BULLETIN
OF THE
University of Notre Dame
NOTRE DAME, INDIANA

ENGINEERING NUMBER

PUBLISHED QUARTERLY AT NOTRE DAME

THE UNIVERSITY PRESS
OCTOBER, 1912

Entered at the Postoffice, Notre Dame, Indiana, as second-class matter, July 17, 1905
DIRECTORY OF THE UNIVERSITY

The FACULTY—Address:

THE UNIVERSITY OF NOTRE DAME,

NOTRE DAME, INDIANA.

The STUDENTS—Address:

As for the Faculty, except that the name of the Hall in which the student lives should be added.

A Postoffice, a Telegraph Office, a Long Distance Telephone, and an Express Office are at the University.

The University is two miles from the city of South Bend, Indiana, and about eighty miles east of Chicago. The Lake Shore and Michigan Southern, the Grand Trunk, the Vandalia, the Indiana, Illinois & Iowa, the Chicago and Indiana Southern, and the Michigan Central railways run directly into South Bend. A trolley line runs cars from South Bend to the University every fifteen minutes.

The Latitude of the University is 41 degrees, 43 minutes, and 12.7 seconds North, and 86 degrees, 14 minutes and 19.3 seconds West of Greenwich.

The elevation is about 750 feet above the sea.

From this it is clear that the location is favorable for a healthful climate where students may engage in vigorous mental work without too great fatigue or danger to health.
BOARD OF TRUSTEES

Very Rev. Andrew Morrissey, C. S. C.,
President.

Rev. John Cavanaugh, C. S. C.,
Chancellor.

Rev. Daniel E. Hudson, C. S. C.,

Rev. William R. Connor, C. S. C.,
Secretary.

Rev. Joseph Maguire, C. S. C.,

Bro. Albeus, C. S. C.,
EXECUTIVE OFFICERS OF THE UNIVERSITY

Rev. JOHN CAVANAUGH, C. S. C.,
President.

Rev. MATTHEW WALSH, C. S. C.,
Vice-President.

Rev. MATTHEW SCHUMACHER, C. S. C.,
Director of Studies.

Rev. JOSEPH BURKE, C. S. C.,
Prefect of Discipline.

Rev. WILLIAM MOLONEY, C. S. C.,
Secretary.
The University of Notre Dame was founded in the year 1842, by the Very Reverend Edward Sorin, the late Superior General of the Congregation of Holy Cross. In an act approved January 15, 1844, the Legislature of Indiana gave the University power to grant degrees. The beginning of this act is:

"Be it enacted by the General Assembly of the State of Indiana, that Edward Frederick Sorin, Francis Lewis Cointet, Theophilus Jerome Marivault, Francis Gouesse and their associates and successors in office, be, and are hereby constituted and declared to be, a body, corporate and politic, by the name and style of the 'University of Notre Dame du Lac,' and by that name shall have perpetual succession, with full power and authority to confer and grant, or cause to be conferred and granted such degrees and diplomas in the liberal arts and sciences, and in law and medicine, as are usually conferred and granted in other universities in the United States, provided, however, that no degree shall be conferred or diplomas granted, except to students who have acquired the same proficiency in the liberal arts and sciences, and in law and medicine, as is customary in other universities in the United States."
UNIVERSITY BUILDINGS

THE ADMINISTRATION BUILDING

The dimensions of this building are 320 by 155 feet; it is five stories in height and is surmounted by a dome 207 feet in height. The executive offices, two study-halls, some dormitories and class rooms and the dining-rooms are in this building. The Library and the Bishops' Memorial Hall are also here temporarily. This building, like all the others of the University, is lighted by electricity and gas, and heated by steam. The corridors of the first floor are decorated with mural paintings by Gregori.

THE CHURCH

The Church of the Sacred Heart is 275 by 120 feet in ground dimension and 125 in height from the floor to the roof ridge. The interior is decorated by Gregori, and the architecture is Gothic. There is a large crypt and many chapels. In the tower is a chime of 32 bells and the great six-ton chief bell.

THE LIBRARY

The Library contains 60,000 volumes and several thousand unbound pamphlets and manuscripts. The department of literary criticism, history, political science and the Greek and Latin classics are well represented. Special libraries containing reference works on technical subjects are provided in the Colleges of Engineering and Science. The College of Law has a complete library of its own. Ample reading room is provided in the main library. The best literary magazines and reviews, as well as current numbers of scientific and technical journals are kept on file.
Students have access to the Library from 8:00 A. M. to 9:00 P. M.

WASHINGTON HALL

This hall is 170 feet in length, 100 feet in width, and about 100 feet in height. It contains the rooms of the Department of Music, the reading rooms for Brownson and Carroll Halls, and the University Theatre. The theatre is elaborately equipped with stage settings. It will seat 1,200 persons. Lectures by men eminent in public and professional life are given here. Concerts and plays by professional companies are also presented in this theatre. The dramatic clubs of the University present several plays annually.

SCIENCE HALL

is situated a few steps south of Washington Hall. Its dimensions are 105 by 131 feet, and it is three stories in height. A large central space, the full height of the building, is occupied by a museum containing mineral, fossil and biological specimens. The departments of Physics, Civil Engineering, Philosophy, Botany and Biology have recitation rooms and laboratories in this building. The equipment for each of these departments is extensive and complete. Description of the equipment will be found later in this catalogue.

THE MUSEUM

connected with the departments named above, is well arranged for convenience of study. The sociological collection on the second floor at present fills sixteen large cases and represents typical forms of all the orders and genera of vertebrate and invertebrate animals. A large collection of representative ver-
tebrate skeletons forms a considerable part of the museum.

Facilities for the publication of research on subjects of natural history are afforded in the pages of the *American Midland Naturalist*, which appears bi-monthly from the laboratory of botany at the University.

The collection in Geology and Mineralogy occupy the first floor. These collections are arranged in a series of cases on each side of the building. In one series is a carefully classified collection of minerals and ores. The opposite series of cases contain a large geological collection; some of the specimens here are of the rarest fossil remains of animals and plant life.

**THE CHEMICAL LABORATORIES**

occupy a large three-story building directly south of Science Hall. The entire first floor is devoted to advanced work and space is given to three large laboratories, a library and lecture room. The second floor is occupied by the Department of Pharmacy, and contains a large, well-equipped laboratory, a modern drug store, a lecture room and museum, a library for pharmaceutical publications, and a general stock-room. The general inorganic, organic and elementary chemical laboratories are on the third floor. Each laboratory is provided with ample hood accommodations, and each desk is furnished with water, gas and suction.

**ENGINEERING HALL**

This building is situated in the southern part of the grounds and is a large two-story brick structure, well lighted and heated. The lower floor contains the mechanical laboratory, machine shop, blacksmith shop and foundry. The second floor provides the shop for wood-work and also contains a well lighted drawing
room where students in designing may consult complete workings of the best steam engines and pumps to be found on the market. In this building are likewise the dynamo laboratory, designing room and recitation rooms of the Electrical Engineering department.

THE OBSERVATORY

This building is located near the Chemical Laboratories and is designed for an equatorial telescope and for a transit or meridian circle. The equatorial telescope now in the building is intended for students of astronomy, and is in use whenever favorable weather permits.

SORIN HALL

This building is 144 feet in length, with two wings 121 feet in depth. It has a basement and three high stories, and contains 191 private rooms for advanced students. These rooms are furnished, and students of full Senior, Junior, or Sophomore standing in any of the Colleges are not required to pay rent. On the first floor there is a chapel, a law lecture room and a law library. The building is lighted with electricity and heated with steam. In the basement are recreation rooms and bath rooms.

CORBY HALL

Corby Hall is a second residence building. It has three stories and a basement, and is 240 feet in width. There are 125 private rooms for students, with recreation rooms and a chapel. The building is lighted with electricity and gas and heated with steam.

WALSH HALL

This newest dormitory building is situated South of Sorin, fronting the quadrangle. Its dimensions
are 230 feet by 41 feet. It faces East and all the front rooms are made up of suites each consisting of a commodious study room, flanked on either side by a bedroom. Attached to each suite is a private bath and toilet. Each room is supplied with hot and cold water. The rear rooms are singles and the general toilet and bath rooms are of hollow, fire-proof tile, walls and ceilings covered with wire lath and plaster, making practically a fire proof building. It is equipped with a distinct system of stand-pipes for fighting fire. The entire corridor floors are built of reinforced concrete, covered with Roman ceramic mosaics. In finish and equipment Walsh Hall is believed to be the best college dormitory building in America. It embraces three stories besides the admirable basement and attic, and it is capable of accommodating over a hundred students.

BROWNSON HALL

Brownson Hall occupies the east wing of the Administration Building and contains the living and study rooms of Preparatory students of seventeen years of age and upwards. There is a common study hall, a common lavatory, and two large sleeping rooms in which each student has an alcove curtained to secure a personal privacy. Experience shows that the discipline of these common rooms works admirable effects on students who have not yet contracted solid habits of study.

CARROLL HALL

Carroll Hall is in the west wing of the Administration Building. It is in all respects similar to Brownson Hall, except that it is intended for younger students. The regulations are more particularly adapted to their age and scholastic attainments. Preparatory students
between the ages of thirteen and seventeen years are placed in this hall.

**ST. JOSEPH'S HALL**

St. Joseph’s Hall is located at the extreme south-western end of the campus and is devoted exclusively to living and study rooms. In this building live those students who defray one-half the cost of board and tuition by waiting at table during the meals. The conditions for admission to this hall are: (1) The payment of two hundred dollars ($200.00) a year on the first of August, and (2) satisfactory service as a waiter. The waiting in no wise interferes with the student's work, and all the educational advantages are open to him. It is to be regretted that through the lack of endowment the University can offer only a limited number of such opportunities each year. It is necessary to apply early for these appointments.

**THE INFIRMARY**

This building, 200 feet by 45 feet in ground measurement and three stories in height, contains rooms for the use of students during illness. The sick are cared for by Sisters of the Holy Cross, and the University physician visits them daily.

**THE GYMNASIUM**

The Gymnasium which was burned down in November, 1900, was replaced by a building 230 by 200 feet on the ground. The track-hall is now 100 by 180 feet on the ground. It is used for indoor meets, winter baseball practice, basketball and military drill. The gymnastic hall is 100 by 40 feet and is furnished with a full set of apparatus; below that are the offices, dressing rooms and shower baths. Friends of the University and the alumni contributed more than
three thousand dollars to the fund for rebuilding.

Cartier field is an enclosed field for athletic games. There is a permanent grand stand near the baseball diamond and the running track, and a portable stand near the football rectangle. The field contains ten acres of ground, and is a gift to the University from Mr. Warren A. Cartier, C. E., of the class of '87.

OTHER BUILDINGS

There are numerous other large buildings connected with the University: Holy Cross Hall, Dujarie Hall, the Community House, the Presbytery, and Saint Edward's Hall, the last-named being a school for children under the age of thirteen, in care of the Sisters of the Holy Cross.

SYSTEM OF INSTRUCTION

The entire plan of studies is based on the modified elective system. The student is free to select his own curriculum conformably to his natural liking, the career in life he may have in view, or the determinate intellectual bent developed during his secondary school years; but, though he is free to elect his own studies, he has not, however, unlimited freedom in this respect. The principle of general election is modified. Lest the young Freshman in his inexperience choose unwisely, he is aided in making his choice of studies by being permitted to select from among a number of parallel programs leading to baccalaureate degrees. Eighteen programs are open for his choice in the Colleges, each embracing courses which, in the opinion of the Faculty, contribute best to cultural, scientific or professional knowledge. These programs are, in some cases, made elastic by the introduction
of elective courses, especially in the Junior and Senior years. Students who wish to spend a limited time in study and can not complete all the courses in a program for a degree may register as special students and elect any course for which their preparation has fitted them.

The hours scheduled in the different programs are credit hours based on the average amount of time required for preparation of recitations. One hour of recitation is regarded as the equivalent of two hours of laboratory work. The minimum number of credit hours which a student must carry, except in his Senior year, is sixteen, the maximum number which he may ordinarily carry is twenty. Students who wish to take more work than is indicated by the maximum requirements must apply by formal petition to the Faculty for the requisite permission.

REGULATIONS GOVERNING ADMISSION TO THE COLLEGES

Candidates who wish to enter any of the Colleges must present evidence, either by examination or by a properly attested certificate, of ability to enter on the courses of the Freshman year. The specific subjects required for entrance will be found later in this catalogue.

Examinations in all the subjects required for admission to the University are held at Notre Dame in September, the beginning of the Fall Term and in February, the beginning of the Spring Term.

A candidate failing to pass satisfactory examinations in one or more of the subjects required for admission to any college program may, at the discretion of the Faculty, be admitted to his class conditioned, to make up his deficiency by extra study
within one school year. Only when the conditions are removed will the student be admitted to full standing in his class.

Students who have completed a four year course in High Schools or Preparatory Schools of recognized standing will be admitted without examination to the Freshman year of any program to which their preparatory studies entitle them.

Candidates for admission to advanced standing who are required to take examinations must pass, in addition to the usual entrance examinations, an examination in the work already done by the classes they desire to enter. The additional subjects may be found in the several programs of studies described later in this catalogue.

Applicants for advanced standing who present certificates from other colleges or universities may be received at the discretion of the Faculty with or without examination as regards particular cases.

No students will be admitted to any course of the Senior year until all conditions have been cancelled.

Catholic students are required to take the prescribed courses in Evidences of Religion.
<table>
<thead>
<tr>
<th>Colleges</th>
<th>Total</th>
<th>Elective</th>
<th>Mathematics</th>
<th>Chemistry</th>
<th>Physics</th>
<th>Zoology, Physiology</th>
<th>Botany, Ecology</th>
<th>English</th>
<th>French or German</th>
<th>History</th>
<th>Latin</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts Letters</td>
<td>16</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>16</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Engineering</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Science</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Letters' College</td>
<td>16</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Law</td>
<td>16</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

* Including departments of Letters, History and Economics and Journalism.

† Four units of Language required. 
‡ For admission to the College of Arts and Letters and Law one unit of Science is required.
Degrees are conferred only on regular students who have satisfied the full entrance requirements and have completed satisfactorily the courses prescribed. The courses required for the several degrees conferred by the University will be found described in this catalogue. Written theses and formal examinations are demanded of all candidates for degrees. One full scholastic year of resident study is absolutely required.

BACHELORS

The courses of study offered to candidates for the degree of Bachelor extend by fixed programs throughout the four scholastic years. In the College of Arts and Letters one of four degrees is conferred on an undergraduate—Bachelor of Arts (A. B.), Bachelor of Letters (Litt. B.), Bachelor of Philosophy (Ph. B.), Bachelor of Philosophy in Journalism (Ph. B. in Jour.)—dependent on the special program of studies the candidate selects. The College of Science offers six degrees for choice to undergraduates—Bachelor of Science (B. S.), Bachelor of Science in Biology (B. S. Biol.), Bachelor of Science in Chemistry (B. S. Chem.), Bachelor of Science in Pharmacy (B. S. in Ph.), Graduate in Pharmacy (Ph. G.), Pharmaceutical Chemist (Ph. C.). The College of Engineering offers five degrees—Civil Engineer (C. E.), Mechanical Engineer (M. E.), Electrical Engineer (E. E.), Mining Engineer (E. M.), and Chemical Engineer (Ch. E.). Two degrees are offered by the College of Architecture—Bachelor of Science in Architecture (B. S. A.), and Bachelor of Science in Architectural Engineering (B. S. A. E.). The College of Law offers the degree of Bachelor of Laws (LL. B.). In the College of Music one degree is offered—Bachelor of Music (B. M.). In order to
obtain this degree the candidate must have studied music in the University for one complete year. He must have a thorough theoretical knowledge of four instruments mentioned in the courses described later, and a practical mastery of one of them. He shall pass a written examination in harmony, counterpoint and composition, and he must submit to the examiner two original compositions: (a) a fugue for full orchestra, or for four voices with independent orchestral accompaniment; (b) a composition in the free form (sonata or rondo) for pianoforte, or a trio (pianoforte, violin and violincello).

The degree of Bachelor will not be conferred unless the candidate shall have been in residence for one complete scholastic year in his Senior year of study.

MASTERS

The degree of Master is open to students who have received the degree of Bachelor from Notre Dame or from some other college in good standing, and who make application to the Committee of the Faculty on Graduate Study for the privilege of pursuing advanced work. All work must be approved by this Committee. One year of residence, at least, is required of candidates who have received their Bachelor's degree at another college. Those who have received their Bachelor's degree from Notre Dame, may, in some cases to be determined by the Committee, obtain the Master's degree for work done in absentia.* One major and one or two minor courses will constitute the curriculum, forming a consistent coordinated plan of advanced work pursued with some definite aim. On completion of the required work the candidate

* No degree is conferred in honorem except the degree of Doctor of Laws (LL. D.)
must pass a satisfactory examination in writing, under the professors who give his subjects of instruction. The candidates for this degree must also write a dissertation of notable merit on some topic connected with his major subject, the thesis to contain in the minimum five thousand words. The subject of the thesis must be announced to the Committee by December 1, and submitted for examination by May 15. Five printed or typewritten copies of the thesis must be presented to the University to be placed in the library. The fee for examination of work done in absentia is twenty-five dollars. The fee for this degree is fixed at fifteen dollars.

DOCTOR OF PHILOSOPHY

Three years must be spent by the candidate in University work before the degree of Doctor shall be conferred,—two of these must be spent at Notre Dame and one may be passed at some other university on approval of the Committee of the Faculty on Graduate Study. The candidate must pass satisfactorily examinations in French and German on entrance. The work for the degree shall consist of one major and two minor courses of instruction approved by the Committee. Research study shall form the most important part of the candidate's work. On completion of his work the candidates must pass minute examinations on the three subjects of his curriculum and must defend his dissertation before the whole Faculty. The thesis must be printed and one hundred and fifty copies presented to the University. A copy of the thesis must be handed to the Committee one month before the examinations. The degree will not be conferred for merely faithful work, and not for miscellaneous study, but for original research and for high attain-
ment in one branch of study. The fee for this degree is fixed at twenty-five dollars.

**SPECIAL STUDENTS**

Students who do not wish to become candidates for a degree by following the prescribed courses of any program may register as special students and attend any of the courses of instruction for which their previous academic training has fitted them. Such special students are governed by the same regulations and discipline as the other undergraduates. They are required to pass the same examinations in the courses they pursue as the other students. In exceptional cases men of mature age, who have been out of school or college for several years, but whose training in practical affairs has been sufficiently educative, will be accepted as special students by satisfying the Faculty of their ability to pursue with profit any course of instruction.

On leaving the University special students may receive on application certificates stating their proficiency in the courses they have pursued.

**THE MARTIN J. McCUE MEDAL FOR CIVIL ENGINEERING**

The McCue Medal for Civil Engineering, presented by Mr. Warren A. Cartier, Civil Engineer, of the Class of '87, is awarded to the student of the Department of Civil Engineering who has obtained the best record in all the courses prescribed in the program. The medal is awarded only when the student's record has attained a fixed standard. In computing the grades the courses in mathematics count fifty per cent. Only students who have been in residence for four full years are eligible to compete for this prize.
DISCIPLINE

Official reports of each student’s class standing will be sent to parents and guardians quarterly.

The Faculty maintains that an education which gives little attention to the development of the moral part of a youth’s character is pernicious, and that it is impossible to bring about this development where students are granted absolute relaxation from all Faculty government while outside the class-room. A young man must learn obedience to law by the actual practice of obedience. Here students are required to obtain permission for any departure from the regular daily routine.

Moreover, the quiet and concentration of mind that are needed for college work are not obtained except where discipline exists.

Therefore the following regulations, shown by experience to be salutary, are enforced at the University.

1. No student shall leave the University grounds without permission from the President or the person delegated to represent him.

2. Leave of absence will not be granted to students during the term, except in cases of urgent necessity. There is no vacation at Easter.

3. Students are required to report at the University immediately after arriving at South Bend. This rule is binding not only at the beginning of the scholastic year, but at all other times when leave of absence has been granted. Unnecessary delay in South Bend is looked upon as a serious violation of rule.

4. Flagrant disobedience to authority, cheating in examinations, the use of intoxicating liquors, immorality, the use of profane and obscene language,
and an unauthorized absence from the University limits are among the causes for expulsion. In case of suspension or expulsion for such offences, no fee shall be returned.

5. The use of cigarettes is strictly forbidden, a second offence being punished by suspension for one month.

6. No branch of study shall be taken up or discontinued without the consent of the Director of Studies.

7. Preparatory students are enrolled in Brownson, Carroll or St. Edward’s Hall according to age; boys seventeen years of age or older are placed in Brownson Hall; those over thirteen and under seventeen, in Carroll Hall, and those under thirteen, in St. Edward’s Hall.

8. The use of tobacco is forbidden except to such students of Sorin, Corby, Walsh and Brownson Halls as have received from their parents written permission to use tobacco.

9. Continued violation of regulations in Sorin, Corby or Walsh Halls leads to suspension.

10. Although students of all religious denominations are received, the University is nevertheless a strictly Catholic institution, and all students are required to attend divine service in the University Church at stated times.

11. Undue attention to athletics at the expense of study will not be permitted; but students are expected to take part in outdoor sports.

12. A limited number of athletic contests is permitted with college organizations from without.

13. All athletic associations of the students are strictly forbidden to countenance anything that savors of professionalism.
14. All athletics are governed by a Faculty Board of Control which will be guided in its rulings by the regulations adopted by the Conference Colleges. The Vice-President of the University and six members of the Faculty will compose this Board, and reserve the right of a final decision on all questions concerning athletics. The Faculty Board will determine the amateur standing of the members of the athletic teams and apportion the finances. By this means indiscreet and unconsidered action of students will be checked.

LECTURES AND CONCERTS

Each winter, eminent men are invited to lecture before the students. Among those who have addressed the University in the past few years may be noted five Apostolic Delegates, Cardinals Satolli, Martinelli and Falconio, Monsignors Agius and Bonzano; Cardinal Farley; Arch-bishops Ireland, Riordan, Keane, Glennon, Christie and Spalding; and Bishops Alerding, McQuaid, Maes, Muldoon, O'Gorman, Shanley Hickey, Hanna and MacSherry. There were also such noted European churchmen as the Abbé Felix Klein, Bishop John S. Vaughan and the foremost of living English historians, Dom Gasquet; also men of letters like Rev. D. J. Stafford, Marion Crawford, Maurice Francis Egan, Henry Van Dyke, Seumas MacManus, William Butler Yeats, James Jeffrey Roche, Hamilton Wright Mabie, Opie Read, Leland Powers, Henry James and the Rev. John Talbot Smith; and such men of affairs as President Taft, ex-Vice-President Fairbanks, ex-Senator Hill, ex-Senator Beveridge, ex-Attorney General Charles Jerome Bonaparte, ex-Representatives J. Adam Bede, the Honorable William P. Breen, Representative Bourke Cochran, Dr. James
C. Monaghan, Willis M. Moore, the Honorable Edward McDermott, His Excellency Wu ting Fang, William Jennings Bryan, Senator B. F. Shively, Max Pam, Governor J. Harmon, Hannis Taylor and Chief-Justice Fitzpatrick of Canada.

Concerts are given frequently by organizations from without.

**STUDENT SOCIETIES**

There are several literary and debating societies in the University which do such creditable work at their meetings and in preparation for them that their work takes on the nature of added courses of instruction. In each society a member of the Faculty acts as adviser. An Inter-Hall League has been formed and public debates are held annually. The College of Law also has an active debating club. The training in public speaking has always received special attention at the University. In nineteen public debates with other universities and colleges Notre Dame has but once met defeat—the decision of the judges in the greater number of these debates being unanimous. The University Dramatic Club and the Philopatrian Society stage at least three plays annually for presentation in public. The University Band, the University Orchestra and the University Glee Club also appear regularly in concerts.

Students of the Department of Civil and Electrical Engineering have each a society in which papers on engineering subjects are read and discussed. Men prominent in their profession are invited to lecture to these societies. The Pharmaceutical Society meets to discuss subjects of interest in the world of pharmacy. In other departments where no such formal organizations has been effected similar results are reached by seminars.
NECESSARY EXPENSES

Matriculation Fee (payable on first entrance) ........ $10.00

BOARD, TUITION, Lodging, Washing, and Mending of Linen, per school year .................. 400.00

PAYABLE ON ENTRANCE IN SEPTEMBER

Matriculation Fee (payable first year only) ........ $10.00
First Payment on Board and Tuition .................. 250.00
Use of Gymnasium and Natatorium and admission to intercollegiate games and contests throughout the year ................................................... 10.00
Special Lecture, Entertainment and Concert Course .... 5.00
Spending money or orders for clothing will not be given students unless a deposit has been made for this purpose.
In this First Payment must also be included any Extra Expense the student may wish to incur, such as charges for Private Room or Special Courses (listed below).

PAYABLE ON JANUARY 15

Balance on Board and Tuition ......................... $150.00
and any extra expenses the student may have incurred.
No student will be entered for the second term whose account for the first term has not been adjusted.
No rebate will be allowed for time of absence at the opening of the Terms, September and February. The charge of $400.00 covers the tuition fee, which is fixed at $100.00 per Scholastic Year. The latter sum is accepted as an entirety for Tuition during the Scholastic Year, and will not be refunded in whole or part if the student be dismissed for wilful infraction of the fundamental rules and regulations herein stated and hereby brought to his notice; and so likewise in the event of his leaving and absenting himself from the University at any time or for any cause without proper permission. However, an exception is made if it seems to be expedient for him to go to his home because of severe or protracted illness. Degrees will not be conferred on any student whose account with the University has not been settled.
OPTIONAL EXPENSES—PAYABLE IN ADVANCE

For the Scholastic Year:

PRIVATE ROOMS—

Seniors, Juniors, and Sophomores Free, but a nominal charge of $15.00 is made to defray expenses connected with the care of rooms; Freshmen... $50.00 and upwards.

It must be distinctly understood that reference is here made only to Seniors, Juniors and Sophomores who bear no conditions; that is to say, who have completed all the subjects in the Preparatory and Freshman work, otherwise regular rent will be charged for rooms. Similarly, only unconditioned Freshmen are allowed the special rate quoted above.

Preparatory Students.................. $80.00 and upwards.

While students, as a rule, are advised to confine themselves to the regular courses of the programs they have entered, any of the following may be taken at the rate mentioned per Scholastic Year, payable in advance. The charges are pro rata for any portion of the year.

Instrumental Music—Lessons
  Lessons on Guitar, Flute, Cornet, Clarinet or Mandolin........... $60.00  30.00
  On Piano and use of Instrument
  Use of Piano for Advanced Students ................ $30.00
  Telegraph ..................... 25.00
  Typewriting, Full Course 20.00
  One month ................ 5.00
  Phonography ............... 15.00
  Applied Electricity .... 25.00
  Vocal Culture ............ 75.00

  Lessons on Violin ....... 60.00
  *Use of each instrument 5.00
  Artistic Drawing .......... 25.00
  Elocution, Special Course 10.00
  “Scholastic”—College

  Paper ..................... 1.50
  Library Fee ............... 5.00
  Physical Culture .......... 5.00

Laboratory fees listed later in this catalogue.

GRADUATION FEE

For all Courses leading to Bachelor Degrees, $10.00; Commercial Course, $5.00.

* As the string and band instruments available for rent are few, students taking up these studies are advised to furnish their own instruments.
REMARKS

Term bills and other accounts are subject to sight draft if not paid within ten days after they have been rendered.

The Entrance Fees, cost of Books, Music and Laboratory Fees, etc., are required with first payment.

Remittance should be made by draft, post-office money order or express, payable to the order of the President.

Checks on local banks are not desirable, and exchange will be charged in all cases.

Sorin, Corby, Walsh, Brownson and Carroll Halls are closed during the months of July and August. Students wishing to spend their Summer Vacation under the care of the University authorities can be accommodated at San José Park, Lawton, Michigan.

The charge for the vacation at San José Park is $100.00. Classes (two hours per day) are included in this arrangement. Special tutoring at professors' rates.

A limited number of student waiters can be received at reduced rates. For conditions of entrance see paragraph entitled St. Joseph's Hall,
In the industrial development of a country the engineer takes an important part. Many new industries are springing up and the great activity in those already established throughout the world creates a demand for the services of trained engineers.

The programs of studies in the five departments of engineering at Notre Dame are arranged to give a knowledge of the fundamental facts and theories that are applied in engineering work. Mathematics is foremost among these requirements. The natural sciences receive their share of attention and due importance is given to language in arranging the programs of studies.

Laboratory work and field work give a certain amount of practice in the application of the theory to actual physical conditions. These conditions are made to correspond as closely as possible to the real work of the engineer.

A student who has no liking for mathematics should not be encouraged to take up an engineering course. The successful engineer is one who thinks clearly and acts accurately. Clear thinking is necessary to master mathematical subjects and skill and accuracy are acquired by applying the results of mathematical calculations to particular practical cases in laboratory work.

Five regular programs of studies have been arranged: one leading to the degree of Civil Engineer, one to the degree of Mechanical Engineer, one to the degree of Electrical Engineer, one to the degree of Engineer of Mines, and one to the degree of Chemical Engineer.

Special Short Courses in Electrical and Mechanical Engineering are offered to accommodate those who wish
to fit themselves for practical work in the shortest possible time.

The various laboratories are equipped with the most approved forms of instruments and appliances and considerable time is given to technical work. The equipment for each department will be found described and referred to on the succeeding pages of this catalogue.

In addition to the work in the laboratories and the power plants of the University, students are taken on inspection tours to the important engineering works in the neighborhood. Several of the largest manufacturing plants in the world are in South Bend or the vicinity.

In the schedules of studies one hour credit is given for each recitation or lecture which requires from one to two hours' preparation. Two hours actual time in laboratory work, shopwork or drawing is required for each hour on the schedule.

EXPENSES

In addition to the regular fee for matriculation, board, tuition, lodging, etc., as given on page —, the regular students in the five Engineering Programs are required to pay laboratory fees to cover, in part, the cost of materials consumed and the deterioration of the apparatus used.

LABORATORY FEE

<table>
<thead>
<tr>
<th>Assaying II</th>
<th>$15.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry I</td>
<td>5.00</td>
</tr>
<tr>
<td>Chemistry II</td>
<td>15.00</td>
</tr>
<tr>
<td>Chemistry III, VI, VIII, X1b, X1c, XIII, XIV, XV, each</td>
<td>10.00</td>
</tr>
<tr>
<td>Chemistry V</td>
<td>20.00</td>
</tr>
<tr>
<td>Chrystallography IV</td>
<td>2.00</td>
</tr>
<tr>
<td>Electrical Laboratory I, II and IV, each</td>
<td>15.00</td>
</tr>
<tr>
<td>Gas Engine Laboratory</td>
<td>10.00</td>
</tr>
<tr>
<td>Mechanical Laboratory</td>
<td>5.00</td>
</tr>
<tr>
<td>Metallurgy I</td>
<td>5.00</td>
</tr>
<tr>
<td>Course</td>
<td>Fee</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Mineralogy II, Sophomore Year</td>
<td>10.00</td>
</tr>
<tr>
<td>Mineralogy II, Junior Year</td>
<td>5.00</td>
</tr>
<tr>
<td>Mineralogy III</td>
<td>5.00</td>
</tr>
<tr>
<td>Petrography V</td>
<td>5.00</td>
</tr>
<tr>
<td>Physical Laboratory I and III, each</td>
<td>5.00</td>
</tr>
<tr>
<td>Physical Laboratory IV</td>
<td>15.00</td>
</tr>
<tr>
<td>Shopwork, all four-year programs, per term</td>
<td>15.00</td>
</tr>
<tr>
<td>Surveying III, V, VIII, each</td>
<td>5.00</td>
</tr>
</tbody>
</table>

**ENTRANCE SUBJECTS**

**ALGEBRA.** The whole subject as far as logarithms, as given in *Wentworth’s College Algebra*, or an equivalent in the larger treatises of other authors.

**GEOMETRY.** Plane and Solid, including the solution of simple problems and numerical examples, as given in the works of *Wentworth, Chauvenet, Newcomb*, or an equivalent in treatises by other authors.

**TRIGONOMETRY.** Plane and Spherical.


**HISTORY.** General outlines of Ancient, Medieval and Modern History.

**GEOGRAPHY.** Physical, as much as is contained in *Tarr’s* text-book or an equivalent treatise.

**PHYSICS.** Elementary. The preparation on this subject should include a course of lectures, illustrated by experiments and recitations from a text-book like *Carhart and Chute’s*, or *Gage’s*. Laboratory work required.

**CHEMISTRY.** The elements of Chemistry. Laboratory work required.

**BOTANY, PHYSIOLOGY, AND ZOOLOGY.** Elementary.

**MODERN LANGUAGE.** Engineering students must present a three years’ course in German, French or Spanish.

**ENGLISH.** Part of the examination time is given for answering questions upon text-books and readings
required in the preparatory courses in English; the re-
mainder for writing an essay.

Subjects required for entrance to Freshman year:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>4</td>
</tr>
<tr>
<td>History</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3½</td>
</tr>
<tr>
<td>French or German</td>
<td>3</td>
</tr>
<tr>
<td>Science</td>
<td>2</td>
</tr>
<tr>
<td>Drawing</td>
<td>½</td>
</tr>
<tr>
<td>(Chemistry and Physics)</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>1</td>
</tr>
</tbody>
</table>

THE DEPARTMENT OF CIVIL ENGINEERING

The course of instruction are designed to prepare students for a thorough and systematic training in the sciences and in the principles of Civil Engineering, to perform intelligently the duties of their profession, either in the office or in some of the responsible positions superintending the construction and operation of public works. To secure these results the student is given, not only a sound theoretical training in the courses of study, but he is also required to study the practical applications of the principles upon which the theory is based. The first two years are devoted to the study of mathematics and the theoretical branches. The last two years are given to the study of applied courses—practical work in the laboratory and field, as much as possible, being required throughout the course.

Sufficient instruction is given in French and German to enable the student to read easily and intelligently professional works in these languages; and the study of English is pursued until the student is qualified to prepare acceptable themes on professional subjects. Instruction based upon standard text-books on engineering is given throughout the course by means of lectures, recitations, practice in laboratory, drawing-room and field. This work is largely supplemented by assigning to the student, for solution, practical problems bearing directly upon the subject matter discussed in the class-
room and requiring original investigation, thus training the student to habits of independence and awakening his interest in the work of his profession.

The Department is provided with all the instruments necessary for effective work in the different branches of field engineering. The instrumental outfit consists of surveyor's transits, engineers' transits with levels and vertical circles attached to telescopes, also solar attachments, engineers' wye levels and a plane table with all the attachments, clinometers, chains, tapes, leveling rods, etc., and one Olson's cement testing machine. After the student is taught the use and adjustment of the instruments, surveys, elementary in character, are commenced and continued progressively until the more difficult principles and methods are understood. In a similar manner is instruction given in the courses of sanitary engineering, hydromechanics, resistance of materials, bridges and roofs, etc., thus familiarizing the student with practical engineering subjects, and the most improved method of execution and designing. A large draughting room offers facilities for the proper study of all the courses in mechanical drawing and design. The room is splendidly lighted from above, well ventilated and contains the latest form of drawing tables. There are suitable arrangements for blueprinting, both by natural and electric light.

The constantly growing city of South Bend, with a population now of sixty thousand, is one of the most important manufacturing cities in the Middle West. Some of the largest plants in the world are situated here. One of the greatest water power developments in the United States is located a few miles from the University. Special advantages are thus afforded to students for the inspection of the most modern engineering works now
completed or in process of construction. The City Engineer is one of the examining board.

A thesis on some subject approved by the head of the Department connected with the course of study, is required to each student as a condition of graduation. The thesis must embody the results of original research.

THE DEPARTMENT OF MECHANICAL ENGINEERING

The Program of studies in Mechanical Engineering, leading to the degree of Mechanical Engineer, is open to young men who wish to prepare themselves for the designing of machinery, with its appurtenances, and for the successful management of power plants. As the program requires a thorough knowledge of pure and applied Mathematics, as well as of Physics, only those capable of adapting themselves to these requirements should take it up. The program of the department is modeled in the two fold belief that a thorough fundamental training is best secured by a study of the practical application of the principles involved, as well as of the theoretical principles.

The work of the department, conducted in connection with other departments elsewhere described, consists of the study, by text-book or lectures, of the materials used in mechanical engineering, accompanied by the science of pure mechanical kinematics, which traces the motions of connected parts without reference to the cause of such motions, to the work done or energy transmitted. This is succeeded by machine design, which is a direct development of kinematics, and the course continues throughout the Junior and Senior years.

The courses in Shop work are most complete. The first year's work is confined to practice in the woodshop, in which the principles of carpentry, turning, and
pattern-making are taught. When the students have become sufficiently skilled in woodwork, they take up the work of the foundry, blacksmith shop, and machine shop. A systematic course of training is provided, which advances the student by easy steps until he has mastered all the details of the work.

The latter part of the Senior year is largely taken up in the preparation of a graduation thesis. Here especially the student is taught to depend as much as possible upon his own resources and abilities in exercising his ingenuity. This is the culminating effort of the program embodying its chief results, and is expected to show considerable originality.

Every possible advantage is given the student wishing to specialize in some of the branches of engineering, toward furthering his knowledge and ability in the particular field desired. He may take up general machine design, steam design, specifications and contracts, installation and erecting, original research or gas engine design and operation. A systematic curriculum of study will be outlined in each individual case leading to a complete and proficient knowledge of the work undertaken.

Access may be had to all machinery and apparatus of the University contained in the various power plants and laboratories elsewhere described, and every effort is made by the authorities to make the work as comprehensive as possible.

The laboratories and shops are equipped with all necessary apparatus and machinery. The wood shop is supplied with modern work-benches fully equipped with the smaller tools necessary for carpentry, lathes for turned work, two jig saws, a pony planer, a joiner, an edge moulder and shaper, a universal trimmer, circular saw with dado and drilling attachments and band saw,
the whole forming an adequate equipment for a thorough mastery of joinery, scroll work and pattern making.

The power for operating the machine shop is derived from the electric plant of the University, two ten-horse power motors being used for this purpose, from which power is transmitted to the various machines by line shafting running the entire length of the building. The latest improved lathes have been provided, nine in number, varying from a five-inch swing in the smallest to a large engine lathe with sixteen foot bed, having a capacity for work twenty-eight inches in diameter. Two drill presses, a large planer, a shaping machine and a Brown and Sharp milling machine complete the outfit, thus making the machine shop a model of its kind. There have been completed lately in the machine shop seven new screw cutting lathes of fourteen-inch swing, a high speed bench hand lathe, one twenty-eight inch Sibley and Ware drill press, one horizontal 8x12 slide valve steam engine and a wood milling machine. The equipment is added to regularly, and recently a Seneca Falls lathe of fourteen inch swing and eight foot bed, a Crown high speed lathe, a Toledo punch press and a complete new set of chucks, drills, taps, mandrels and lathe dogs have been installed to meet the additional requirements of the courses. It is the policy of this department to refrain as much as possible from exercise work, and each student is usually taking part in the construction of some new machine or engaged on general repair work for the University, a plan which is regarded superior to a fixed routine of exercises.

The blacksmith shop has the usual complement for teaching forging, annealing, welding and tool-making. In the foundry work the student is instructed in the proper disposition of gates and sprues, the mixing of
sand, setting up and drawing simple and complicated patterns and core making. This is supplemented with lectures on the proper mixing and heating of cast iron for the various purposes for which it is used.

In addition to the facilities afforded by the shops, the engineering students have access to the steam and power plants of the University which have been recently remodeled and made to compare favorably with the best contemporary practice. The main steam plant contains two batteries of ten horizontal tubular boilers, aggregating 1200 horse power. In connection with the boilers is installed the necessary testing apparatus as follows: a Worthington hot water meter for measuring the amount of feed water, a feed water thermometer for getting temperature of same, a high range thermometer for temperature of generated steam, a throttling calorimeter for ascertaining the quality of steam and an automatic recording pressure gauge giving a continuous record of the boiler pressure. Provision is made for finding the temperature and pressure of the flue gases by means of a pyrometer and draught gauge and for obtaining samples of flue gas for analysis with Fisher's analysis apparatus. These, with a Carpenter coal calorimeter for determining the heating value of fuel, comprise a full and complete equipment for giving the student an intimate knowledge of the practical part of boiler management and testing. A Webster feed water and purifier, two compound duplex pumps, two vacuum pumps working on the heating system, two large Worthington fire pumps 16x9 by 12 with a capacity of 1500 gallons per minute, with numerous separators, steam traps, automatic reducing valves, etc., complete, the apparatus in the main steamplant. A McEwen high speed automatic engine, an Armington and Sims engine of smaller type and several low speed horizontal
engines with polar and roller planimeters, indicators, reducing wheels, slide rules and other necessary instruments, are used in studying the operation of the steam engine, distribution and economy of steam, regulation, valve setting and heat wastes.

There have been recently donated to the mechanical laboratory about four hundred brass and iron fittings used in steam and gas engineering, including feed water injectors, sight feed lubricators, oil cups, safety valves, relief valves, different varieties of globe valves, gate valves, tees, elbows, crosses, unions, bushings and reducers. Many of these have been sectioned to show the dimensions, and facilitate a study of the internal structure and arrangement of parts.

In the gas engine laboratory are installed one horizontal eleven horse power four cycle engine completely equipped for experimental runs, with indicator reducing motion, prony brake, scales and thermometers, a five horse power two-cycle vertical gas engine of the marine type, a four horse power horizontal four cycle gasoline engine with circulating pump and cooling tower, one Motsinger auto-sparker with induction coil, one Apple ignition dynamo with storage battery, two Hendricks automatic igniters together with carburettors, spark plugs, spark coils, indicators, and all necessary equipment for a complete study of the gas engine.

Recent additions include the latest type Kingston carburettor and muffler, a National storage battery, Pittsfield induction coils and dash coils, two Wizard magnetos with brass armored spark coils, one four engine cylinder distributor and a number of improved standard and meter spark plugs.

A set of castings for an eight horse power engine to be operated by alcohol has been placed in the machine
shop, and the work of designing and building the engine will be undertaken by the students.

In the department library, standard authors may be consulted and the current literature on engineering topics is kept on file for reference, as well as a complete line of trade catalogues.

**TWO-YEAR PROGRAM IN MECHANICAL ENGINEERING**

*Theory, Design and Operation of Gas, Oil and Vapor Engines.*

This program is devoted exclusively to the study of explosive motors, in theory, design, construction and operation.

The rapid progress made in recent years in the design of gas engines, together with their adaptation to the supplying of power for almost every requirement, has led to the establishment of this program for young men wishing to make a special study of this branch of engineering.

The essential work of the first year consists of a general descriptive study of the different types of engines with discussions on the general management, operations, care and special uses to which this type of motor may be applied. During the second year the general theory of the gas engine is studied and the design of an engine for specific purposes is undertaken by each student.

The laboratory work will consist in part of indicator practice, determination of mechanical and thermodynamic efficiency, speed regulation, and economy. To these are added studies in various kinds of ignition, operation of vaporizers and carburettors and practical management of internal combustion engines. A con-
siderable part of the work will consist of the complete adjustment and successful operation on the test-block, under varying loads of the engine built by the student. Experiments in flame, electric and hot tube ignition, operation of vaporizers and carburettors, construction of spark coils and care of motors will complete the work.

The courses in shopwork are intended to give practical application to the theories advanced in the class room by the complete building and testing of a gas engine of a design to be selected by the demonstrator. Each student is required to prepare the patterns and core boxes, machine the castings and forgings, assemble the complete engine and submit a comprehensive report of a test on the machine constructed. If the report proves satisfactory a certificate of proficiency is given to the student and the gas engine becomes his own property.

For admission to this program the student should have completed courses XIVa and XIVb in shopwork and must certify by examination or certificate evidence of a knowledge of algebra as far as logarithms, plane geometry, and his further ability to pursue the studies of the first year. In case a student has not had this preparatory work, he may, with special effort complete it in addition to the regular work of the course. Candidates shall also write a short essay, which must be satisfactory in spelling, sentence and paragraph construction.

THE DEPARTMENT OF ELECTRICAL ENGINEERING

The remarkable development of electrical industries during the past few years has created a demand for men skilled in the theory and practice of electrical and mechanical work. The study of the subjects arranged in the program of Electrical Engineering is intended
to give a general education as well as a special training in the technical branches involved in the various practical applications of electricity in industrial operations.

General theory is given in lectures and by recitations from standard text-books. In the laboratories and shops the operations explained in the class-room are performed by the student, in doing which he acquired skill in handling tools and instruments, and obtains a working knowledge of the principles involved. Careful records of the work done in laboratories are kept by the student and are handed in for suggestions and corrections at the end of every week.

The University is located near a great manufacturing centre in the growth of which electricity is taking a very prominent part. Electric power generated by steam is now being distributed and utilized in several large plants, some using the three phase alternating system, while others are using the direct current. Several of the largest water power developments in the Middle West are situated within a few miles of the University. From this system we receive three phase alternating currents which furnish light for our buildings and grounds, and power for driving motors in our shops and printing office, etc., all of which are operated by electricity.

There are numerous other transmission lines and electrical power plants operated by water power within a short distance. Our students visit these plants accompanied by an instructor who points out the applications of the text-book theory in the design of electrical apparatus and its operation under actual working conditions.

Each candidate for graduation must present at the end of the Senior year an acceptable thesis embodying the results of an extended original research on an
engineering subject, chosen at the beginning of the year, with the approval of the head of the department. The descriptive part must be typewritten, and bound in book form together with the drawings.

The equipment for the laboratory work in electrical engineering includes dynamos typical of the various classes, accessory apparatus and measuring instruments as follows: An A. C. induction motor arranged to operate on single phase circuits with a condenser compensator, a high frequency 1000 V. 33 K. W. composite wound Wood alternator of the latest type with exiccatore and a full set of switchboard instruments, several transformers of different capacity, a high tension transformer for testing insulation, an Edison bipolar 10 K. W. 125 V. generator, a Thompson-Houston arc light machine with regulator and fifteen lamps, a Wood arc machine, capacity 25 lights, an Edison bipolar, 3 K. W. 125 V. dynamo with special winding, a Van Depoele compound wound dynamo, a special A. C. 5 H. P. dynamo or rotary converter, a series wound dynamo with wrought iron field, number of small motors, a 10 H. P. induction motor, three phase, 220 volts. 60 cycles, a motor generator set consisting of an adjustable speed 8 H. P., D. C. motor, direct connected to a special multiphase, revolving field A. C. dynamo.

A three K. W. three phase rotary converter, an eight K. W. rotary converter, a set of inclined coil alternating current portable instruments, voltmeter, ammeter and wattmeter, telegraph relays, sounders, switchboard, etc., telephone apparatus including subscribers sets of various modern types, a fifty drop manual switchboard complete and a lot of separate drops, jacks, switches, lighting arresters, etc., automatic telephone switchboard containing first and second selector and connector switches,
interrupter heat coils, etc., and three subscribers sets—with this apparatus all the operations involved in the operation of a 10,000 system may be performed, a complete central energy switchboard, several lines and subscribers sets and a selective signaling four party line outfit, a collection of historical sets including Reis' transmitter and receiver, a standard portable bridge, a common portable bridge, a testing battery, a power or foot lathe with wood turning tools, drills and hand tools for metals, a set of tools for metal working, a calibrating lamp rack, a D'Arsonval and common galvanometers, Ballistic galvanometer, standard condenser, etc., for capacity work, resistance boxes, standard meghoms, etc., high resistance Thompson galvanometer, standard cells, voltmeter arranged for the comparison of incandescent lamps, a plug switchboard controlling all circuits, a plating dynamo and a buffer for cleaning and polishing work to be plated, solution tank, etc.,—in all, a complete outfit for electrotype work, a hot wire ammeter, twelve ammeters and voltmeters mostly of the Weston type for direct current measurements, a Kohlrausch bridge for measuring battery resistance, etc., a lot of arc lamps series and constant potential, open and enclosed arcs. Wattmeters of various types, a collection of motor starting rheostats, several sets of parts of incandescent lamps showing the various stages in their manufacture, a large collection of porcelain insulators used in electrical work including a lot of insulators for high tension transmission lines, a lot of armature core disks, transformer core stampings, dynamo frames, formed coils, brush holders, pole pieces, samples of insulation, commutator segments, etc., used in dynamos of good design, donated by leading manufacturers of electrical machinery, a case of marked samples of wire insulators,
lamps and other construction materials, a library of practical books of reference and files of leading periodicals and trade publications, a Cooper Hewitt mercury vapor lamp, a high frequency Tesla coil and condenser, a working model of the induction motor, an armature winding model mounted to rotate in bipolar and multipolar fields, a storage battery 25 cells with universal switch to connect for various voltages.

For the work of electricity and magnetism in the courses in physics there are the following: An absolute electrometer, a Holtz machine and apparatus for illustrating static phenomena, four induction coils, six bridges of different types, several ammeters and voltmeters, one 2,000 lb. electro magnet, standard resistance coils, a historical set of motors showing evolution of the modern machine from the early form of the reciprocating type, ten galvanometers of various types, a complete X-ray outfit, a set of apparatus for wireless telegraphy. For further apparatus consult pages 53, 54 and 55 of the general catalogue.

For the work in chemistry, drawing and shopwork, the equipment and facilities will be found described on pages 58, 71 and 87.

**SHORT PROGRAM FOR APPLIED ELECTRICITY**

Students who do not wish to take the languages and higher mathematics required in the regular four-year program should take up the Short program, which may be completed in two years. The studies are arranged to give an accurate knowledge of the fundamental theories of electricity and magnetism, as well as a certain amount of skill in handling electrical machinery and appliances. Algebra, geometry, trigonometry, and elementary physics are included, for they are necessary
in order to carry on successfully the practical work of designing, manufacturing and testing or operating electrical apparatus. Training in this practical work is given in the drafting room, the machine shops, and in the electrical and physical laboratories.

The actual conditions of the commercial application of electricity to the distribution of light and power are learned by testing, repairing and making additions to the University plant, and by visiting the numerous electric establishments in the vicinity, accompanied by an instructor.

The study of the principles of mechanical drawing is taken up early in the program and sufficient practice is given to enable the student to make working drawings and to follow them in the construction of apparatus in the shops and laboratories.

Applicants for admission to the Short program should be at least 17 years of age. They should have a fair knowledge of the subjects taught in the common schools, especially arithmetic and algebra, as far as logarithms and plane geometry. They shall also write a short essay which must be satisfactory in spelling, punctuation, sentence and paragraph construction.

THE DEPARTMENT OF MINING ENGINEERING

The wonderful growth and expansion of the mining industry, not only in this country but in Mexico, Central and South America, has created a constant demand for trained men who have a thoroughly practical as well as theoretical knowledge of mining operations.

The aim of this department is to give the student sufficient training in the various technical branches of mining to enable him to project and successfully carry through a mining enterprise.

The course of studies leading to the degree of Mining
Engineer includes the essential subjects of Mechanical Engineering, particularly those which have special prominence in mining work; for the economical operation of any mine depends to a great extent upon the judicious selection and proper operation of the machinery in the power plant, mill and smelter. Likewise the subjects of Civil Engineering with but few exceptions, are embraced in the mining course, for the reason that many of the problems of Civil Engineering must be solved in the laying out and directing of mining work. Plans and surveys of the surface improvements and underground workings of a mine are made by the Mining Engineer.

In addition to these subjects the course includes the following special branches: Crystallography, Mineralogy, Petrography, Physical and Chemical Geology, Economic Mining, Geology, Metallurgy, Ore Dressing, Assaying and a thorough study of Inorganic Chemistry in its application to mining and metallurgy.

Throughout the course the object is not only to present clearly the theory underlying each subject, but to fix it in the mind of the student by practical work in the laboratory, shop, drafting room and in trips to the mining districts where the student becomes familiar with the practical application of the principles laid down in the text-book and lectures.

The subject of the thesis required in this course must be along the line of mining and consists of original research work in one of its special branches, to be approved by the head of the department.
THE DEPARTMENT OF CHEMICAL ENGINEERING

Chemical manufacture has developed so rapidly and grown so exacting that there has arisen a demand for men who not only can create and improve chemical processes strictly so-called, but who can deal with the problems of construction and maintenance as far as they are related to the chemical industries. To prepare young men for such work the course in Chemical Engineering has been designed. The student taking up this course is given a thorough training in chemical principles similar to that outlined in the Course in Chemistry except that the laboratory period is somewhat shortened. To this training is added a certain amount of the theory and laboratory practice in Mechanical Engineering sufficient for the needs of chemical industries, together with a consideration of electrical currents as used in chemical manufacture.
PROFESSORS IN THE COLLEGE OF ENGINEERING

Rev. John Cavanaugh, C. S. C.,
President.

Rev. Matthew Walsh, C. S. C.,
History.

Rev. Alexander Marion Kirsch, C. S. C.,
Geology.

Rev. Joseph Maguire, C. S. C.,
Chemistry.

Rev. Michael Quinlan, C. S. C.,
Mathematics.

Rev. Julius Nieuwland, C. S. C.,
Chemistry.

Rev. Thomas Irving, C. S. C.,
Physics.

Rev. Michael J. Oswald, C. S. C.,
German.

Rev. Charles L. Doremus, C. S. C.,
French.

Rev. Francisco Marin, O. P.,
Spanish.

Rev. Ernest Davis, C. S. C.,
Chemistry.

Rev. William Bolger, C. S. C.,
Economics.
REV. CORNELIUS HAGERTY, C. S. C.,
Philosophy.

MARTIN J. MCCUE, M. S. C. E.,
Civil Engineering and Astronomy.

FRANCIS XAVIER ACKERMAN, M. S.,
Mechanical Drawing.

EDWARD JOSEPH MAURUS, M. S.,
Mathematics and Surveying.

JEROME JOSEPH GREEN, M. E. E. E.,
Electrical Engineering.

WILLIAM LOGAN BENITZ, M. E. E. E.,
Mechanical Engineering.

KNOWLES B. SMITH, E. M.,
Mining Engineering.

JOSÉ ANGEL CAPARO, M. S.,
Electrical Engineering and Physics.

THOMAS STEINER, C. E.,
Mathematics.

JOHN M. COONEY, A. M.,
English.

JESSE E. VERA, M. E. E. E.,
Mathematics and Physics.

JAMES HINES, Ph. B.,
Mathematics.

CARL EGGERT,
Shopwork.

JOHN FRIEDMAN,
Assistant in Shopwork.
### STUDIES PRESCRIBED FOR THE DEGREE OF CIVIL ENGINEER

#### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>5</td>
<td>80</td>
<td>I</td>
<td>Anal. Geom.</td>
<td>5</td>
<td>80</td>
<td>II</td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>77</td>
<td>I</td>
<td>English</td>
<td>3</td>
<td>77</td>
<td>I</td>
</tr>
<tr>
<td>French</td>
<td>4</td>
<td>93</td>
<td>I</td>
<td>French</td>
<td>4</td>
<td>93</td>
<td>I</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4</td>
<td>58</td>
<td>III</td>
<td>Chemistry</td>
<td>4</td>
<td>58</td>
<td>III</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>I</td>
<td>Surveying</td>
<td>3</td>
<td>64</td>
<td>II, III</td>
</tr>
</tbody>
</table>

#### SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus</td>
<td>5</td>
<td>81</td>
<td>III</td>
</tr>
<tr>
<td>Des. Geometry</td>
<td>3</td>
<td>63</td>
<td>I</td>
</tr>
<tr>
<td>Surveying</td>
<td></td>
<td></td>
<td>IV, V</td>
</tr>
<tr>
<td>Geodesy</td>
<td>5</td>
<td>64</td>
<td>VI</td>
</tr>
<tr>
<td>Physics</td>
<td>5</td>
<td>91</td>
<td>II, III</td>
</tr>
<tr>
<td>Drawing</td>
<td>1</td>
<td>72</td>
<td>V</td>
</tr>
</tbody>
</table>

#### JUNIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: An. Mechanics</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytic Mechanics</td>
<td>5</td>
<td>66</td>
<td>VIII</td>
</tr>
<tr>
<td>Geology</td>
<td>2</td>
<td>78</td>
<td>III</td>
</tr>
<tr>
<td>Stereotomy</td>
<td>2</td>
<td>72</td>
<td>VI</td>
</tr>
<tr>
<td>Astronomy</td>
<td>2</td>
<td>57</td>
<td>I</td>
</tr>
<tr>
<td>Philosophy</td>
<td>4</td>
<td>90</td>
<td>IV</td>
</tr>
<tr>
<td>Pol. Science</td>
<td>4</td>
<td>93</td>
<td>IX</td>
</tr>
</tbody>
</table>

#### SENIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: Engineering</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>5</td>
<td>68</td>
<td>XII</td>
</tr>
<tr>
<td>Hydromechan.</td>
<td>3</td>
<td>70</td>
<td>XVI</td>
</tr>
<tr>
<td>Bridges, Roofs</td>
<td>5</td>
<td>69</td>
<td>XIV</td>
</tr>
<tr>
<td>Sanitary Eng.</td>
<td>2</td>
<td>69</td>
<td>XIII</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBJECTS: Engineering</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>5</td>
<td>68</td>
<td>XII</td>
</tr>
<tr>
<td>Hydromechan.</td>
<td>3</td>
<td>70</td>
<td>XVI</td>
</tr>
<tr>
<td>Graph. Stat.</td>
<td>5</td>
<td>70</td>
<td>XV</td>
</tr>
<tr>
<td>Sanitary Eng.</td>
<td>2</td>
<td>69</td>
<td>XIII</td>
</tr>
<tr>
<td>Roads, Pav'mt, Thesis</td>
<td>2</td>
<td>67</td>
<td>XI</td>
</tr>
</tbody>
</table>
### Freshman Year

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
<th>Second Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>5</td>
<td>80 I</td>
<td>Anal. Geom.</td>
<td>5</td>
<td>80 II</td>
</tr>
<tr>
<td>French</td>
<td>4</td>
<td>93 I</td>
<td>French</td>
<td>5</td>
<td>93 I</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71 I</td>
<td>Drawing</td>
<td>3</td>
<td>71 II</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4</td>
<td>58 III</td>
<td>Chemistry</td>
<td>4</td>
<td>58 III</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVa</td>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVb</td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>77 I</td>
<td>English</td>
<td>3</td>
<td>77 I</td>
</tr>
</tbody>
</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
<th>Second Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus</td>
<td>5</td>
<td>81 III</td>
<td>Calculus</td>
<td>5</td>
<td>81 IV, V</td>
</tr>
<tr>
<td>Drawing</td>
<td>2</td>
<td>73 VIII</td>
<td>Drawing</td>
<td>2</td>
<td>73 VIII</td>
</tr>
<tr>
<td>Physics</td>
<td>5</td>
<td>91 II, III</td>
<td>Physics</td>
<td>5</td>
<td>91 II, III</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVc</td>
<td>Shopwork</td>
<td>3</td>
<td>88 XIVd</td>
</tr>
<tr>
<td>Pol. Science</td>
<td>4</td>
<td>93 IX</td>
<td>History</td>
<td>4</td>
<td>80 IIB</td>
</tr>
</tbody>
</table>

### Junior Year

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
<th>Second Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>An. Mechanics</td>
<td>5</td>
<td>66 VIII</td>
<td>Hydromechan.</td>
<td>2</td>
<td>70 XVI</td>
</tr>
<tr>
<td>Kinematics</td>
<td>3</td>
<td>84 V</td>
<td>Mech's of Mat.</td>
<td>3</td>
<td>67 X</td>
</tr>
<tr>
<td>Physics</td>
<td>2</td>
<td>92 IV</td>
<td>Mach'nDesign</td>
<td>2</td>
<td>85 VI</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>88 XIVe</td>
<td>Valve Gears</td>
<td>1</td>
<td>85 VIIb</td>
</tr>
<tr>
<td>Philosophy</td>
<td>4</td>
<td>90 IV</td>
<td>Physics</td>
<td>2</td>
<td>92 IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Shopwork</td>
<td>3</td>
<td>88 XIVf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Philosophy</td>
<td>4</td>
<td>90 IV</td>
</tr>
</tbody>
</table>

### Senior Year

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
<th>Second Term</th>
<th>Hrs. a Wk.</th>
<th>Subj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>2</td>
<td>83 II</td>
<td>Steam Power</td>
<td>4</td>
<td>83 III</td>
</tr>
<tr>
<td>Thermodynam.</td>
<td>4</td>
<td>82 I</td>
<td>Plants</td>
<td>3</td>
<td>84 IV</td>
</tr>
<tr>
<td>Steam Power Plants</td>
<td>4</td>
<td>83 III</td>
<td>Steam Boilers</td>
<td>3</td>
<td>84 I</td>
</tr>
<tr>
<td>Mech'an Lab.</td>
<td>2</td>
<td>86 VIII</td>
<td>Thermodynam.</td>
<td>4</td>
<td>82 I</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>88 XIVf</td>
<td>Surveying</td>
<td>3</td>
<td>84 II, III</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thesis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
STUDIES PRESCRIBED FOR SHORT PROGRAM IN MECHANICAL ENGINEERING

FIRST YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs.</th>
<th>SEE FOR DESCRIPTION</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a Wk.</td>
<td>P'ge</td>
<td>Course</td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td>5</td>
<td></td>
<td>E</td>
<td>Trigonometry'</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>I</td>
<td>Drawing</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVc</td>
<td>Shopwork</td>
</tr>
<tr>
<td>Chemistry</td>
<td>5</td>
<td>57</td>
<td>I</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Physics</td>
<td>5</td>
<td>91</td>
<td>I</td>
<td>Physics</td>
</tr>
<tr>
<td>Gas Engines</td>
<td>5</td>
<td>86</td>
<td>X</td>
<td>Vapor Engines</td>
</tr>
</tbody>
</table>

SECOND YEAR

| Gas Engine Design     | 15   | 87   | XI     | Gas Engine Design     | 10   | 87   | XI     |
| Gas Power Plants      | 3    | 85   | VII    | Gas Engine Laboratory | 3    | 87   | XIII   |
| Gas Engine Construction | 3   | 87   | XII    | Gas Engine Construction | 3   | 87   | XII    |
|                        |      |      |        | Engines and Boilers   | 3    | 86   | IX     |
# STUDIES PRESCRIBED FOR THE DEGREE OF ELECTRICAL ENGINEER

## FRESHMAN YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>5</td>
<td>80 I</td>
<td>Anal. Geom.</td>
<td>5</td>
<td>80 II</td>
</tr>
<tr>
<td>French</td>
<td>4</td>
<td>93 I</td>
<td>French</td>
<td>4</td>
<td>93 II</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71 I</td>
<td>Drawing</td>
<td>3</td>
<td>71 II</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4</td>
<td>58 III</td>
<td>Chemistry</td>
<td>4</td>
<td>58 III</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVa</td>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVb</td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>77 I</td>
<td>English</td>
<td>3</td>
<td>77 I</td>
</tr>
</tbody>
</table>

## SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus</td>
<td>5</td>
<td>81 III</td>
<td>Calculus</td>
<td>5</td>
<td>81 IV, V</td>
</tr>
<tr>
<td>Des. Geometry</td>
<td>2</td>
<td>72 III</td>
<td>Des. Geometry</td>
<td>2</td>
<td>72 III</td>
</tr>
<tr>
<td>Physics</td>
<td>3</td>
<td>91 XIVc</td>
<td>Physics</td>
<td>5</td>
<td>91 II, III</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVa</td>
<td>Shopwork</td>
<td>3</td>
<td>87 XIVd</td>
</tr>
<tr>
<td>Pol. Science</td>
<td>4</td>
<td>93 IX</td>
<td>History</td>
<td>4</td>
<td>80 IIb</td>
</tr>
</tbody>
</table>

## JUNIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytic Mechanics</td>
<td>5</td>
<td>66 VIII</td>
<td>Hydromechan.</td>
<td>2</td>
<td>70 VIII</td>
</tr>
<tr>
<td>Kinematics</td>
<td>3</td>
<td>84 V</td>
<td>Mech's of Mat.</td>
<td>3</td>
<td>67 VIII</td>
</tr>
<tr>
<td>Physics</td>
<td>2</td>
<td>90 IV</td>
<td>Mach'n Design</td>
<td>2</td>
<td>85 VI</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>88 XIVe</td>
<td>Electrical Measurement</td>
<td>1</td>
<td>92 V</td>
</tr>
<tr>
<td>Philosophy</td>
<td>4</td>
<td>90 IV</td>
<td>Shopwork</td>
<td>3</td>
<td>88 VI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calorimetry</td>
<td>1</td>
<td>92 VI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Philosophy</td>
<td>4</td>
<td>93 IV</td>
</tr>
</tbody>
</table>

## SENIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>SEE FOR DESCRIPTION P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamo Machinery</td>
<td>4</td>
<td>74 III</td>
<td>Dynamo Mach</td>
<td>4</td>
<td>74 I</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>5</td>
<td>82 I</td>
<td>Electrical Lab.</td>
<td>4</td>
<td>75 IV</td>
</tr>
<tr>
<td>Electrical Lab.</td>
<td>4</td>
<td>75 IV</td>
<td>Designing</td>
<td>2</td>
<td>75 V</td>
</tr>
<tr>
<td>Designing</td>
<td>3</td>
<td>75 V</td>
<td>Thermodynamics</td>
<td>5</td>
<td>82 I</td>
</tr>
<tr>
<td>Power</td>
<td>1</td>
<td>76 VIII</td>
<td>Illuminating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td></td>
<td></td>
<td>Engineering</td>
<td>1</td>
<td>76 XII</td>
</tr>
<tr>
<td>Electric Ry.</td>
<td></td>
<td></td>
<td>Thesis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## STUDIES PRESCRIBED FOR SHORT PROGRAM IN APPLIED ELECTRICITY

### FIRST YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>5</td>
<td></td>
<td>C</td>
<td>Geometry</td>
<td>5</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>I</td>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>II</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVa</td>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVb</td>
</tr>
<tr>
<td>Physics</td>
<td>5</td>
<td>91</td>
<td>I</td>
<td>Physics</td>
<td>5</td>
<td>91</td>
<td>I</td>
</tr>
<tr>
<td>Applied Electricity</td>
<td>5</td>
<td>73</td>
<td>I</td>
<td>Applied Electricity</td>
<td>5</td>
<td>73</td>
<td>I</td>
</tr>
</tbody>
</table>

### SECOND YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigonometry</td>
<td>5</td>
<td>75</td>
<td>F</td>
<td>Engines and Boilers</td>
<td>3</td>
<td>86</td>
<td>IX</td>
</tr>
<tr>
<td>Designing</td>
<td>3</td>
<td>75</td>
<td>V</td>
<td>Designing</td>
<td>3</td>
<td>75</td>
<td>V</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVc</td>
<td>Shopwork</td>
<td>3</td>
<td>88</td>
<td>XIVd</td>
</tr>
<tr>
<td>Dynamo</td>
<td>5</td>
<td>74</td>
<td>III</td>
<td>Dynamo Machinery</td>
<td>5</td>
<td>74</td>
<td>III</td>
</tr>
<tr>
<td>Machinery</td>
<td></td>
<td></td>
<td></td>
<td>Applied Machinery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied Electricity</td>
<td>5</td>
<td>74</td>
<td>II</td>
<td>Applied Electricity</td>
<td>5</td>
<td>74</td>
<td>II</td>
</tr>
</tbody>
</table>
### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SEE FOR DESCRIPTION</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SEE FOR DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>4</td>
<td>58</td>
<td>III</td>
<td>Chemistry</td>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>71</td>
<td>I</td>
<td>Drawing</td>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVa</td>
<td></td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>87</td>
<td>XIVa</td>
<td>Shopwork</td>
<td>English</td>
<td>3</td>
<td>77</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>77</td>
<td>I</td>
<td>English</td>
<td>Mining Eng.</td>
<td>3</td>
<td>90</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Mining Eng.</td>
<td>3</td>
<td>90</td>
<td>I</td>
<td>Mining Eng.</td>
<td>Surveying</td>
<td>3</td>
<td>64</td>
<td>II, III</td>
<td></td>
</tr>
</tbody>
</table>

### SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SEE FOR DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus</td>
<td>5</td>
<td>81</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>Surveying</td>
<td>4</td>
<td>65</td>
<td>IV, V</td>
<td></td>
</tr>
<tr>
<td>Geodesy</td>
<td>5</td>
<td>91</td>
<td>II, III</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>3</td>
<td>59</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Drawing</td>
<td>1</td>
<td>72</td>
<td>V</td>
<td>History</td>
</tr>
<tr>
<td>Pol. Science</td>
<td>4</td>
<td>93</td>
<td>IX</td>
<td></td>
</tr>
<tr>
<td>Calculus</td>
<td>5</td>
<td>81</td>
<td>IV, V</td>
<td></td>
</tr>
<tr>
<td>Surveying</td>
<td>6</td>
<td>59</td>
<td>IIIII</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>5</td>
<td>91</td>
<td>II, III</td>
<td></td>
</tr>
<tr>
<td>Drawing</td>
<td>1</td>
<td>72</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>4</td>
<td>80</td>
<td>IIb</td>
<td></td>
</tr>
</tbody>
</table>

### JUNIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SEE FOR DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineralogy</td>
<td>3</td>
<td>77</td>
<td>II</td>
<td>Hydromechan.</td>
</tr>
<tr>
<td>Drawing</td>
<td>2</td>
<td>73</td>
<td>VIII</td>
<td>Mineralogy</td>
</tr>
<tr>
<td>Geology</td>
<td>2</td>
<td>78</td>
<td>III</td>
<td>Drawing</td>
</tr>
<tr>
<td>Crystall'phy</td>
<td>5</td>
<td>78</td>
<td>IV</td>
<td>Geology</td>
</tr>
<tr>
<td>Philosophy</td>
<td>4</td>
<td>90</td>
<td>IV</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Ore Dressing</td>
<td>3</td>
<td>89</td>
<td>IV</td>
<td>Assaying</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>3</td>
<td>88</td>
<td>I</td>
<td>Economic</td>
</tr>
<tr>
<td>Phys.Chem.&amp;Geol.</td>
<td>3</td>
<td>78</td>
<td>VI</td>
<td>Mining Geol.</td>
</tr>
<tr>
<td>Petrography</td>
<td>2</td>
<td>78</td>
<td>V</td>
<td>Graph. Static.</td>
</tr>
<tr>
<td>Gas Engines</td>
<td>5</td>
<td>86</td>
<td>X</td>
<td>Petrography</td>
</tr>
<tr>
<td>Mat. of Engin'g</td>
<td>2</td>
<td>83</td>
<td>II</td>
<td>Eng. &amp; Boilers</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>88</td>
<td>XIVE</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

### SENIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>Hrs. a Wk.</th>
<th>P'ge</th>
<th>Course</th>
<th>SEE FOR DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ore Dressing</td>
<td>3</td>
<td>89</td>
<td>IV</td>
<td>Assaying</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>3</td>
<td>88</td>
<td>I</td>
<td>Economic</td>
</tr>
<tr>
<td>Phys.Chem.&amp;Geol.</td>
<td>3</td>
<td>78</td>
<td>VI</td>
<td>Mining Geol.</td>
</tr>
<tr>
<td>Petrography</td>
<td>2</td>
<td>78</td>
<td>V</td>
<td>Graph. Static.</td>
</tr>
<tr>
<td>Gas Engines</td>
<td>5</td>
<td>86</td>
<td>X</td>
<td>Petrography</td>
</tr>
<tr>
<td>Mat. of Engin'g</td>
<td>2</td>
<td>83</td>
<td>II</td>
<td>Eng. &amp; Boilers</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3</td>
<td>88</td>
<td>XIVE</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

### SUMMER WORK.

(To be done during the summer preceding the Senior Year.)

This course consists of actual Mining Engineering practice in the mines of the Lake Superior district, under the direction of the head of the department. Each student is required to make a complete, accurate underground survey with a mining transit, connecting the mine traverse with one on surface, through vertical and inclined shafts. A study of the different methods of mining in several mines are made with special attention given to Geology in its relation to economic mining; ore dressing mills and metallurgical plants are carefully inspected to familiarize the student with the best concentrating and smelting methods. Sixty hours a week for four weeks.
## UNIVERSITY OF NOTRE DAME

### STUDIES PRESCRIBED FOR THE DEGREE OF CHEMICAL ENGINEER

## FRESHMAN YEAR

<table>
<thead>
<tr>
<th>SUBJECTS: First Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
<th>SUBJECTS: Second Term</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>5 80</td>
<td>I</td>
<td>Anal. Geom.</td>
<td>5' 80</td>
<td>II</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4 58</td>
<td>III</td>
<td>Chemistry</td>
<td>4 58</td>
<td>III</td>
</tr>
<tr>
<td>Drawing</td>
<td>3 71</td>
<td>I</td>
<td>Drawing</td>
<td>3 71</td>
<td>II</td>
</tr>
<tr>
<td>French</td>
<td>4 93</td>
<td>I</td>
<td>French</td>
<td>4 93</td>
<td>I</td>
</tr>
<tr>
<td>English</td>
<td>3 77</td>
<td>I</td>
<td>English</td>
<td>3 77</td>
<td>I</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3 87</td>
<td>XIVa</td>
<td>Shopwork</td>
<td>3 87</td>
<td>XIVb</td>
</tr>
</tbody>
</table>

## SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus</td>
<td>5 81</td>
<td>III</td>
<td>Calculus</td>
<td>5 81</td>
<td>IV, V</td>
</tr>
<tr>
<td>Physics</td>
<td>5 91</td>
<td>II, III</td>
<td>Physics</td>
<td>5 91</td>
<td>II, III</td>
</tr>
<tr>
<td>Drawing</td>
<td>2 72</td>
<td>III</td>
<td>Drawing</td>
<td>2 72</td>
<td>III</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4 59</td>
<td>V</td>
<td>Chemistry</td>
<td>4 59</td>
<td>V</td>
</tr>
<tr>
<td>Shopwork</td>
<td>3 87</td>
<td>XIVc</td>
<td>Shopwork</td>
<td>3 88</td>
<td>XIVd</td>
</tr>
<tr>
<td>Pol. Science</td>
<td>4 93</td>
<td>IX</td>
<td>History</td>
<td>4 80</td>
<td>IIb</td>
</tr>
</tbody>
</table>

## JUNIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>5 59</td>
<td>VI</td>
<td>Chemistry</td>
<td>5 63</td>
<td>XV</td>
</tr>
<tr>
<td>Physics</td>
<td>2 92</td>
<td>IV</td>
<td>Physics</td>
<td>2 92</td>
<td>IV</td>
</tr>
<tr>
<td>Anal. Mech.</td>
<td>5 66</td>
<td>VIII</td>
<td>Mech. of Mats.</td>
<td>3 67</td>
<td>X</td>
</tr>
<tr>
<td>Kinematics</td>
<td>3 84</td>
<td>V</td>
<td>Hydromechan.</td>
<td>2 70</td>
<td>XVI</td>
</tr>
<tr>
<td>Drawing</td>
<td>2 73</td>
<td>VIII</td>
<td>Chemistry</td>
<td>2 60</td>
<td>VIII</td>
</tr>
<tr>
<td>Philosophy</td>
<td>4 90</td>
<td>IV</td>
<td>Steam Boilers</td>
<td>3 86</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Philosophy</td>
<td>4 90</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Drawing</td>
<td>2 73</td>
<td>VIII</td>
</tr>
</tbody>
</table>

## SENIOR YEAR

<table>
<thead>
<tr>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
<th>SUBJECTS:</th>
<th>Hrs. a Wk.</th>
<th>P'ge Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>5 61</td>
<td>IX</td>
<td>Chemistry</td>
<td>5 61</td>
<td>IX</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3 63</td>
<td>XIII</td>
<td>Chemistry</td>
<td>4 61</td>
<td>XI</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3 63</td>
<td>XIV</td>
<td>Chemistry</td>
<td>3 63</td>
<td>XIV</td>
</tr>
<tr>
<td>Thermodynam.</td>
<td>4 82</td>
<td>I</td>
<td>Thermodynam.</td>
<td>4 82</td>
<td>I</td>
</tr>
<tr>
<td>Mech'I. Lab.</td>
<td>2 86</td>
<td>VIII</td>
<td>Thesis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COURSES OF INSTRUCTIONS

(In the description of the courses of instruction an hour means forty-five to sixty minutes in the recitation or lecture room and one hundred and twenty minutes in the laboratory, the drawing room or the shop. A term means a half year, or eighteen weeks.)
ASTRONOMY

ASTRONOMY. Practical. This course is designed to meet the requirements of Civil Engineering students and to give them the training and information necessary for intelligently executing certain departments of work to which they may be assigned in the course of their professional career. The course comprises a study of astronomical instruments as well as instruments of more precision than those used in ordinary surveying. The adjustments and use of these instruments are considered, and instruction is given in methods of observation and computation; problems in finding right ascensions and declination; different methods for finding altitude, longitude and time are studied in detail, and the methods for finding right ascensions and declination; different methods for finding latitude, longitude and time are studied in detail, and the methods of making the observation and their adjustments, and discussion of errors. Conversion of solar time into sidereal, and sidereal time into solar. In connection with this subject is given a more complete study of many of the topics considered in elementary astronomy, as here they are treated mathematically; as for example, methods for finding parallax, computation of eclipses, altitudes and correction for refraction. The subjects on procession, nutation, annual aberration, proper motion of stars, etc., are studied. Text-books, Young, Greene,

[Two hours a week for one term.]

CHEMISTRY

I.

(a) GENERAL CHEMISTRY. A minor course dealing with the general principles of chemistry and embracing a study of only the commoner elements and their typical
compounds. Text-book, *Maguire's Elements of Chemistry*  
[Three hours a week for two terms.]

(b) A Laboratory Course covering in the laboratory the work of the Course (Ia.) and designed to accompany it. *Laboratory Manual, Maguire.*  
[Two hours a week for two terms.]

II.

(a) General Chemistry. Lectures, recitations and laboratory. A course in the fundamental principles of the science in connection with the consideration of the non-metals and a somewhat detailed study of the metals. It is intended for those students who have made no previous study of chemistry and is equivalent to the work done in I. and III.  
[Four periods a week for two terms.]

(b) The laboratory consists in the first term of the preparation and study of the gases and the principles involved in such work. In the second term metals are taken up and considered with regard to their qualitative separation.  
[Four periods a week for two terms.]

III.

(a) Advanced Inorganic Chemistry. Lectures and recitations. A complete study of the elements and their most important compounds, following the classification based on Mendeléeff's Law, and including a discussion of the theories of the science. Text-book, *Alexander Smith's College Chemistry.*  
[Two hours a week for two terms.]

(b) Experimental Chemistry. A Laboratory course to accompany Course II., the work consisting of the preparation by the student of the elements and their more typical compounds, determination of molecular
weights, verification of the fundamental laws of chemistry, etc. During the latter part of the course, there is taken up the study of the reactions involved in the separation and detection of the more common inorganic bases and acids, the analysis of salts, mixtures of salts, and the complex substances, such as earths, ores, ashes, etc. Text-books, *Perkin* and *Thorpe*, supplemented with lectures.

[Two to three hours a week for two terms.]

IV.

(a) **Qualitative Analysis.** A course arranged for the students in Pharmacy, comprising a study of the commoner metals and acids, their reactions and separation. Text-book, *Perkin*.

[Four hours a week for one term.]

(b) **Quantitative Analysis.** Course suited to the needs of the students in Pharmacy, comprising the determination of substances, both gravimetrically and volumetrically. Text-books, *Appleton* and *Schimpf*.

[Four hours a week for one term.]

V.

**Quantitative Analysis.** A laboratory study of the principles involved in the quantitative separation and estimation of substances, both gravimetrically and volumetrically. Complete analysis of a number of simple salts, like barium chloride, with partial analysis of many complex substances. Text-book, *Talbot*.

[Four hours a week for two terms.]

VI.

(a) **Elementary Organic Chemistry.** Lectures and recitations. A systematic study of the hydrocarbons and their derivatives, and the investigation of their
properties. Special attention is given to the aliphatic and aromatic series. Text-book, Remsen.

[Five hours a week for one term.]

(b) Experimental Organic Chemistry. A course fitted to accompany the preceding, involving the preparation by the student in the laboratory of the most important and typical organic compounds and the investigation of their properties. Text-book, Gatterman's Manual.

[Two hours a week for one term.]

VII.

(a) Urine Analysis. A course of laboratory exercises in the methods employed in the detection and estimation of the constituents of urine, pathologic as well as normal. Text-book, Holland.

[Three hours a week for one term.]

(b) Toxicology. Symptoms and treatment of poisoning. A chemical and physical examination of the common poisons to familiarize the student with their properties. Attention is also given to their separation from food and animal tissue. Text-book, Holland.

[Three hours a week for one term.]

VIII.

Technical Chemical Analysis. Advanced courses intended for students specializing in chemistry. Special courses, at the option of the student, in

i. Gas Analysis.

ii. Water Analysis.


v. Oils and Fats.

vi. Iron Analysis.

Text-books, Hempel, Mason, Wiley and current journals.

[Five to fifteen hours a week for two terms.]
IX.

(a) Advanced Organic Chemistry. An advanced course, intended for students specializing in chemistry. Lectures, recitations and discussions of special subjects of organic chemistry, synthetic chemistry, isomerism, and stereochemistry. Text-books, Cohen and special reference works.

[Two hours a week for one term.]

(b) Advanced Organic Laboratory. The term is spent principally in the making of organic preparations by methods demanding special care, skill and accuracy in the student.

[Six to eight hours a week for two terms.]

(c) Advanced Organic Laboratory. This term is devoted to ultimate organic analysis, qualitative and quantitative; analysis of carbon, hydrogen, the halogens, sulphur and nitrogen in organic compounds by the various methods; also in the determination of molecular weights of organic compounds. Text-books, special notes and reference work.

[Eight hours a week for one term.]

X.

General Pharmaceutical Chemistry. In this course the chemical bases and their compounds are considered, with special reference to their importance in pharmacy and materia medica. Text-books, Sadler's and Trimble's Pharmaceutical Chemistry.

XI.

(a) Electrochemistry. Lectures and recitations on the principles of electrochemistry and their application in the chemical industries, separation of metals, the preparation of chemical elements and electrosynthesis of compounds. Text-book, Lüpke.

[Two hours a week for one term.]
(b) **Electrochemical Laboratory.** A laboratory course accompanying Course XI (a). Experiments demonstrating the laws and principles of electrochemistry, electrolysis, electrosynthesis and electrometallurgy. Text-book, *Lüpke*.

[One hour a week for one term.]

(c) **Electrochemical Analysis.** A laboratory course for those who have completed (a) and (b). Quantitative determination and separation of metals and anions electrolytically using stationary and revolving electrodes, the mercury cathode and their combinations. Text-book, *Smith's Electro-anaylsis*.

[One hour a week for one term.]

XII.

**History of Chemistry.** The subject is divided into topics and epochs of special interest in the development of chemistry as a science. These are discussed at length, together with the biographies of the men who aided in their development. Lectures and recitations. Seminar and journal work for advanced students. Text-book, *Meyer*. Reference to chemical periodicals.

[Three hours a week for one term.]

XIII.

(a) **Physical Chemistry.** Lectures and recitations. A mathematical exposition of chemical theory on the subject of gas density, solutions, chemical dynamics, the phase rule, thermochemistry, photo-chemistry, etc. Text-book, *Jones*.

[Three hours a week for one term.]

(b) **Experimental Physical Chemistry.** Laboratory work to accompany Course XIII (a). Vapor density methods, calorimetric demonstrations, mole-
cular weight demonstrations by the freezing and boiling point methods, etc.

[One hour a week for one term.]

XIV.

**INDUSTRIAL CHEMISTRY.** Lectures, recitations and laboratory work. The consideration of chemical manufacture, fuels, etc., and the preparation in the laboratory of chemically pure substances, organic and inorganic. Special reference books and journals.

[Three hours a week for two terms.]

XV.

**ADVANCED QUANTITATIVE.** Mostly laboratory work in special methods for gravimetric and volumetric determinations of inorganic substances. Special reference-work. [Five hours a week for one term.]

**RESEARCH WORK.** Special facilities are offered to graduate students desiring to do original research work in chemistry, preparatory to the Master's or Doctor's degree.

## CIVIL ENGINEERING

I.

**DESCRIPTIVE GEOMETRY.** In this course are considered problems on the point, right line, and plane; single curved, double curved, and warped surfaces; problems relating to tangent planes, to single curved, double curved and warped surfaces; intersection of surfaces; spherical projections; orthographic, stero­graphic, globular, cylindrical, and conic projections; construction of maps, shades and shadows; linear perspective; isometric projections; theory and plates. Numerous practical problems and exercises requiring
the application of the principles of Descriptive Geometry, are added by the instructor. Text-book, *Church*. [Three hours a week for two terms.]

II.

Surveying. This course comprises the whole theory of land surveying and leveling; the use and adjustment of the transit, compass, level, and plane table; methods of measuring; relocations of boundaries; supply omissions; obstacles to measurement; computations; field notes and plots; laying out land; parting off land; dividing up land; public land survey. Text-book, *Breed and Hosmer*. [Three hours a week for one term.]

III.

Surveying. Field practice and application of theory; adjustment and use of instruments in the field; solution of problems in the field, the theory of which is taught in the class room; practice in keeping field notes; computation and plots. [One hour a week for one term.]

IV.

Higher Surveying. This course is a more complete treatment of the theory of Surveying than Course II, and cannot be taken until the completion of that course. It treats of the adjustment, use, and care of all kinds of engineering instruments; problems pertaining to solar attachment; topographical surveying with the transit and stadia; mining surveying, mining claims; survey of mines with shafts and drifts; determining positions of ends of tunnels, and depths below surface; Hydrographic surveying which comprises a study of the methods of making soundings and locating the same; the use of bench-marks, gauges, and water
levels; stream measurements, methods and instruments used. City surveying, including a study of re-surveys, topographic surveys, city plan, location of streets, width of grades, field notes, indexing and records. Text-book, Johnson.

[Four hours a week for twelve weeks.]

V.

Surveying. Exercises in the field in the adjustment and use of engineering instruments; stadia and plane table surveying in the fields, leveling; practice in hydrographic surveying.

[One hour a week for one term.]

VI.

Geodesy. This is an elementary course prescribed for Civil and Mining Engineering students and comprises a study of the instruments and methods of observation, base measurements and field work of the triangulation; method of least squares, elementary course; calculation of the triangulation, the theory of probable errors; geodetic latitudes, longitudes, and azimuths. This is followed by a brief discussion of the figure of the earth. Text-book, Johnson.

[Five hours a week for six weeks.]

VII.

Railroad Surveying. This course comprises all the theory pertaining to reconnaissance and preliminary surveying for a railroad; theory and maximum economy in grades and curves; location of curves by deflection angles and offsets; obstacles to location of curves; special problems in curves; theory of compound curves; turnouts and crossings; curving the rail on curves and elevation of outer rail; easing grades on curves; vertical curves; earthwork and prismoidal formula; theory
of excavation and embankment; correction in excavation on curves; cross-section leveling; theory of the transition curve and practical applications. Text-book, Crandall.

[Four hours a week for one term.]

VIII.

RAILROAD SURVEYING. Exercise in the field; staking out and running tangents, simple, compound and transition curves; execution on the ground of many problems previously treated theoretically; survey for a short line of railroad, leveling, cross-section work, and setting slope stakes; making profiles and maps; calculating the necessary excavations and embankments and cost of construction; culverts.

[One hour a week for one term.]

IX.

ANALYTIC MECHANICS. The aim of this course is to prepare students of engineering for the study of the courses of applied mechanics. The course comprises a study of the fundamental principles of statics, kinematics and kinetics. The subjects selected are studied with the object of thoroughly preparing the engineering student to pursue the technical and practical branches of their respective courses. Some of the topics considered in this course are: work, energy, conservation of energy; power, composition and resolution of forces, center of gravity, center of mass, moment of inertia, acceleration, dynamics of rigid bodies; laws of friction, etc.

[For Civil Engineering Students, five hours a week for first term. Two hours a week for second term.]
[For Students in Electrical, Mechanical, Chemical, and Mining Engineering, five hours a week for fourteen weeks.]
X.

MECHANICS OF MATERIALS. This course is intended to meet the requirements of engineering students, and to prepare them, by study of the action and effect of forces on beams and structures, to design economically and intelligently the parts entering into a complete structure. The course comprises a study of the elastic and ultimate strength and ultimate deformation of the materials of engineering, their properties and method of testing, and discussion of cases of simple stresses. The general theory of beams including cases of simple and cantilever beams, overhanging, fixed, and continuous beams, is thoroughly investigated. Columns are examined according to Euler's, Rankin’s and other formulae, and results compared. Some of the other subjects considered in this course are torsion of shafts, the transmission of power by shafts, apparent combined stresses, such as flexure and compression, flexure and torsion, etc. Compound columns and beams, reinforced concrete beams, plate girders and other forms. Then is studied the subjects, resilience and work, impact and fatigue, true internal stresses, centrifugal tension and flexure, unsymmetric loads on beams, the course closing with a study of the mathematical theory of elasticity.

[For students of Civil Engineering, three hours a week for two terms.]

[For students of Electrical, Mechanical, Mining and Chemical Engineering, three hours a week for twenty-two weeks.]

XI.

ROADS AND PAVEMENTS. This course is intended to familiarize the student with the practical details of laying out and constructing highways, the method
of drainage, grading, and most suitable road covering, the improvement of streets in cities and materials used for paving and covering. The manner of preparing the street before paving is placed in position is fully considered and illustrated. The course includes a thorough discussion of the theory of pavements and a description of the various materials used, such as cobble and stone-block, asphalt, brick, wood and broken stone pavements. The method of preparing plans and specifications for the various conditions arising are considered and original plans are prepared by students. Attention is also given to the construction of street-car tracks in paved streets. Text-book, Baker.

[Two hours a week for one term.]

XII.

ENGINEERING. This course is taken by students of Civil Engineering in the Senior year and teaches the best approved methods of constructing engineering works and the styles of structures suitable for different localities. The study is quite comprehensive, including the general theory of the arch and application of the voussoir arch; the theory of earth pressure, and the design of retaining walls; foundations suitable for structures of various classes in connection with which the student becomes acquainted, not only with the methods for ascertaining the bearing power of the foundation, but also the means for constructing deep foundations. The methods for tunnel construction, irrigating canals, river improvements, are included in the course and given by text-book and lectures. The part pertaining to masonry construction include a study of the properties of stone, brick, mortar, the manner of testing foundations under water, the crib and open caisson process, the pneumatic process, the
theory of masonry arches and design, arch centers, selection of site for bridge piers and arrangement of spans, the details of construction of bridge piers and manner of location, specifications for masonry, etc. Text-books, Howe, Patton, Baker, Rankin.

[Five hours a week for two terms.]

XIII.

Sanitary Engineering. This course is a study of the principles and methods of drainage and disposal of sewage in populous districts: shape, material and calculation of sewers; catchbasins, flushing and ventilation; separate and combined systems compared; pollution of rivers; chemical precipitation; results and costs of purification; general municipal and domestic sanitation; inspection of neighboring works. Text-books, Staler and Pierson.

[Two hours a week for two terms.]

XIV.

Bridges and Roofs. This course comprises a study of the different systems of trussed bridges and roof trusses, and the calculation of the strains produced when loaded in any manner, the weight of the structure and the effect of wind included. Both graphical and analytical methods are used. Besides the various systems of trussed bridges, which are studied in detail the plate girders, suspension bridges, cantilever bridges draw bridges, and roofs of various designs are given equal attention; the purpose being to familiarize the student with the different forms and enable him to design and to estimate the cost of construction. Text-book, Merriman.

[Five hours a week for one term.]
XV.

Graphic Statics. This course teaches the determination of stresses in framed structures by the graphical method. Shearing forces, bending moments, centers of gravity, and moments of inertia are graphically determined by the application of the principles of the force and equilibrium polygons; also the determination of stresses in bridge trusses with parallel chord and with broken chords, caused by uniform loads and locomotive wheel loads; graphical determination of stresses in roof trusses, graphical treatment of the arch symmetrical and unsymmetrical cases, graphical methods of arch-ribs of hinged ends, and of fixed ends; stress diagrams; temperature stresses; braced arches; graphics applied to continuous girders. This course is supplemented by full explanations, notes, examples and problems. Text-book, Merriman.

[Five hours a week for one term.]

An elementary course two hours a week for two terms is given to students following the Program in Design and Short Program in Architecture.

XVI.

Hydromechanics. This course is a thorough study of the theory of hydrostatics, hydraulics, and hydrodynamics, to which are added many practical exercises. The subjects admitted are the transmission of pressures, center of pressures; velocity of flow from orifices of various shapes; fluid friction; Bernoulli's theorem with friction: Chezy's formula; Kutter's formula; flow over wires, and through tubes; flow in pipes; loss of head in friction and other losses; flow in conduits, canals, and rivers, velocities in cross sections; methods of gauging the flow, measurement of water power, dynamic pressure of flowing water; designing of water-
works and standpipes; hydraulic motors and relative merits; discussion of water wheels of different types, and a study of the conditions determining high efficiencies; classification of turbines, and a complete study and discussion of the different forms.

[For students in Civil Engineering, three hours a week for two terms. For students in Electrical, Mechanical, Mining and Chemical Engineering, two hours a week for twenty-two weeks.]

DRAWING, MECHANICAL

Drawing A and B (Elementary Freehand, Lettering, Geometrical Drawing) are required to take up drawing I, II.

Two hours of actual time in drawing are required for each credit hour in the schedule.

I.

FREEHAND. This course consists in sketching with pencil from various models of the different machine parts. Later in the term, the use of instruments is taken up illustrating problems in the Engineering course. Textbook, Jamison’s Elements.

[Three hours a week for one term.]

II.

PROJECTION DRAWING. The course embraces the principles of projection, methods of shop-drawing, tinting, tracing, blueprinting, lineshading and the preparation of working drawings of complete machines. This course must be preceded by course I. Textbook, Jamison’s Manual.

[Three hours a week for one term.]
III.

DESCRIPTIVE GEOMETRY. A series of accurate plates is made, illustrating the principles of orthographic and spherical projections, shades and shadows, perspective and isometric projections.

[Two hours a week for two terms.]

IV.

KINEOMATIC DRAWING. Designing of cams and gear teeth, complete working drawings of machines involving the application of kinematics and the computation of dimensions.

[Two hours a week for two terms.]

V.

TOPOGRAPHY. Pen and colored topographical drawing, conventional signs, map drawing from notes taken from surveys. This course must be preceded by Course I. Text-book, Reed.

VI.

STEREOTOMY. This course comprises a study of the application of the principles of Descriptive Geometry to the determination of the forms and sizes of the stones used in the construction of the different classes of arches and masonry structures. This course is given by lectures in the drawing room, explaining the construction of templates, and the use of directing instrument; also explanations of methods of drawing plans, elevation and development of oblique arches, wing walls and the like. A certain number of plates and drawings is required, illustrating the methods of performing practical work.

Drawing and designing plans, elevations and sections of masonry construction, foundations, dams, piers,

[Two hours a week for one term.]

VII.

BRIDGE DESIGNING. This course proceeds from simple framed girders to complete bridge-trusses of various designs,—required of Juniors in Civil Engineering. Complete design of a railroad bridge and detail drawings,—a short general course of bridge designing.

[Two hours a week for one term.]

VIII.


[Three hours a week for two terms.]

ELECTRICAL ENGINEERING

I.

APPLIED ELECTRICITY. A course of lectures and recitations, supplemented by laboratory practice, on the general theory of electricity and magnetism and its application to practical work, as follows: Setting up and testing primary and secondary batteries, systems of call bells, electric and gas lighting appliances, fire and burglar alarms, telegraph and telephone lines, switch boards and accessories. Experiments with induction coils, magnets, switches, voltmeters, ammeters, wheatstone bridges, galvanometers and other measuring instruments. The study of direct current generators and motors, arc and incandescent lighting systems, street railway machinery and appliances, elec-
tric heating and forging, electrolytic process, etc. Text-book, Swoope's Practical Electricity.

[Five hours a week for two terms.]

II.

APPLIED ELECTRICITY. Lectures and laboratory work on the construction and testing of switches, magnets, measuring instruments, induction coils, etc. The calculation of sizes of wire and location of circuits for lighting and power, the experimental study of alternating current machinery and accessories.

If the student has acquired sufficient skill in handling tools in his workshop, he may design and build a small dynamo, starting with rough castings, doing all the fitting and finishing, winding and adjusting, and finally testing for insulation, efficiency, and adaptability to special purposes. This course must be preceded by Course I. (Course I. and II. are required in the Short Program Electrical Engineering; they are elective for general students and those studying telegraphy.)

(Five hours a week for two terms.)

III.

DYNAMO-ELECTRIC MACHINERY. Recitations on the physical reactions, characteristic curves, mechanical points, theory of armature winding, the mathematical theory of alternating currents, phase relations, modern forms of single phase, and multiphase generators and motors, design of transformers. Text-books, Sheldon's Dynamo Electric Machines, Sheldon and Mason's Alternating Currents.

[Four hours a week for two terms.]

IV.

ELECTRICAL LABORATORY. Practical work at wiring buildings for lights and power, testing circuits for
insulation and grounds, construction and operation of storage batteries, management and care of dynamos, characteristic curves of particular machines under different conditions, efficiency, tests of motors by absorption dynamometer methods, alternating current dynamo and transformer tests, the testing of storage batteries, and complete plant efficiency tests. Careful notes are taken.

[Four hours a week for two terms.]

V.

DESIGNING. The designing and making of working drawings of switches, resistance and other electrical apparatus. Calculation of sizes of wire and location of circuits for lighting buildings. Complete drawing of direct and alternating current dynamos. Laying out plants for power and lighting.

[Two hours a week for two terms.]

VI.

Dynamo Machinery. Laboratory. Study of fundamental principles, characteristics of D. C. dynamos, speed and torque of motors, A. C. generators and motors, transformers and accessories, power measurements and efficiency tests.

[Three hours a week for ten weeks.]

VII.

Applied Electricity, Laboratory and Lectures on the use of electricity in buildings, systems of wiring, materials used, the Underwriting requirements for study bells and telephones, electric lighting, photometry and illumination. For students in Architecture.

[One hour a week for one term.]

VIII.

Power Transmission. Lectures and recitations on
pole lines, underground work, limits of voltage, insulators, choice of frequency, cost of construction, depreciation and other financial matters.

[One hour a week for one term.]

IX.

**Electric Railways.** Lectures and recitations on track and overhead construction, cars, trucks, motors and systems of control for both direct and alternating current, sub-stations, operation and financial considerations.

[One hour a week for one term.]

X.

**Telephony.** Laboratory and lectures on general principles, intercommunicating systems, switchboard systems, manual and automatic, operation, cost of equipment, maintenance and depreciation.

[One hour a week for one term.]

XI.

**Wireless Telegraphy and Telephony.** Experimental practice and lectures on the theories involved in the construction and operation of the leading systems, osculators and sending apparatus, detectors and receiving devices, turning to prevent interference.

[Two hours a week for one term.]

XII.

**Illuminating Engineering.** Lectures on the theory and operation of the various kinds of electric and other lamps, distribution of light and the location of lamps to produce the best illumination, practical problems and the study of particular institutions the cost per candle power or per candle foot including first cost, attendance, breakage and depreciation.

[Two hours a week for ten weeks.]
UNIVERSITY OF NOTRE DAME

XIII.

Inspection Trip to Chicago. Study of the larger power, lighting and telephone installations also factory methods in several typical industrial establishments, trips to the hydraulic and steam generating plants along the St. Joseph river.

ENGLISH

I.

Genung's Principles of Rhetoric. A study of the complete text. Frequent practice in simple theme work, versification. Writing in all literary forms and assigned readings.*

[Three hours a week for two terms.]

GEOLOGY

I.

Principles of Geology. Lectures, recitations, demonstrations. The study of the general features of the earth; the material composing the accessible parts of the earth; the arrangements of the material in rocks; the causes of geological changes; the history of the earth and the various forms of life that existed in the different periods of successive geological ages. Textbook, Brigham.

[Four hours a week for one term.]

II.

Mineralogy. The object of this course is to train the student to identify minerals by their physical characteristics, such as crystal form, cleavage, color, hardness and specific gravity without having to resort

* Every Freshman will be obliged to follow a class in correct English, one hour a week, unless his written work gives evidence that he may be dispensed from this special exercise.
to blowpipe or chemical tests except in the rare minerals. Recitations are made upon drawers of minerals in which the student points out the distinguishing features by which he recognizes the different minerals. Text-book, Dana.

[Five hours a week for two terms.]

III.

MINERALOGY. Lectures, recitations, and laboratory work. A study of crystallography and the classification of minerals, accompanied by practice in the laboratory and museum in the determination of minerals, especially the ores. Blow-pipe analysis. Text-book, Crosby.

[Two hours a week for one term.]

IV.

CRYSTALLOGRAPHY. In this course there is made a complete study of the laws in the different systems of crystal formation, by means of laboratory work in models, natural crystals and cleavage specimens. Text-book, Williams.

V.

PETROGRAPHY. This course is a study of rocks with regard to their classification, structure, mineralogical constituents, chemical composition and alterations; a study of the physical characters of the minerals shown in thin transparent rock sections with the aid of the microscope; a practical study of rocks in the hand specimens and also in summer field work.

[Two hours a week for two terms.]

VI.

GEOLGY, PHYSICAL AND CHEMICAL. A course treating of the origin and alterations of rocks, of general eruptive and earthquake action, metamorphism, faulting, jointing, and mountain building: the action of atmospheric
agencies, surface and underground water. All of which subjects are especially considered in their application to mining pursuits. Text-book, Chamberlain and Salisbury’s Geology.

[Three hours a week for one term.]

VII.

Geology, Economic Mining. A study of the genesis of the useful ore deposits, both metallic and non-metallic; an analysis of the relation existing between structural, dynamic and chemical geology, petrography and the ore deposits encountered in mining operations. Frequent reference is made to the bulletins, monographs and reports of the United States Geological Survey. Text-books, Spurr, Reis.

[Two hours a week for one term.]

GERMAN

I.

Grammar, Thomas. Translation from German into English of simple prose; translation of English exercises into German. Reading of short stories and selections from more difficult prose.

German Reader, Miller and Wenkelbach.

[Five hours a week for two terms.]

II.

Grammar, Thomas. Translation into German of narrative prose and selections from history. Sight reading of selections from history.

Herman and Dorothea, Goethe; Lichtenstein, Hauff.

[Four hours a week for two terms.]

III.

Grammar, Thomas. Sight reading of plays, poems
and prose writing. Translation of selections from history and literature; original essays.


[Four hours a week for two terms.]

**HISTORY**

Iib.

A general course in modern history with special reference to its most important periods.

[Four hours a week for one term.]

**MATHEMATICS**

I.

*Algebra*. This course includes a study of the binomial theorem, the theory of logarithms, choice, chance, variables and limits, series, determinants. Then follows a thorough study of the general properties and solution of equations, embracing the subjects of derivatives, transformation, detached coefficients, surd and imaginary roots, incommensurable roots, limits of roots, biquadratic equations, DesCartes' and Cardan's rules; Sturm's theorem, Horner's method. Text-book, *Wentworth*.

[Five hours a week for one term.]

II.

*Analytic Geometry*. This course includes a study of the point and right line; conic sections; their equations and properties; discussion of the general equation of the second degree containing two variables; different systems of co-ordinates; transformation of co-ordinates; an elementary course in geometry of three dimensions, embracing the point, straight line, plane and surfaces

[Five hours a week for one term.]

### III.

**Calculus, Differential.** This course as also Courses IV. and V., is designed to meet the requirements of Engineering students. It includes a study of the methods for the differentiation of algebraic, logarithmic and exponential, trigonometric, and inverse trigonometric functions, successive differentiation, and differential coefficients; treatment of implicit and compound functions; expansion of functions; indeterminate forms; partial differential coefficients of the first order and of higher orders; direction of curvature; radius of curvature; envelopes; maxima and minima of functions of one independent variable, and of several independent variables; tracing curves; differentials of arcs, plane areas, surfaces and volumes of revolution. Text-book, *Osborn*.

[Five hours a week for one term.]

### IV.

**Calculus, Integral.** Integration of elementary form and of rational fractions; integration by rationalization and by parts; successive integration; multiple integrals; definite integrals, limits of integration; double integration applied to plane areas; rectification of plane curves; quadratures of plane areas and surfaces of revolution; surface and volume of any solid; intrinsic equation of curve. This course is supplemented by numerous exercises and examples. Text-book, *Osborn*.

[Five hours a week for twelve weeks.]
V.

Differential Equations. An elementary course for Engineering students, supplementary to the course of integral calculus. It embraces equations of the first order and degree; equations of the first order, but not of the first degree; singular solutions; linear equations with constant coefficients; special forms of equations with higher orders. Numerous applications to mechanics and physics are introduced during the course. Text-book, *Murray*.

[Five hours a week for six weeks.]

Advanced Work. The prescribed courses in pure mathematics are I. to V. inclusive. The following advanced courses are offered, based on standard authors. The text-books are not necessarily the same every year. The number of students required to constitute a class in any one subject must be at least five.

(a) Higher Algebra, *Hall and Knight, Smith, Crystal.*
(b) Advanced work in Trigonometry, *Todhunter, Lock.*

[Three hours' recitation a week for one subject.]

MECHANICAL ENGINEERING

I.

Thermodynamics. The subject begins with a theoretical study of the steam engine, gas engine, steam turbines and other heat motors involving the laws of thermodynamics of gases, saturated vapors and super-
heated steam. The applications of this preliminary work are then dwelt upon, and prime movers, the injector, condenser, refrigerating machinery, boilers and pumps are studied in detail. During the second term a study of the different types of internal combustion engines is made together with a general study of costs in operating power plants. Frequent reference is made to trade catalogues, of which an abundant supply should be obtained by the student. Text-book, Cardullo's Thermodynamics; References: The Steam Engine and Turbine, Heck; Steam Engine Theory and Practice, Ripper.

[Four hours a week for two terms.]

II.

MATERIALS OF ENGINEERING. This course, supplemented by shop work and laboratory work in testing materials of construction, is designed for the purpose of acquainting the student with the properties of the material he will use in his profession. Tensile and shearing strength, elasticity and resistance are studied, together with the effects of strain, intermittent loading and impact. The process of manufacture of the most important materials is taken up, and estimates of the cost of construction at market prices complete the work. Text-book, Thurston's Materials of Engineering.

[Two hours a week for one term.]

III.

STEAM POWER PLANTS. The preliminary work of this course comprehends a brief study of the history of the steam engine together with its development and differentiation into the standard types at present on the market. Subsequently, the elements controlling designs for specific purposes are considered. Finally the study of the Power Plant as a whole is taken up and the
relations between engines, turbines, pumps, condensers, boilers, piping, fuel and auxiliaries are dwelt upon in detail. A completely worked out plan for a specific equipment is required of each student. The text-book is Gebhardt’s *Steam Power Plant Engineering*; References: *Steam Power Plants*, Meyers; *The Mechanical Engineering of Power Plants*, Hutton; *Steam-Electric Power Plants*, Koester.

(Five hours a week for two terms.)

IV.

**STEAM BOILERS.** This subject is treated much as that of Course III. The determination of sizes of parts from consideration of strains, thickness of shells, size of rivets, braces, furnaces and proper methods of connection of boilers, with efficiency of furnaces and life of boiler are some of the subjects considered. The method of determining the efficiency of fuels, heating surfaces, heights of chimneys, boiler setting and materials used in connection are also discussed. Text-book, *Steam Boilers* by Munro.

[Three hours a week for one term.]

V.

**KINEMATICS.** This course treats of the geometry of machinery, the determination of the paths of the various parts of an elementary combination and the constraining of the parts to move in these paths. The general theory is then applied to cams and gear teeth, the relative motion of machine parts and the kinematic trains, belts, pulleys, speed cones, link work and other aggregate combinations. *Barr’s Kinematics of Machinery* is the text-book used.

[Three hours’ recitation and two hours’ drawing a week for one term.]
VI.

(a) **Machine Design.** This work involves a study of the form and strength of machine parts as applied in designing, with computation of dimensions for fastenings, bearings, rotating pieces, belt and tooth gearing, etc. The derivation of rational formulae and the determination of empirical formulae are included and applied in designing. The text-books used are *Unwin's Elements of Machine Design, Low's Handbook for Mechanical Engineers* and *Reed's Machine Design and Drawing.*

[Two hours a week for one term.]

(b) **Valve Gears.** This includes a complete study of the Bilgram diagram as applied to side valves and the principal automatic cut-off engines. The radial gears, such as Hackworth, Walschaert, Marshall and Joy are treated in the same way, and in conclusion the student is made familiar with the various types of Corliss valves, shifting eccentrics and like motions. The text-book is *Halsey's Valve Gears.*

[One hour a week for one term.]

VII.

**Gas Power Plants.** A study from text-book, reference works, current technical magazines and catalogues of manufacturers of the adaptation of the various types of prime movers available as power sources. From a set of specifications for a given power plant submitted to the student, a detailed plan is required, showing the selection and arrangement of the power units, method of piping, arrangement of fuel handling apparatus and other auxiliaries.

Must be preceded by Course X. and taken in conjunction with Course XI.

[Three hours a week for one term.]
MECHANICAL LABORATORY. The work taken up includes a study of the methods of testing the steam engine under varying running conditions, valve setting, calibration of thermometers, gauges and indicator springs, use of Prony brake, Weber and Emerson dynamometers, Pelton water wheel, Weir calibration, etc. Text-book, Carpenter's Experimental Engineering.

[Five consecutive hours a week for one term.]

IX.

STEAM ENGINES AND BOILERS. A brief course in the study of boilers and steam engines designed to familiarize the student with the different types in use and their respective merits. Only that theory is taken up which is necessary to the working out of problems, the ultimate object of the course.

Students taking this course must provide themselves with an abundant supply of trade catalogues. Text book, Power and Power Transmission, Kerr.

[Three hours a week for one term.]

X.

GAS AND VAPOR ENGINES. This course, extending over two terms, is given to a general descriptive study of all the types of gas engines and explosive motors. The general construction of gas, oil, vapor engines is studied together with their adaptation to various uses.

Results due to change in ignition, compression and variation of working fluid; methods of speed regulation and government and the details of auxiliaries as, pumps, carburettors, hot tubes, batteries, spark coils and dynamos are dwelt upon. The text-book used is Gas, Oil and Vapor Engines by Hiscox.

[Five hours a week for two terms.]
XI.

Gas Engine Design. A complete study of the thermodynamics and design of the gas engine, by textbook, lectures and drawing board. The major subjects taken up are power, efficiency, economy, forces due to gas pressure and inertia and dimensions of engine parts. Luke's Gas Engine Design is the text-book used.

[Five hours' recitation and ten hours' drawing a week for two terms.]

XII.

Gas Engine Construction. The complete working up from rough castings and forgings of a small type of gas engine. This is part of the thesis work for students in the Short Program and requires the complete machining and assembling of the engine and must be preceded by Courses X. and XI.

[Three hours a week for two terms.]

XIII.

Gas Engine Laboratory. Indicator practice, commercial efficiency, governing economy, speed regulation. Experiments in ignition, spark coil construction, carburettors and vaporizers. Test of engine constructed by the student.

[Two afternoons each week for two terms.]

SHOPWORK

XIV.

(a) Woodwork. Exercises in planing, splicing, framing, scroll sawing and turning.

(b) Application of Carpentry to pattern making, cores, etc., including parts of machines, pipe joints, cranks and bearings.

(c) Foundry Practice. Setting up and drawing simple and complicated patterns. Lectures on heating
and pouring metals for different purposes. Core making.

(d) Iron Forging, welding, annealing, shaping, tool making, tempering and case hardening.

(e) Benchwork in iron, including surface chipping, key setting, draw filing, scraping and polishing.

(f) Accurate Work on the lathe, planer, shafting and milling machines. Construction of machine tools, reamers, taps, twist drills, gear wheels and complete machines.

[Three hours a week for two terms.]

Thesis. Each candidate for a degree in Mechanical Engineering must present for graduation a thesis of considerable magnitude which will exhibit his knowledge of the courses he has followed. It may embrace designing, experimental investigation or original research, in a subject selected by the student and approved by the professor. The major part of the second term, Senior year, is devoted to this work, and graduation is conditional upon the knowledge of mechanical engineering displayed in its preparation.

METALLURGY

I.

Metallurgy. Among the subjects studied in this course are the following—classification of ores, sampling, crushing, milling practice, roasting and smelting; the various extraction processes of the following metals—gold, silver, copper, lead and zinc, are given special attention; the production of pig iron in blast furnaces.

A trip of inspection is made to smelting plants, blast furnaces and mills (stamps and rolls) in order to familiarize the student with metallurgic plants in operation.

[Three hours a week for one term.]
II.

Assaying. This course consists of a series of actual determinations of the quantity and value of gold, silver and lead in the various ores by the crucible and scorification methods of the fire assay; the assaying of gold and silver bullion; determining the strength of cyanide working solutions; the assay of gold bearing cyanide solutions; and wet determinations of copper and zinc.

[Eight hours a week for one term.]

III.


[Two laboratory hours a week for one term.]

IV.

Ore Dressing. A course in which a detailed study is pursued of the various processes of mechanically separating and saving valuable minerals from the valueless gangue of ores, whereby the valuable minerals are concentrated into smaller bulk and weight by discarding a large portion of the waste.

The principal subjects treated are: Preliminary and final crushing by means of rock-breakers, steam and gravity stamps with amalgamation; rolls, Chilian, Huntington; tube and ball mills; screen sizing and classifying; sand and slime concentrating on jigs, tables and vanners; magnetic separation, pneumatic concentration, oil flotation processes; locating and constructing the mill. The course includes a trip of inspection to a number of the most modern concentrating mills in the lake Superior district where the student engages in practical work in the study of mill construction, operation and efficiency. Text-book, Richards.

[Three hours a week for one term.]
MINING ENGINEERING

I.
MINING ENGINEERING, PRINCIPLES OF. This course includes a general study of Mining operations divided into the following subjects: Occurrence of minerals in the earth's crust, discovery, boring, excavation, supporting excavations, exploitation, haulage, hoisting, drainage, ventilation, lighting, access, ore dressing and treatment. Text-book, Foster and Brough.

[Five hours a week for two terms.]

II.
MINING SURVEYING. A study of the subject of surveying in its special application to mines, through lectures, plotting of problems and recitations; for students who take the summer course in the mines. The following subjects receive particular attention—recording of notes in underground traverses and their subsequent plotting, a comparison of metal mine and coal mine surveys, the methods of connecting surface with underground surveys by means of both the auxiliary telescope and plumb lines and the deputy mineral surveyor's methods of surveying mining claims for patent. Each student is required to make a complete mine map from notes of actual mine surveys. Text-book, Trumbull.

[Three hours a week for one term.]

PHILOSOPHY

IV.
A general course in philosophy designed to acquaint the student with the important problems of philosophy. It is hoped sufficient interest will be aroused in the student in this abridged presentation to enable him to continue, of his own accord, an intelligent study of this important subject.

(Four hours a week for two terms.)
PHYSICS

I.

(a) Physics. Instruction in Physics is given by lectures and recitations in which the general laws of mechanics, heat, acoustics, optics, electricity and magnetism are presented. The course is intended to meet the needs of those who desire a general knowledge of the subjects, as well as to lay the foundations for advanced work. Particular attention is paid to the correct statement of principles, so that in his advanced work the student will have nothing to unlearn or relearn. Text-book, Carhart and Chute.

[Three hours a week for two terms.]

(b) The Laboratory Work of this course consists of a series of experiments which verify and apply practically the fundamental principles of physics. The student also receives instruction in the use and careful handling of apparatus, accurate observation, and correct deduction of results. Neat and concise reports of all experiments are kept by each student and form the basis for the grades in his work.

[Two hours a week for two terms.]

II.

General Physics. In this course there is a more extended treatment of the same subjects than is given in Course I. Mathematical principles are applied to physical phenomena. Special attention is paid to accuracy in the mathematical work and in the statements of the principles involved. Lectures and recitations. Text-book, Crewe.

[Three hours a week for two terms.]

III.

Physics. The application of mathematics in physical
work. Measurements of length, mass and time. Work in mechanics, heat, light, sound, electricity and magnetism. The work is done in the laboratory and the student is taught to depend on his own resources and to check his results.

[Two laboratory hours a week for two terms.]

IV.

PHYSICAL LABORATORY. Students in Electrical and Mechanical Engineering will have a special set of experiments on electricity, comprising special advanced work in heat, light, mechanics, sound, magnetism, general electricity, galvanometry, electrical quantity, induction, the dynamo, the magnetic properties of iron. Accuracy in observation and in the calculation and recording of the results is required. Students may specialize here according to the program which they are following. This course must be preceded by Courses II. and III.

[Three hours a week for one term.]

V.

ELECTRICAL MEASUREMENTS. Laboratory practice with galvanometers, voltmeters, ammeters and wattmeters, resistance work, the relation or equivalence between electric energy and heat, capacity and inductance, insulation tests.

[Three hours a week for one term.]

VI.

CALORIMETRY. Accurate work in laboratory, using methods of mixtures, bomb and other calorimeters in measuring the calorific values of gaseous and solid fuels, quantitative measurements of radiation and conduction of heat as applied to pipe coverings, etc.

[Three hours a week for ten weeks.]
VII.

METEOROLOGY. A government station was installed at the University by the United States Weather Bureau in March, 1912. An elementary course in meteorology is offered to students.

[One hour a week for one term.]

VIII.

RESEARCH WORK. Courses are offered in Theory of Heat, Theory of Electricity and Magnetism, Optics, the Constitution of Matter, Conduction of Electricity by Gases, Theory of Sound, Hertzian Waves. Calculus required to take up any of these topics.

[Two to five hours a week for one term.]

POLITICAL SCIENCE.

IX.

THE ELEMENTS OF ECONOMICS. A general survey of the subject based upon some standard text. Similar in scope to Course I. though briefer in presentation.

[Four hours a week for one term.]

FRENCH

I.

Grammar with written and oral exercises; the inflection of nouns and adjectives, the use of all the pronouns, the conjugation of regular and common irregular verbs; the correct use of moods and tenses, the essentials of French syntax, and the common idiomatic phrases. Reading of three of the following works: *La Tache de Petit Pierre*, Mariet; *Un Cas de Conscience*, Gervais; *La Main Malheureuse*, Guerber; *Sans Famille*, Malot; *Readings from French History, Super*.

[Five hours a week for two terms.]
II.

Advanced grammar with composition, study of idioms, memorizing. Dictations and conversations on practical topics, and careful reading of five of the following works: Le Voyage de M. Perrichon, Labiche; Roman d'un Jeune Homme Pauvre, Feuillet; Fables Choisies, La Fontaine; Le Medecin Malgré Lui, Molière; Le Cid, Corneille; Esther, Racine; Pages oubliées de Chateaubriand; La Question d'Argent, Dumas; Standard French Authors, Guerlac.

[Five hours a week for two terms.]

III.

The study of this course is devoted chiefly to the prose and poetry of the nineteenth century and includes composition, conversation, history and general view of French literature; besides a translation and criticism of the best writers, such as; Causeries du Lundi, Ste., Beuve; On Rend l'Argent, Coppée; Hernani, Hugo; Méditations, Lamartine; Athalie, Racine; L'Avare, Molière; Mlle. de la Seiglière, Sandeau; Les Origines de la France Contemporaine, Taine; Expédition de Bonaparte en Egypte, Thier; Ste. Elizabeth de Hongrie, Montalembert; Historie de la Littérature Française, Duval.

[Four hours a week for two terms.]

N. B.—The works studied are not necessarily the same every year.

SPANISH

I.

General outlines of grammar with composition. Translation of easy tales from Trueba, Fernon Caballero, Perez Escritch, etc., with select fables of Samaniego, and Irate.

[Five hours a week for two terms.]
II.

Spanish prose and poetry of the eighteenth and nineteenth centuries, with composition and the history of the literature of the period.

[Five hours a week for two terms.]

III.

Literature of the sixteenth and seventeenth centuries; Cervantes, Calderon, Lope de Vega. History of the literature of the period, with essays in Spanish.

[Four hours a week for two terms.]

IV.
