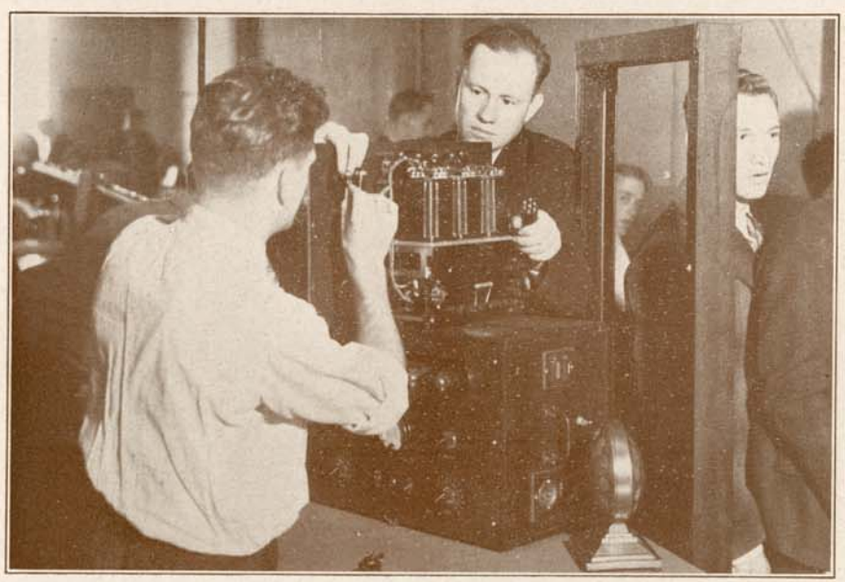
TELEVISION—INSTALLING A TELEVISION SCANNING DISC



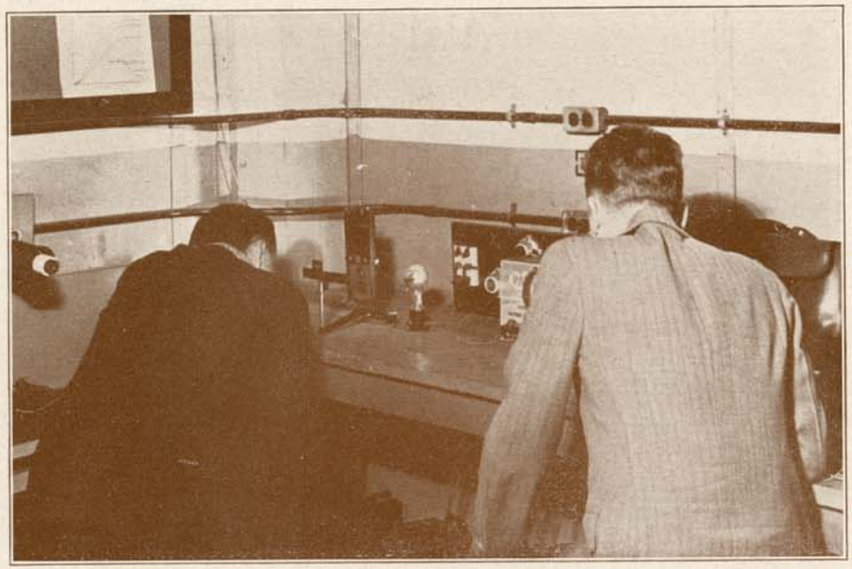
SPEECH AMPLIFICATION—BUILDING A SPEECH AMPLIFIER



TALKING MOVIES—THREADING A SOUND FILM IN A PROJECTOR

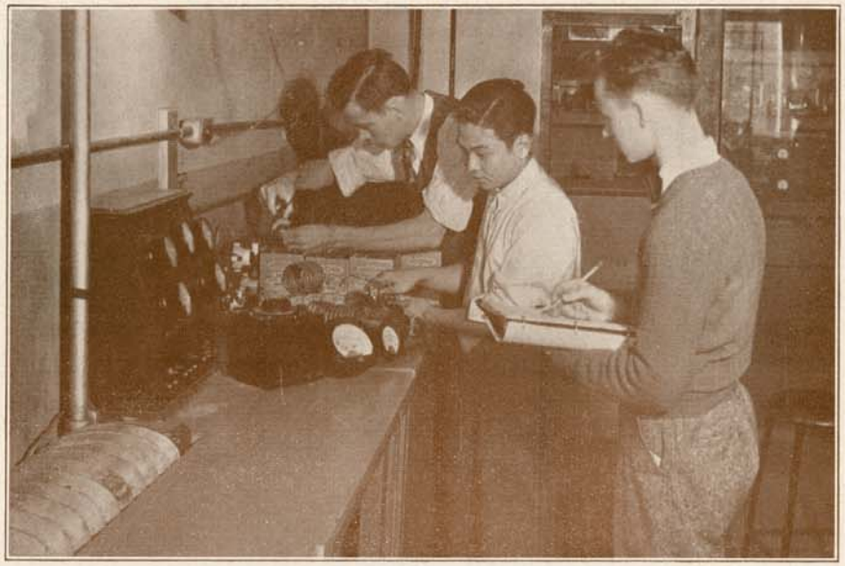


SPEECH AMPLIFICATION—PREPARING AMPLIFIER UNIT FOR RELAY RACK MOUNTING

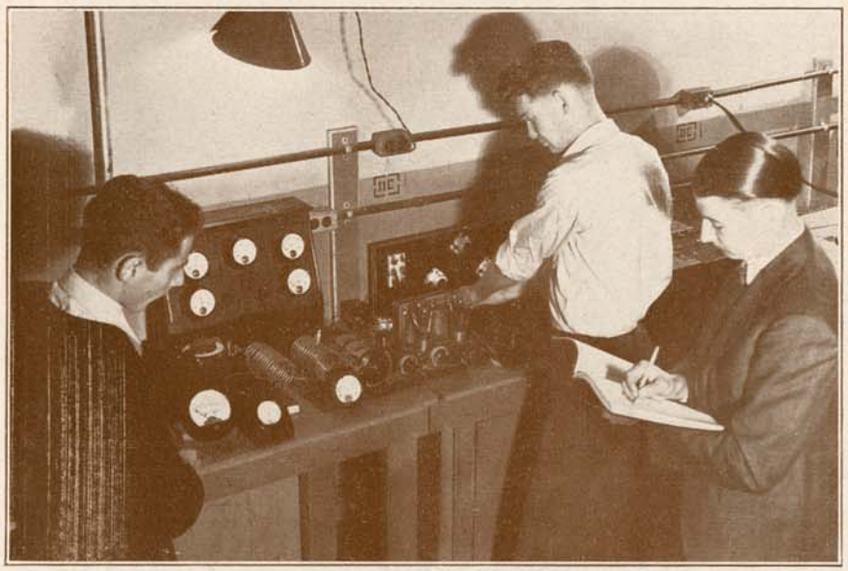


THE PHOTO-ELECTRIC CELL-MEASURING RESPONSE OF A PHOTO-ELECTRIC CELL OR "THE ELECTRIC EYE" SO ESSENTIAL IN TELEVISION, PICTURES BY WIRE, ETC.

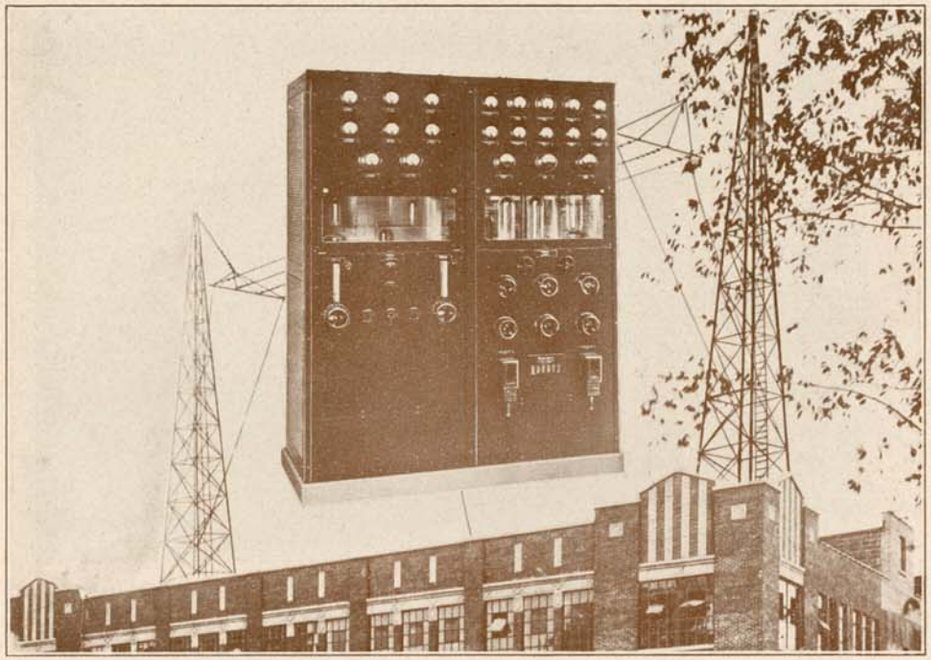
THE GLOW TUBE—DETERMINING CHARACTERISTICS OF A TELEVISION GLOW TUBE



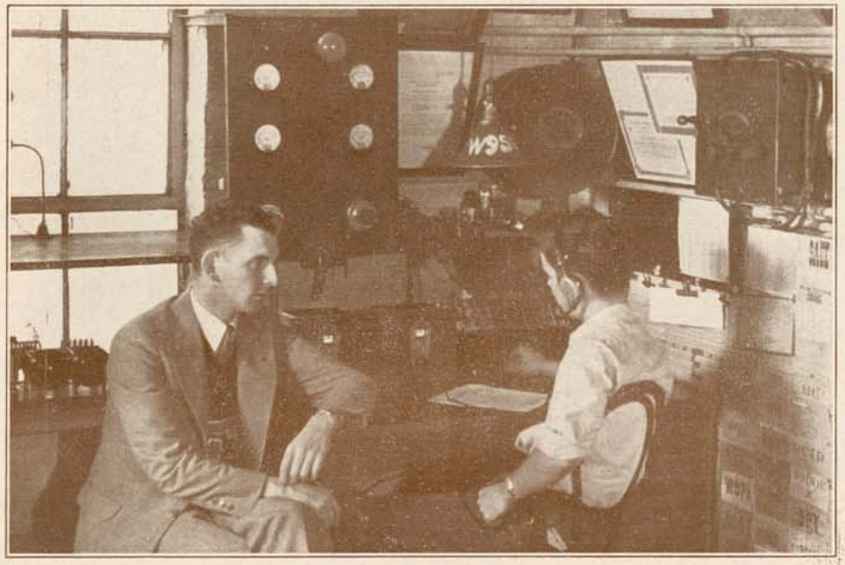
RADIO TRANSMISSION—BUILDING A HARTLEY TRANSMISSION OSCILLATOR



RADIO TRANSMISSION—DETERMINING PERCENT MODULATION OF RADIO TUBE TRANSMITTER



THE TOWERS OF BROADCAST STATION WISN. INSERT—WESTERN ELECTRIC NO. 6-B RADIO TRANSMITTER ASSEMBLY AS INSTALLED IN WISN.



ON DUTY IN THE STUDENTS' "SHACK" W9SO

tion—practically all of the United States west of the Allegheny Mountains, Alaska, the Hawaiian Islands and the Philippine Islands. This area was organized by William P. Gainer, Chief Operator of W9SO. The plan of organization calls for one university or college radio club, in each state, of sufficient power and schedule time, to act as a key station for all the communication of that state. These state key stations are in turn responsible to the section key stations, which together with the Executive Committee at Washington, controls the activities of the Union. A large number of colleges have become members.

## W9SO Reported Porto Rican Hurricane and Communicated with Commander Byrd Base

W9SO was the first station in the world to receive distress reports from Porto Rico during the recent hurricane there. Student operators picked up the messages after the Island had been cut off from communication with the outside world for almost 24 hours, receiving the signals sent from a sending set frantically rigged up by the operator at San Juan, Porto Rico. The message was immediately relayed to Washington, D. C., and on the following day, Admiral T. T. Craven expressed the Navy's appreciation in the following dispatch: "The Chief of Naval Operations desires to express his appreciation of the excellent work done by two of your amateur operators in copying and forwarding a radiogram from Porto Rico. Not only does this show very good operating ability, but the forwarding of the dispatch to the Navy Department indicates excellent initiative."

Station W9SO was also in communication with Commander Byrd's base station in the Antarctic region.

## Students Have Radio Club

Centering around W9SO, the students' Radio Club gives further impetus to practical activities. Organized by six licensed amateur operators attending the School, the Club built and now operates the Amateur Station W9SO and is affiliated with the American Radio Relay League, a national organization of amateur stations. With their own isolated club room, "Shack" W9SO, on the roof of the School building, and many of their 40 members owning their individual "Ham" stations, the Club acts as a center for the radio interests of all the students in the course.

## Operator's Government License

During the period spent in school, the student has ample opportunity to practice code if he desires, and may be well prepared to write the U. S. Government examination for amateur operators. With additional practice in code, graduates who have availed themselves of this opportunity, have had no difficulty in passing the examination for first-class commercial operators.

## Radio Broadcast Station WISN

The School of Engineering operates WISN, the 250 watt radio station in conjunction with the Wisconsin News, a large Milwaukee daily. This completely equipped station has recently added much new and thoroughly modern apparatus, including an automatic crystal control which keeps the station on its assigned wave length. A new speech amplifier of the most modern type has also been installed. Much of the broadcasting is carried on through remote control from important places throughout the city.

As this station is under the technical supervision of the school, radio students have ample opportunity to study the intricacies of a modern broadcasting station and the design, construction, and operation of transmitting equipment.

Besides its studio programs, it also furnishes chain features, being a member of the celebrated Columbia Chain.

# Wisconsin Radio Trades Association Servicemen's Registration

In 1926, the Wisconsin Radio Trade Association, under the leadership of Mr. Michael Ert, adopted the policy of examining, grading, and registering radio servicemen. This Association is composed of radio dealers and distributors of Wisconsin and the Upper Michigan Peninsula. Prior to 1926, a radio serviceman was hired on his own recommendation. Any enterprising young man who had built a few radio sets and who could give a good account of himself was hired. Members of the Association were soon to find, however, that many of these self-styled experts had little fundamental radio knowledge and that they often did more harm than good to the apparatus they attempted to install or repair. Their inexperience had the further bad effect of creating much ill-will among patrons.

The only remedy was to examine all candidates for service positions and grade them according to their ability. In that way, an employer could judge by the grade attained by each applicant just how much to expect of him in the way of efficiency on the job. The plan adopted consisted of classifying service men on three grades:

CLASS "C" MAN—A man having a knowledge of electricity and radio, but who has not had the practical experience can take the least difficult of the examinations and have the grade "C" assigned to him. Such men are considered competent to install aerials, to install A-c sets that have been previously tested, and to assist Class "B" men.

CLASS "B" MAN—The next more thorough examination is taken by men having more knowledge of radio and electricity, and who have had experience in the field. Class "B" men possess the ability to do general service work, to locate and remedy trouble in radios, to install A-c and battery sets—general all-around service men. The "B" examination is not entirely technical, but rather is designed to determine a man's practical ability. The holder of a "B" card would be classed as a first-rate practical man.

CLASS "A" MAN—Class "A" rating is given only to men who have had at least three years radio experience and who are capable of taking charge of a service department, able to construct testing equipment—real radio experts with experience. The association authorizes its examiner to give the Class "A" examination twice yearly, and only to men holding Class "B" cards. It is a very thorough and complete examination, demanding technical and theoretical knowledge as well as practical experience and application.

### School of Engineering Course Endorsed by Wisconsin Radio Trade Association

Soon after the inception of the School of Engineering Radio courses the Wisconsin Radio Trade Association recognized the service this course renders to the radio world in supplying trained, expert workers for the advancement of the industry. The association examined the courses, and some of its graduates, and the association's stamp of unqualified endorsement was set upon it, and Radio Servicemen's Registration Cards, Classes "B" and "C" were issued to all students satisfactorily completing the course and complying with qualifications required by the Association.

The Radio Advisory Committee of the School is partially composed of directors of the Trade Association, who are of great assistance in keeping the school's course constantly adapted to the practical needs of the modern radio industry.



### Class "B" and "C" Servicemen's Cards to School of Engineering Radio Graduates

Permanent arrangements have been made whereby any man who successfully completes the School of Engineering course in Radio, and thereby complies with the W. R. T. A. requirements, is entitled to the Association's Class "B" or Class "C" license for servicemen. So, besides his diploma or certificate, the School of Engineering radio graduate receives his Radio Serviceman's Registration Card, Class "B" or "C", issued by the W. R. T. A. This card gives its bearer a prestige in his business readily recognizable not only in Wisconsin, but throughout the United States.

In general, a student is usually qualified for a Class "C" license after three months in the Radio course and for a Class "B" license after six months.

For the convenience of students, the examiner representing the W. R. T. A. gives the examinations for "B" and "C" cards at the School of Engineering every three months at the completion of each school term.

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# General Information

## LOCATION

The School of Engineering of Milwaukee occupies a modern, fireproof building located on the corner of North Jackson and East Wells Streets.

The immediate surroundings are ideal, the building being directly across from a shady park with its cool elms, splashing fountain, and historic Courthouse. St. John's Cathedral, an old landmark of early Milwaukee, is on the corner opposite the school building. The tower of St. John's is regarded as one of the most beautiful pieces of architecture in the country. Picturesque Lake Michigan and the parks which border its shores are but four blocks from the school.

Although the school is located near the heart of the downtown business district, it is not far from a quiet residential section where students may secure comfortable rooms.

## THE SCHOOL YEAR

**The School Year**—The year is twelve school months in length. School is in session the entire year, with the exception of a two-weeks vacation in August. For convenience in the division of work and the admission of students at a properly advanced stage of the course, the school year is divided into four terms of three months each. New classes are formed at the beginning of each of these terms, and students may enter at the opening of any term, and commence work with a newly organized class, or with some advanced class for which it has been determined they are eligible.

## TIME REQUIRED

**Radio or Radio Technichian Course requires six months**—A graduate will have obtained a fundamental knowledge of electric circuits, the theory of radio reception, and commercial servicing. He would be qualified to

pass the Radio Trades Association examination for class "B" serviceman in conformity with the rules of the Wisconsin Radio Trades Association.

Graduates of this course possess the ability to qualify for general service and repair work, radio sales and service. They are able to locate and remedy troubles, install sets, test and assemble elements and circuits.

**The Radio Engineering Course requires one full year.** The first six months of the one year course covers the same ground as the six months course. The second six months comprise lectures and laboratory work on speech amplification, synchronized sight-sound pictures, D-c. and A-c. electrical theory applied to radio, D-c. and A-c. motors and generators, principles of salesmanship, radio broadcasting, transmission, and television.

Graduates of this course have a thorough knowledge of the principles of radio and will be qualified to take charge of a Radio Department in a retail organization, and perform radio service work in the field. The course prepares its graduates for practical work as engineers in installation of Public Address Systems; Synchronized Pictures of "talkie;" as Engineers; as all-around Radio Men, capable of taking charge of service departments, acting as sales representatives or sales managers, designing and constructing radio sets, inspecting and testing equipment, etc.

The time specified for these courses is based on all-day classes, five days per week. The courses may also be taken on the half-day plan, in which event the time required will be twice as long.

## DIPLOMA

Upon satisfactorily completing any course, a certificate of profiiciency is issued. If desired, a lithographed diploma will be furnished at a nominal charge.

## CURRICULUM

The subjects taught are those which are fundamental to an engineering knowledge in the opinion of hundreds of highly successful electrical engineers and educators who have been consulted freely. The arrangement of the subject matter is such that each term is a complete unit in itself. No matter how many terms a student completes, he will have a definite amount of both practical and theoretical knowledge which continually adds to his economic value and earning power.

In general, each subject is presented from a practical viewpoint, adding theory at a time when the need is realized by the student who desires further progress and at a time when he will understand theory rather than merely memorize statements.

The teaching methods are in conformity with the best practice obtained by study of all modern authorities combined with the years of experience on the part of the instructors. The aim and value of the study is known to the student, thereby his interest is held, and most rapid progress results.

## ADMISSION

For entrance to the Radio courses, it is desirable that the applicant have a high school education or its equivalent. A student who has not had a high school training will be assigned to classes which will enable him to carry on the work. In other words, the subjects in mathematics, outlined for the



high school graduate, will be replaced by subjects which will be in accordance with the qualifications of the applicant who had not attended or completed high school. In all other respects, the courses are the same.

## ADVANCED CREDIT

Students presenting advanced credits earned in a recognized college or university will be given credit for the same subjects at the School of Engineering of Milwaukee, provided, of course, that the ground covered is reasonably identical with the courses offered at the School of Engineering of Milwaukee.

## SUMMER SESSIONS

At outlined elsewhere, students may attend summer sessions of the school, which are so arranged as to give a complete one-term course of study, including subjects given during any other term in the year. This advantage is made possible by the fact that the curriculum is arranged on a term basis.

## REGULATIONS

The regulations of the School of Engineering of Milwaukee include only such rules as are necessary to the proper organization and operation of the school. It is expected that a student will be obligated, both by reason and loyalty, to observe such regulations as are published from time to time, since upon them depends the free and healthful activity of the institution whose benefit he seeks.

The general deportment observed in the building or on any property of the school is such as would be logically consistent with ordinary consideration and good breeding. The student's own conscience of what constitutes right and wrong is usually the only necessary guide.

Such delinquencies as tardiness, absence, deficiencies and offenses against good order are summarily dealt with; and students may be dismissed when, in the opinion of the faculty or administrative officers of the school, they pursue a course of conduct detrimental to themselves, their fellow students, or to the institution.

## STUDENT HEALTH

Located on the shore of the great Lake Michigan, and high in altitude, Milwaukee is one of the most healthful cities of America. It is also blessed with many other natural endowments and beautiful parks. It is in the heart of the broad, clear country for which Wisconsin is famous. Bathing beaches, skating lagoons, skiing facilities, and the surrounding chains of lakes allow for proper recreation for students, as well as provide healthful living conditions.

## STUDENT ADVISORY BOARD

The members of the advisory board and the faculty, being men of broad experience, are especially capable of giving advice to the individual student, and this advice is at all times available to any who may wish to benefit by it. While it is not the policy of the administration to intrude upon the personal affairs of the student body, yet the kindly sympathy and timely advice of the advisory board and faculty members have been of great asssitance to those students who have confided their personal difficulties in them. The school recognizes the situation in which young

men are placed upon leaving home, especially for the first time, and is keenly alive to the need of supplying such encouragement as may be required.

## INSPECTION TRIPS

The Radio classes at School of Engineering are taken on occasional inspection trips to the various radio stores, shops, broadcasting stations, and plants in Milwaukee, giving the student opportunity to observe the actual working of processes and methods of the industry.

The trips are taken under the supervision of the instructors in the Radio department, augmented by guides provided at each store or plant.

## SPECIAL HELP

When a student needs personal guidance in any particular branch, special attention by the faculty is given him along that line. Each student is given the assistance necessary to enable him to thoroughly grasp all details of the instruction. It is because of this thoroughness that the School of Engineering of Milwaukee has gained the reputation it enjoys today.

## PUBLIC LECTURES

The School is fortunate in being visited by engineers of national prominence who are secured from time to time to deliver technical and popular addresses to the students. The personal contact with these men is most beneficial in placing the student in closer touch with the trend of engineering thought.

## EMPLOYMENT

The School of Engineering of Milwaukee maintains an employment department which is in constant touch with the executives and employment departments of Milwaukee industries and outside concerns. The service offered to the registrant, indefinitely, in this department are four:

1. Part-time employment for the student wishing to earn part of his expenses while attending school. (While we invariably find suitable positions for all students we cannot guarantee them.)
2. Placement in suitable positions upon graduation.
3. Placement of the student or changes to his advantages after graduation.
4. Supplying former students, and others now occupying executive positions, with desirable employees from graduating classes.

## STUDENT AID ASSOCIATION

The Student Aid Association has been founded to place at the disposal of worthy young men the distinguished training facilities of the School of Engineering of Milwaukee. The student who is financially



handicapped may apply for a loan to help him through any term or course. It is not restricted to those in the last two years of college work.

Applications are considered in the order received and should be filed at least thirty days in advance of the term opening for which it is to be used. Security consists of the endorsement of one financially and morally responsible person. Loans are repayable in small monthly amounts, generally 10% of the face of the loan, after the student leaves school.

Those desiring to apply for a loan may secure the necessary forms by writing to the registrar.

## STUDENT ACTIVITIES

The need of healthful and profitable recreation and indulgence in student activities other than those designated in the curriculum is recognized by the officials of the School of Engineering. These activities are promoted by the authorities and members of the student body.

Social functions, too, are on the year's program, including student gatherings of various kinds, which are helpful to the young man's development.

Evening lectures and similar beneficial entertainments are provided by the school, as well as occasional public affairs in the various halls and theaters of Milwaukee. As a rule, no week passes without at least one program, applying to electricity, music, literature, or occasionally an evening of social entertainment. The lighter side of the student's life, that necessary auxiliary to school routine, is in sufficient abundance for the best welfare of a young man.

This school is always watchful of its students' conduct and no activity is permitted which is not conducive to the general advancement of student morale.

## SCHEDULE OF STUDIES FOR

**6 months Radio Reception**

**1 year Commercial Radio Engineering**

The six months Radio Course is especially adapted to prepare men for sales, service, manufacturing, and a general understanding of the principles of radio involved in radio reception, necessary mathematics being included in the course.

The Commercial Radio Engineering course carries the student through a second six months of radio which includes radio transmission, "talking movies," sound amplification, and television, together with the necessary mathematics and courses in direct current motors, and generators, and alternating current motors and generators.

# OUTLINE OF COURSES

## SIX MONTHS COURSE IN RADIO

### TERM 1

| Course | No. | Subjects | Periods Per Week* |
|---|---|---|---|
| Radio | 1 | Theory of Reception | 10 |
| Radio | 6 | Reception Laboratory | 10 |
| Radio | 11 | Fundamental D-c and A-c Theory Applied to Radio | 5 |
| Elect. | 2 | Electric Metering and Testing | 10 |
| Math. | 7x | Algebra | 5 |

### TERM 2

| | | | |
|---|---|---|---|
| Radio | 2 | Advanced Theory of Reception (Short Wave Reception and Design) | 10 |
| Radio | 7 | Advanced Reception Laboratory | 10 |
| Radio | 4 | Commercial Servicing | 10 |
| Radio | 12 | Advanced A-c Theory Applied to Radio | 5 |
| Math. | 8 | Algebra | 5 |
| Engl. | 1 | Commercial English | 5 |

## ONE YEAR COURSE IN COMMERCIAL RADIO ENGINEERING

Terms 1 and 2 (as shown above)

### TERM 3

| | | | |
|---|---|---|---|
| Radio | 3 | Theory of Transmission | 5 |
| Radio | 8 | Transmission Laboratory | 10 |
| Radio | 13 | Vacuum Tube Analysis | 5 |
| Elect. | 3 | D-c Motors and Generators | 10 |
| Math. | 9 | College Algebra | 5 |
| Com. Eng. | 1 | Salesmanship | 5 |

### TERM 4

| | | | |
|---|---|---|---|
| Radio | 5 | Speech Amplification—Synchronized Pictures and Television | 10 |
| Radio | 9 | Speech Amplification—Synchronized Pictures and Television (Laboratory) | 10 |
| Radio | 10 | Code Practice Optional | 5 |
| Elect. | 5 | A. C. Generators and Motors | 10 |
| Math. | 10 | Trigonometry | 5 |

## RADIO TRANSMISSION

Term 3 as outlined above. Students enrolled in this course alone must have had necessary previous general radio experience.

## SPEECH AMPLIFICATION, TALKING MOTION PICTURE OPERATION, PRINCIPLES OF TELEVISION

Term 4 as outlined. Students enrolling in this course alone must have had necessary previous general radio experience.

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*—A period is 45 minutes in length. Terms are 3 months in length.

x—For students having had high school algebra. Students not having had high school algebra are registered in Math. 1, 2, 7, and 8, or in such mathematics as they are qualified to study, as substitutes for Math. 7 to 9, inclusive.



# SUBJECTS OF INSTRUCTION

## DEPARTMENT OF PRACTICAL ELECTRICITY

MESSRS. BIECK, O'HARA, MURRAY, WIEDNER, KOEPP, TIETZ.

ELECT. 2. ELECTRIC METERING AND TESTING. This course is given to familiarize the students with the fundamental principles of electricity. Resistance measurements by various methods; power consumption and efficiency of electrical appliances; operation of the Wheatstone bridge; location of faults in wires and cables; elementary principles of magnetism; testing for magnetic properties of iron and steel; calibration of voltmeters, ammeters, and various types of watthour meters; electroheating, temperature coefficients for copper, iron, nichrome, and other metals; Joule's equivalent; fundamental principles of alternating current; study of the sine wave, the relation between the average, effective, and maximum voltages; Ohm's law for A-c circuits; Vector diagrams; relation between resistance, impedance, and reactance; current and voltage relations in A-c circuits containing resistance, reactance, and capacity; true and apparent power in A-c circuits; determination of power factors.

MESSRS. BIECK, WIEDNER, TIETZ.

ELECT. 3. D-C. GENERATORS AND MOTORS. (Lecture and laboratory 10 periods per week.) Generators: Shunt, compound and interpole generator connections and operation; voltage regulation of generators; parallel operation of compound generators; troubles and remedies of D-c generators. Motors: Direct current motor parts; fields, coils and armature; principles and operation of series motors, shunt motors, differentially and cumulatively connected compound motors, interpole motors and crane motors; power measurements of motors, calculation of losses, horse power tests. Methods of starting motors; speed control, reversing rotation, etc.; location of troubles and faults; application of motors to drive line shafts, blowers, pumps, presses, etc.; calculating speed changes by different pulley ratios. A selected group of laboratory experiments are performed in which a student connects, tests and operates various types of D-c generators and motors.

MESSRS. O'HARA, MURRAY, KOEPP.

ELECT. 5. A-C. GENERATORS AND MOTORS AND TRANSFORMERS. (Lecture and laboratory 10 periods per week.) Alternating current generators: Connections and operation of the single-phase and three-phase alternator; induced e. m. f.'s, wave shape, alternating current, magnetic field, synchronizing alternators; power measurements in single-phase and three-phase alternating current circuits; power factor; true watts; apparent watts and reactive watts; power factor corrections. Voltage regulation by synchronous condensers, Terrill regulators, and induction regulators. Alternating current motors; connections and operation of single-phase squirrel cage induction motors; repulsion motors; three-phase squirrel cage induction motors; starting compensators; slip ring induction motors; synchronous motors and use of same for power factor correction; troubles in A-c motors and generators. Single phase transformer, auto-transformer, three-phase transformer connections, voltage and current relations on three-phase systems, two-phase transformer connection. Laboratory experiments include single-phase transformer connections; auto transformer connections; three-phase transformer connections; voltage and current measurements in three-phase systems; two-phase transformer connections; single-phase generator connections and tests; single-phase and three-phase power measurements; determinations of power factor in single-phase and three phase circuits; synchronous motor connections; synchronizing alternator; single-phase and three-phase inductor motor connections; parallel operation of alternators; slip ring induction motor connections.

MESSRS. O'HARA, KOEPP.

## DEPARTMENT OF RADIO

PROFESSORS IHRKE, DE LAND
MESSRS. HJERMSTAD, OKLUND

RADIO 1. THEORY OF RECEPTION. Fundamentals of receiving circuits; types of receiving antennae and methods of installation; national board of fire underwriter's code regulations; simple receiving circuits; elementary detectors and their use in the receiver; the electron tube; characteristics and uses of the vacuum tube; amplification; functions of amplifiers; frequency ranges; methods of coupling; methods of correcting frequency characteristics of audio amplifiers; theory of regeneration and regenerative circuits; radio-frequency amplification and methods of regeneration control; use of special vacuum tubes for radio frequency amplification; the thermionic rectifier and its application as a detector in radio receivers; development and use of the linear detector; modern radio receivers; the tuned radio-frequency receiver; the Neutrodyne; the Superheterodyne; band pass tuning system; reproducers and loud speakers; the telephone receiver; the development of the magnetic cone; the dynamic cone, the electro-static reproducer and other special speaker developments; selection and best use of the loudspeaker; power supply systems; the thermionic rectifier as used in plate supply units; the A-c receiver; methods of obtaining power supply; methods of obtaining biasing voltages; principles of public address systems.

MR. DE LAND.

RADIO 2. ADVANCED THEORY OF RECEPTION. Calculations of tuned radio frequency transformer ratio; voltage gain of a t. r. f. stage; gain due the tube, gain due the coil, figure of merit of a coil, effect of coupling, effect on secondary resistance of close coupling; calculations of possible side band cutting; compromise between selectivity and sensitivity; effect of several stages of t. r. f. on fidelity; turns ratio into a detector tube; short wave theory; peculiarities, skip distance, short wave receivers, circuits and calculations, antenuators and filters.

MR. DE LAND.

RADIO 3. THEORY OF TRANSMISSION. Transmitting antenna systems, current and voltage distribution in antenna, counterpoise systems; the vacuum tube as an oscillation generator, frequency doublers and radio frequency power amplifiers; the vacuum tube as a modulator, methods of modulation; microphones and microphone control; the vacuum tube transmitter, general requisites of a modern broadcast transmitter; broadcast organization, arrangement of studio programs, remote control broadcasts, chain broadcasting; high frequency or short wave transmitters, peculiarities of high frequency transmission, construction and trouble shooting, requirements of a modern short wave transmitter, methods of stabilizing the output; radio beacons and direction finders, bilateral and unilateral characteristics, calibration and theory of operation, visual, indicating system for aircraft; aviation radio communication.

MR. OKLUND.

RADIO 4. COMMERCIAL SERVICING. Too'ls, instruments; interference, power lines and other circuits, household appliances, atmospheric conditions (fading and static), defective equipment; antenna circuits, underwriter's rules, types of antenna systems, lightning arresters, grounds and counterpoises; tube troubles, determination and study of the characterstics, static tests, dynamic tests, reaction of tubes, types of tubes (A-c and D-c); troubles within the set, antenna circuit, radio-frequency amplifier, detector unit, audio-frequency amplifier, oscillator.

MR. HJERMSTAD.

RADIO 5. SPEECH AMPLIFICATION, SYNCHRONIZED PICTURES AND TELEVISION. History and nature of electric reproduction of speech, Public address



systems; announcing systems; centralized radio systems, acoustic problems; synchronized speech and sound, history and development; methods of reproduction, the wax disc (Vitophone), sound track systems (Movietone, R. C. A. Photophone); methods of synchronization and automatic speed control; set-up and installation of theater systems; adjustment and operation of disc and sound track systems, service methods, acoustic problem in theater installations; the photo-electric cell, principle of television methods, construction and operation of equipment.

MR. IHRKE.

RADIO 6. RECEPTION LABORATORY. Study of different methods of determining resistance; bridge circuits; calibration of an ohmmeter; magnetic lines of force illustrated by means of a secondary rotating inside of a primary; calibration of a capacity meter; circuit tracing of radio receivers; study of a dry type bridge rectifier; electrolytic and gaseous rectifiers; static characteristics of vacuum tubes (3 element and heater types); amplification factor, mutual conductance and plate resistance; construction and operation of a radio-frequency oscillator employed as a grid dip meter; construction and operation of radio frequency detector, and audio frequency units. Radio 6 is a laboratory course supplementing Radio 1.

MR. HJERMSTAD.

RADIO 7. ADVANCED RECEPTION LABORATORY. Mutual inductance; response curves for inductively coupled circuits; distributed capacity of a radio frequency transformer; effect of resistance in a tuned radio frequency circuit; parallel resonance; series resonance; apparent radio frequency resistance of a circuit; characteristics of filament type rectifiers, including filter system, for full wave and half wave operation; dynamic characteristics of a 171-A tube; static characteristics; amplification factor; mutual conductance and plate resistance of 224, 171-A, 245 and 250 tubes. Radio 7 is a laboratory course supplementing Radio 2.

MR. HJERMSTAD.

RADIO 8. TRANSMISSION LABORATORY. Design, construction and calibration of a self-excited oscillator; construction and operation of a V. T. oscillator (R. F. Power Amplifier System); construction and calibration of wavemeter; construction of a radio-telephone transmitter employing a V. T. oscillator and a V. T. modulator; construction and operation of speech amplifier for use with telephone transmitter; construction and calibration of volume indicator. Radio 8 is a laboratory course supplementing Radio 3.

MR. DE LAND.

RADIO 9. SPEECH AMPLIFICATION, SYNCHRONIZED PICTURES, AND TELEVISION LABORATORY. Photo-electric cell circuits and measurements; disc and sound track pick-up methods; equalized input to the amplifiers; fading methods; general wiring layouts in synchronized picture systems; operation and adjustment of sound projector; light interrupter system for gain measurement; construction and complete tests on television receiver and transmitter. Radio 9 is a laboratory course supplementing Radio 5.

MR. IHRKE.

RADIO 10. CODE PRACTICE. (Optional). Under the International Agreement of 1927 all of the nations which were parties to the agreement required of their operators a certain sending and receiving ability of the International Morse Code. The U. S. Government (Department of Commerce) requires: 1st Class commercial operators to take code at 25 words per minute; 2nd class commercial operators to take code at 20 words per minute; amateur operators to take code at 10 words per minute. In this course the student is given in-

struction in the International Morse Code—both sending and receiving. After completing this Radio 10 the student should be able to send and receive at least 10 words correctly per minute. The student is thoroughly instructed in radio laws, regulations and theory pertaining to the attainment of a government Amateur Radio Operator's License. Completion of the above will enable the student to pass the examination for a U. S. Government First Class Amateur Radio Operator's License.

Mr. Oklund.

Radio 11. Fundamental D-c and A-c Theory Applied to Radio. Direct Current, Ohm's Law; power and energy; series and parallel circuits; voltage divider systems; calculations of drain current; resistance ratios; variation in voltage; Kirchoffs laws applied to B eliminator circuits; voltage drops at various plate currents, general A-c theory, wave shape, frequency, wave length; voltage and current relation; inductance and capacitance; condensers; choke coils; resistors; power and energy; resonance; series and parallel; filter circuits.

Mr. De Land.

Radio 12. Advanced A-c Theory Applied to Radio. Analysis of fundamentals of tuned circuits; complete vector representation of simple tuned circuits and coupled circuits (band pass); calculation of double resonance peaks; characteristics of air-core and iron-core coils at high frequencies; permalloy and iron dust; resistance of an antenna; self-induction in various coil forms; phase difference of a condenser; internal capacity of coils; electrostatic and magnetic shielding.

Mr. Ihrke.

Radio 13. Vacuum Tube Analyses. Detailed analyses of factors affecting vacuum tubes in operation as amplifier, detector, oscillator; oxide-coated and thoriated filaments; potential distribution in a tube; conditions controlling amplification factor; plate impedance, inter-electrode capacities, input impedance of tubes for proper matching to circuits; possibilities of self-excitation; parasitic oscillations; action of piezo-electric crystal control; special forms of tubes; oscillograms on tubes with associated apparatus.

Mr. Ihrke.

## DEPARTMENT OF MATHEMATICS

Profs. Simpson, Boren, Hartman, Haverson, Murray;
Messrs. Duhn, Oklund, O'Hara.

Math. 1. Mathematics for Electricians. The aim of this course is to prepare students to solve the problems which arise in their elementary work in electricity. It also forms the foundation for further courses in mathematics. Review of common fractions and decimals; addition; subtraction; multiplacation; and division of Algebraic numbers. Solution of equations of one variable. Problems solved by equations.

Mr. Boren.

Math. 2. Algebra. Special products; factoring, using the standard type forms; solution of equations by factoring; fractions involving the four fundamental operations; solution of equations containing fractions; solution of problems. Some linear equations of two variables, solution and graphical interpretation.

Messrs. Duhn, Oklund.

Math. 7. Algebra. Algebraic and graphical study of first degree equations; solution of simultaneous linear equations involving two or three variables; graphical solution; square roots and quadratic surds; solution of



quadratic equations involving one unknown, by completing the square, by use of the formula and by the graphical methods. Special products and factoring.

Mr. Murray.

Math. 8. Advanced Algebra. Algebraic and graphical solution of different types of quadratic equations involving two unknowns; theory of the quadratic equation; the formation of the equation and the nature of the roots; a rigid study of radicals and exponents; the unit vector as an operator of rotation and complex numbers; logarithms.

Messrs. Hartman, Haverson.

Math. 9. College Algebra. General study of linear equations, including the use of determinants of the third order; development of the solution of the general quadratic equation; theorems concerning the number and nature of the roots of the quaratic; graphical and algebraic solution of simultaneous quadratic equations; mathematical induction is used in the development of the binominal theorem. A study of quadrature numbers leading up to the study of complex numbers; theory of equations; remainder theorem; factor theorem; number of roots of the general equation; Descarte's rule of signs, transformation of equations and solution of general equations; study of logarithms, involving change of base of the system; partial fractions, series.

Messrs. Hartman, Haverson.

Math. 10. Plane Trigonometry. Discussion of rectangular co-ordinates, plane angles; angular measurement; degrees, radians; relation between angle, radius and arc of circle; the trigonometric functions, their definitions and uses; values of trigonometric functions for typical angles are derived; practice in use of trigonometric tables, both logarithmic and natural; representation and discussion of trigonometric functions when plotted as a function of angle; inverse trigonometric functions; trigonometric identities; solution of trigonometric equations, including those of simultaneous nature; development and practice in the use of functions of the sum and difference of two angles, double angles, and half angles; solution of right triangle; solution of oblique triangle; law of sines, cosines and tangents; extensive applications of trigonometry to work in practical fields.

Messrs. Boren, Haverson.

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## DEPARTMENT OF ENGLISH

Professor Nyberg

English 1. This course gives a thorough grounding in sentence sequence, the sequence of larger units, time order, space order, logical order, outlines, paragraphing, transitions, the theory of proportion; common errors in grammar and rhetoric, and their correction; the effective use of words with reference to precision, suggestiveness and variety; exposition, its nature, logical processes, definitions, the aim and chief uses of descriptive exposition; pure description compared with descriptive exposition; process exposition studied with reference to its aims, uses, methods, in narrative and descriptive settings; exposition of ideas; organization of ideas, as well as their amplification by means of examples from masterful writers; nature of argument, the analysis of the question, planning the argument, proving the proposition, refutation, and persuasion, purely intellectual argument and the appeal to the emotions; description, guiding principles, selection of details and point of view; narration. The course is based upon the needs of the engineer.

Mr. Nyberg.

## DEPARTMENT OF COMMERCIAL ENGINEERING

PROFESSOR BALL

COM. ENG. 1. SALESMANSHIP. In this course particular pains are taken to acquaint the student with the general principles of Salesmanship. It is not the intention of the course to confine itself to the selling of merchandise over a counter, or instruct the traveling salesman in the technique of selling his merchandise, but to emphasize the sales relations which are constantly occurring between any man and his associates in the business, industrial, or social world. The view is taken that a man is constantly selling something. It may be merchandise, his personal services, some idea which he may have to present, or perhaps a viewpoint which he wishes shared by another. The first two weeks of this course consist of introductory lectures on elementary psychology, with particular emphasis on impressions which people receive and how they react to them, and develop this thought to a realization of the desirability of conducting one's self to obtain the best possible reactions from his associates. A sale or sales process is analyzed with reference to the buying motives or reasons why people make a purchase or arrive at a decision. The sales process itself is divided into the pre-approach obtaining the interview, the approach, the sales demonstration, the meeting of objections, closing the sale, and the departure. This course also includes the analysis of various items of merchandise, or even ideas in order to obtain the sales points involved, and their proper method of presentation.

DR. BALL.

## TUITION FEES AND TERMS

SIX MONTHS' COURSE—Tuition for the six months' course is $295.00 cash upon enrollment. If the monthly payment plan is preferred, the tuition on the full-day basis is $95.00 the first month and $50.00 a month for five months.

ONE YEAR COURSE—Cash price is $475.00. On the installment plan, $100.00 the first month and $50.00 per month for 9 months, and $25.00 the next month, making a total of $575.00.

## EXPENSES

ding living expenses consid-
United States. The student
eering of Milwaukee will find
:

)..... $295.00
..... 475.00
.....$35.00 to $45.00 per mo.

es and fees of similar nature.
standard of living of the stu-

heir expenses while attending
s is possible in some cases, it
complete expenses would usu-
rsue the courses of study. A
ess he has sufficient funds to
ng expenses for at least two
ssist students in obtaining po-
unusually successful in finding
ıtee can be made as the school
tuations.



# Advisory Board

One of the most valuable assets of the School of Engineering of Milwaukee is the large number of Electrical and other industries located in the Milwaukee district.

The School of Engineering of Milwaukee has enjoyed the co-operation of many of these industries. In order, still further, to promote the common interest, an Advisory Board, consisting of representatives of important corporations has been organized. Through occasional meetings of the entire Board, as well as through sub-committees, and through individual conferences, the School of Engineering of Milwaukee has been enabled to strengthen the work of its academic department and broaden its contacts with the industry itself.

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BURT WILLIAMS,
Public Accountant, Official Tax Consultant for Wisconsin Bankers' Association.

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Gustav J. A. Trostel ..... President

Walter F. Kemke ..... Secretary

Charles Friend ..... Treasurer

William George Bruce — Alvin P. Kletzsch



## INFORMATION BLANK

School of Engineering of Milwaukee,
North Jackson and East Wells Sts.,
Milwaukee, Wisconsin.

Date.....193...

Name.....Home Address.....

Previous education.....Married or single.....

Do you desire part-time employment?.....

Where employed now?.....How long?.....

Kind of work?.....

Have you sufficient funds for tuition?.....

If not, how much can you invest for your education?.....

When do you plan to enroll?.....

Remarks .....

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If previous education includes any work in high school, this should be accompanied by a statement from the high school principal as to credits earned.