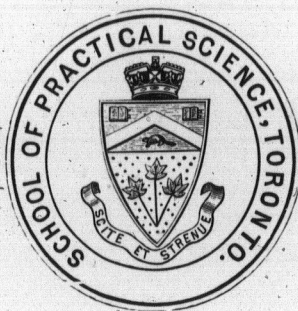


CALENDAR
OF THE
SCHOOL OF PRACTICAL SCIENCE,
PROVINCE OF ONTARIO,
WITH A
SYLLABUS
OF THE

*Courses of Instruction and of the Regulations for
Diplomas.*

Twelfth Session,



1889-90.

TORONTO:
PRINTED BY WARWICK & SONS, 68 AND 70 FRONT STREET WEST.
1889.



Faculty of the School.

SIR DANIEL WILSON, LL.D., F.R.S.E., CHAIRMAN OF THE BOARD.

MEMBERS OF THE BOARD.

E. J. CHAPMAN, Ph.D., LL.D.....	<i>Professor of Mineralogy and Geology.</i>
JAMES LOUDON, M.A.....	<i>Professor of Physics.</i>
R. RAMSAY WRIGHT, M.A., B.Sc.....	<i>Professor of Biology.</i>
J. GALBRAITH, M.A., Assoc.M.Inst.C.E.	<i>Professor of Engineering.</i>
W. H. PIKE, M.A., Ph.D.....	<i>Professor of Chemistry.</i>
SIR DANIEL WILSON, LL.D., F.R.S.E.	<i>Professor of Ethnology.</i>
W. H. ELLIS, M.A., M.B.	<i>Professor of Applied Chemistry.</i>
ALFRED BAKER, M.A.....	<i>Professor of Mathematics.</i>

ASSISTANT INSTRUCTORS, 1888-9.

W. J. LOUDON, B.A.....	<i>Demonstrator in Physics.</i>
F. W. BABINGTON.....	<i>Demonstrator in Applied Chemistry.</i>
A. B. MACALLUM, B.A., M.B., Ph.D....	<i>Lecturer in Physiology.</i>
L. B. STEWART, P.L.S., D.T.S.....	<i>Lecturer in Surveying.</i>
J. MCGOWAN, B.A.....	<i>Fellow in Mathematics.</i>
J. G. WITTON, B.A.....	<i>Fellow in Physics.</i>
J. J. MCKENZIE, B.A.....	<i>Fellow in Biology.</i>
G. CHAMBERS, B.A.....	<i>Fellow in Chemistry.</i>
F. G. WAIT, B.A.....	<i>Fellow in Mineralogy and Geology.</i>
D. BURNS, GRAD. S. P. S.....	<i>Fellow in Engineering.</i>

SECRETARY OF THE BOARD:

H. H. LANGTON, B.A.,

To whom application may be made for information further than that contained in the present Calendar.

Engineering Department.

SESSION 1888-9.

STUDENTS IN ATTENDANCE.

REGULAR STUDENTS.

1st Year.

Allan, J. R.
Beatty, H. J.
Boulton, W. R.
Cant, G. F.
Deacon, T. R.
Dill, C. W.
Dunbar, M.
Hill, V.
Lane, Andrew.
Lawson, W.

Langley, C. E.
Macallum, A. F.
McAllister, J. E.
McCollum, T. E. B.
McLennan, R.
McPherson, C. W.
Moore, J. E. A.
Newman, Wm.
Paterson, J. E.

Playfair, N. L.
Robinson, J. K.
Ross, J. A.
Russell, Wm.
Smith, Angus.
Sylvester, G. E.
Symmes, H. D.
Thomson, R. W.
Warren, E. C.

2nd Year.

Bowman, F. M.
Bucke, M. A.
Corrigan, G. D.
Duff, J. A. (B.A.)
Eaman, J. A.

English, A. B.
Garland, N. L.
Hutcheon, J.
Innes, W. L.
Meade, H.

Merrill, E. B.
Pedder, J. R.
Peterson, C. E.
Wiggins, T. H.

3rd Year.

Carey, Brock.
Chalmers, W. J.
Clement, W. A.
Hanning, G. F.
Haultain, H. E. T.

Irvine, J.
James, D. D.
Mill, F. X.
Moberly, H. K.
Ritchie, N. T.

Rosebrugh, T. R. (B.A.)
Shillinglaw, W. H.
Wickett, T.
Withrow, W. J.

MECHANICAL ENGINEERING.

2nd Year.

Ross, R. A.

SPECIAL STUDENTS.

MECHANICAL ENGINEERING.

Hanly, J. B.

Hale, W. B.

Wickson, F. R.

MINING ENGINEERING.

Chewett, H. J. (Grad. S. P. S.)

SURVEYING.

Cameron, A. J.

Fawcett, Adam.
Fitzgerald, J.

Johnston, T. K. (B.A.)

DRAWING.

Fawell, J. H.

Mickle, A.

Topp, C. W.

GRADUATES.

NOTE.—Graduates are requested to inform the Professor of Engineering as to changes in their addresses.

1881.—J. L. Morris, C.E., P.L.S., Pembroke.

1882.—J. McAree, P.L.S., D.T.S., Toronto.

D. Jeffery, Contractor, Winnipeg.

J. H. Kennedy, C.E., Architect, etc., St. Thomas, Ont.

1883.—G. H. Duggan, Dominion Bridge Co., Montreal.

J. W. Tyrrell, P. and D.L.S., Toronto.

D. Burns, Fellow in Engineering, School of Practical Science, Toronto.

1884.—E. W. Stern, Kansas City, Mo.

A. R. Raymer, Assistant Engineer, Canadian Pacific Railway, Greenville, Maine.

J. Robertson, P.L.S., Coad & Robertson, Civil Engineers, P.L. Surveyors, etc., Glencoe, Ont.

W. C. Kirkland, Canadian Pacific Railway.

J. McDougall, B.A., Canadian Pacific Railway.

1885.—B. A. Ludgate, P.L.S., Peterboro', Ont.

O. McKay, P.L.S., Windsor.

E. E. Henderson, P.L.S., Canadian Pacific Railway, Brownville, Maine.

F. W. Bleakley, care of A. W. Keadie, Quincy, California.

H. J. Bowman, P. and D.L.S., Berlin, Ont.

1886.—T. K. Thomson, Pencoyd Bridge and Construction Co., Penn.

H. G. Tyrrell, Pencoyd Bridge and Construction Co., Penn.

R. Laird, P.L.S., Toronto.

A. M. Bowman, P. and D.L.S., Berlin, Ont.

E. B. Hermon, P. and D.L.S., Vancouver, British Columbia.

- 1887.—A. E. Lott, Atcheson, Topeka and Santa Fee Railway, Topeka, Kansas.
 J. Roger, Fullerton, Ont.
 J. C. Burns, Architect's Office, Toronto.
 C. H. Pinhey, P. and D.L.S., 630 Wellington Street, Ottawa.
 A. L. McCulloch, Galt.
 F. Martin, Surveyor's Office, Orangeville.

- 1888.—J. F. Apsey, P.L.S., Toronto.
 W. T. Ashbridge, City Engineer's Office, Toronto.
 E. F. Ball, Niagara, Ont.
 D. B. Brown, Cornwall, Ont.
 C. M. Canniff, City Engineer's Office, Toronto.
 H. J. Chewett, Toronto.
 J. Gibbons, Renfrew, Ont.
 R. McDowall, Toronto.
 G. W. McFarlen, Surveyor's Office, Toronto.
 C. J. Marani, Toronto.
 G. R. Mickie, B.A., Toronto.
 J. H. Moore, Newmarket, Ont.
 G. H. Richardson, Can. Pacific Railway, Toronto.
 K. Rose, Riverdale, California.
 J. E. Ross, Beachburg, Ont.
 C. H. C. Wright, 56 Maverick Street, Chelsea, Mass.

FELLOWSHIP IN ENGINEERING.

A Fellowship of the value of \$500 per annum, paid in eight monthly instalments, has been established, open only to Graduates in Engineering of the School.

The Fellow is required to take such portions of the work of instruction as may be assigned to him by the Professor of Engineering.

Candidates for the Fellowship are required to make written application to the Secretary on or before 20th September.

PRIZEMEN.

- | | | | |
|--------|----------------|--------------------|-------------|
| 1879.— | I. Year..... | J. McAree..... | 1st. prize. |
| 1880.— | II. Year..... | J. L. Morris | 1st prize |
| 1881.— | I. Year..... | G. H. Duggan..... | 1st prize. |
| | II. Year..... | D. Jeffrey..... | 1st prize. |
| 1882.— | I. Year..... | A. R. Raymer..... | 1st prize. |
| | " | E. W. Stern | 2nd prize. |
| | II. Year..... | G. H. Duggan..... | 1st prize. |
| | III. Year..... | D. Jeffrey..... | 1st prize. |

1883.—	I. Year	B. A. Ludgate	1st prize
	" "	A. M. Bowman	2nd prize.
	II. Year	A. R. Raymer	1st prize.
	" "	E. W. Stern	2nd prize.
	III. Year	G. H. Duggan	1st prize.
1884.—	II. Year	B. A. Ludgate	1st prize.
	III. Year	E. W. Stern	1st prize.
	" "	A. R. Raymer	2nd prize.
1885.—	I. Year	A. E. Lott	1st prize.
	" "	J. Roger	2nd prize.
	II. Year	T. K. Thompson	1st prize.
	III. Year	B. A. Ludgate	1st prize.
1886.—	I. Year	C. H. C. Wright	1st prize.
	" "	J. E. Ross	2nd prize.
	II. Year	A. E. Lott	1st prize.
1887.—	I. Year	H. E. T. Haultain	1st prize.
	II. Year	C. H. C. Wright	1st prize.
	III. Year	A. E. Lott	1st prize.
	" "	J. Roger	2nd prize.
1888.—	I. Year	E. B. Merrill	1st prize.
	I. Year	F. M. Bowman	2nd prize.
	II. Year	D. D. James	1st prize.
	III. Year	C. H. C. Wright	1st prize.

UNIVERSITY OF TORONTO.

DEGREE OF C. E.

Date of Admission.

1885.....	J. L. Morris
1886.....	J. H. Kennedy.

Department of Analytical and Applied Chemistry.

Regular Students.

2nd Year.

BOUSTEAD, W.

JAMES, O. S.

Special Student.

TUBEY, C. W.

School of Practical Science,

PROVINCE OF ONTARIO.

CALENDAR FOR THE SESSION 1889-90.

In the Session of 1877 the Legislative Assembly gave its sanction to the establishment of a School of Practical Science on the basis proposed in a memorandum of the Minister of Education, confirmed by the Lieutenant-Governor in Council, on the 3rd day of February, 1877.

By the scheme thus approved of, the Government effected an arrangement with the Council of University College, whereby the students of the School of Practical Science enjoy full advantage of the instruction given by its Professors and Lecturers in all departments of Science embraced in the work of the School. In addition to this, the Faculty of the School of Science includes Professors of Engineering and Applied Chemistry, and assistants in the several departments.

The position which it is intended that the School of Practical Science shall occupy in the educational system of Ontario may be indicated as follows :—

I.—Students, who have passed through the regular courses of the School, will be enabled to prosecute professionally : (1) Engineering ; (2) Assaying and Mining Geology ; or (3) Analytical and Applied Chemistry. With this view, Diplomas will be granted in each of those branches after due examination.

The instruction in Engineering is designed to give the student a thorough knowledge of the scientific principles of the Profession, and also to afford such practical training in drawing and surveying as will make him immediately useful in the office and field.

The establishment of a Diploma for special qualifications in Assaying and Mining Geology, apart from the knowledge of these subjects incidental

to the course of Mining Engineering, is called for by the necessity which exists for the development of the mineral wealth of the Province. Students who pass through the course necessary to obtain this Diploma will have acquired the knowledge requisite for inspecting and surveying mineral lands, as well as the ability to report accurately on the composition and value of economic minerals generally.

The importance of the study of Chemistry is now fully recognized, and in Canada, through the Public Analyst and otherwise, protection is being secured to consumers, while the producers are necessarily brought to recognize its importance. The course in Chemistry is such as to fit the student for the position of Public Analyst or of Consulting or Resident Chemist.

II.—It is designed to furnish preliminary scientific training for students entering the professions of Surveying and Medicine.

Certificates in Surveying will be granted after due examination, which will have the effect of shortening the ordinary period of apprenticeship to a Land Surveyor, by the length of time covered by such certificates—one, two or three Sessions, as the case may be.

The School of Practical Science offers to Medical Students thoroughly practical courses of instruction in those sciences which form the best preliminary training for the study of Medicine. The Lectures and Laboratory Courses are arranged so as to conform with the Regulations of the University of Toronto.

III.—Persons desirous of instruction in any of the subjects taught in the School, may be allowed to attend separate courses in these, as *Special Students*.

ARCHITECTURE.

Students who intend to pursue Architecture as a profession, are advised to take, if possible, the regular course in civil engineering, as the instruction given in this course in the subjects of Drawing, Colouring, Principles of Construction (Carpentry, Masonry and Iron work), Strength and other Properties of Building Materials, Flow of Water and Air, Theory of Heat, etc., will be as useful to them as to civil engineers. They may enter as special students if they please.

REGULATIONS
RESPECTING THE
SCHOOL OF PRACTICAL SCIENCE.

*Approved by His Honour the Lieutenant-Governor in Council the
16th day of April, 1889.*

1. The internal management and discipline of the School shall be vested in the Board consisting of the Professors and the Chairman, as nominated by the Lieutenant-Governor in Council.
2. The Academic Year shall consist of two Terms, the First Term extending from 1st October to 23rd December ; and the Second Term from 8th January to 18th April.
3. There shall be three Departments in which Diplomas shall be granted, viz :—
 - (1) Engineering.
 - (a) Civil Engineering (including Mining Engineering).
 - (b) Mechanical Engineering (including Electrical Engineering).
 - (2) Assaying and Mining Geology.
 - (3) Analytical and Applied Chemistry.

A Diploma shall be granted to each student who shall have completed to the satisfaction of the Faculty, the Regular Course in any of the above Departments.

4. The Regular Course for the Diploma of the School in each Department is three years in duration.

5. A student who proposes to obtain the Diploma of the School in one of the above Departments must have passed the Matriculation Examination required for admission to a University in any part of Her Majesty's Dominions, or the Entrance Examination of the Law Society of Upper Canada, or of the College of Physicians and Surgeons, or any of the Examinations prescribed for Teachers in Public or High Schools of the Province of Ontario, or must present a certificate signed by a Head Master of a High School or Collegiate Institute, that he possesses qualifications equivalent to those required for such teachers.
6. Special Students may be permitted to attend such lectures or courses of instruction or of practical work, as the Board may think proper.
7. Certificates of attendance and standing may be given upon due examination to Special Students, and such students shall not be required to pass an Entrance Examination.
- (6 and 7 apply to Medical Students taking special work, also students preparing themselves to be Surveyors, Architects, etc.)
8. At the end of the session, examinations will be held in the different subjects taught, and prizes will be awarded for excellence in each Department. Candidates for Diplomas and Certificates are required to enter for these.
9. All Regular Students are required to be in attendance at the School during the whole of each term, unless exempted by special permission of the Board. The term will not be allowed to any student who has attended less than three-fourths of the required lectures and practical lessons, or who has been reported to the Board for bad conduct, and adjudged guilty thereof.
10. Students of the School of Practical Science shall attend such courses of lectures as are delivered by the Professors of the University College to the students thereof, so far as applicable to both classes of students, while instruction of a practical character in the Department of Engineering is especially appointed for students of the School.

REGULATIONS RESPECTING EXAMINATIONS.

Approved by the Board, March 8th, 1889.

No candidate will be allowed his examination who has not paid all fees and dues for which he is liable.

The minimum percentage of marks required to pass in the written examinations will be fixed from time to time by the Board.

The minimum percentage of marks required to pass in the practical work connected with any subject shall be one and one-half times the minimum required in the case of a written examination.

In order to pass in subjects wherein both written and practical examinations are held the candidate must pass in each examination.

In order to pass the practical examinations in the subjects of Applied Mechanics, Descriptive Geometry and Surveying, the following minimum number of drawings must be made in the respective years :—

	Civil Engineering.	No. of Drawings.	Mechanical Engineering.	No. of Drawings.
I Year.—	Applied Mechanics....	8	.....	13
	Descriptive Geometry.	6	.....	10
	Surveying	9		
II Year.—	Applied Mechanics....	7	.....	11
	Descriptive Geometry.	12	.....	12
	Surveying	4		
III Year.—	Applied Mechanics....	8	.....	12
	Descriptive Geometry.	11	.....	11
	Surveying	4		

The above minimum number of drawings will include only such drawings as shall be specially prescribed for the purpose.

These drawings will be prescribed one by one as the work of the session proceeds.

Drawings prescribed for the 1st term of the session will not be counted unless finished in that term.

To pass in Drawing the above-mentioned minimum number of drawings must be made, together with as many practice sheets as may be prescribed.

The number of practice sheets to be made by each student will depend upon his progress.

The minimum percentage of marks prescribed for practical work must be obtained in drawing.

The marks allotted to the above-mentioned minimum number of drawings form two-thirds of the total marks allotted in this subject.

The drawings must be made on paper 15 x 22 inches, unless otherwise prescribed.

The Board reserves the right of disposing of the drawings as they may think proper. No drawing may be removed from the school without permission.

No drawings will be counted which have not been made in the drafting rooms and during the hours allotted to such work.

To pass in Surveying the minimum percentage required for practical work must be obtained in the field work.

No field notes will be counted which have not been taken in the field and during the hours allotted to such work.

Vacation Work must be handed in during the first week of the ensuing session, otherwise it will not be counted.

Vacation notes must be on construction only and consist of not less than 20 nor more than 30 pages. The sketches must be free-hand pencil drawings with figured dimensions.

Theses must consist of not less than 20 nor more than 30 ordinary foolscap pages.

The minimum percentage of marks required for practical work will be required in the case of vacation notes and theses.

No notes whatever, whether made during the session or the vacation will be counted unless made in the standard note books of the School.

SUPPLEMENTAL EXAMINATIONS.

A candidate below the standing of the third year, who has failed in one or two subjects, will be required to take supplemental examinations in such subjects.

In case a candidate has failed in both the written examination and the practical work in a subject, it will be necessary for him to obtain the

minimum percentage required for practical work in the written examination, and to do such extra practical work during the ensuing session as may be prescribed.

Should his failure have been in only the practical work of a subject he will be required to take a supplemental written examination, and to do such extra practical work during the ensuing session as may be prescribed. If his failure has been in the written examination only, he will be required to take a written supplemental examination. In each of these latter cases the minimum percentage required for a written examination will be exacted.

The supplemental written examinations will begin on the first day of the session.

In the case where a candidate fails to pass a supplemental examination it will count as one of the two supplemental examinations which may be allowed him after the next annual examination.

Candidates of the standing of the third year will not be allowed the privilege of a supplemental examination.

Candidates who fail in being promoted to a higher year will be required to take the whole course of instruction, both theoretical and practical, over again before presenting themselves a second time for examination.

The fees to be paid by a student repeating a year will be the regular fees for such year.

Students are required to spend the hours of every working day between nine a.m. and five p.m. in the work laid down in the time table.

No exemption from any of the foregoing regulations will be granted unless under such exceptional circumstances as may be deemed sufficient by the Board, and which must be fully set forth in a formal petition.

PRIZES.

Two prizes are open for competition in each year ; the first prize of the value of \$10.00, the second of \$5.00.

These will be awarded to the students who stand first and second in general proficiency in the subjects of the year, under the following conditions, viz. :—

The candidate must have passed in each subject and have obtained at least 75 per cent. of the total number of marks allotted to the subjects.

The following is an approximate list of the examinations to be held and of their relative values in the competition for prizes :—

I. Year.

Examinations held at end of Session.

Value.	Subject.	Value.	Subject.
100....	Algebra.	100....	Statics.
100....	Euclid.	100....	Dynamics.
100....	Plane Trigonometry.	100....	Descriptive Geometry.
100....	Analytical Geometry.	100....	Surveying.
		100....	Chemistry, Elementary.

Examinations held during the Session.

Value.	Subject.
300.....	Drawings.
100.....	*Field Notes.
30.....	Construction Notes.
100.....	+Experimental Physics.

II. Year.

Examinations held at end of Session.

Value.	Subject.	Value.	Subject.
100....	Calculus.	100....	Strength of Materials.
100....	*Astronomy.	100....	Rigid Dynamics.
100....	Optics.	100....	+Theory of Mechanism.
100....	Hydrostatics.	100....	Descriptive Geometry.
100....	+Magnetism & Electricity.	100....	*Surveying.
		100....	Spherical Trigonometry and Geodesy.
		100....	Chemistry, Theoretical.
		100....	Chemistry, Practical.
		100....	*Mineralogy and Geology.
		100....	*Mineralogy, Practical.

Examinations held during the Session.

Value.	Subject.
300.....	Drawings.
100.....	*Field Notes.
100.....	Construction Notes.
100.....	Experimental Physics.
100.....	Thesis (at beginning of term).

* Civil Engineering only.

+ Mechanical Engineering only.

III. Year.

Examinations held at end of Session.

Value.	Subject.	Value.	Subject.
100...	Method of Least Squares.	100....	Theory of Internal Stress.
		100....	Theory of Construction.
		100....	†Mechanics of Machinery.
		100...	†Machine Design.
		100....	Hydraulics.
		100...	Thermodynamics.
		100....	Descriptive Geometry.
		100....	*Practical Astronomy and Geodesy.
		100....	*Surveying and Levelling.
		100....	Chemistry, Applied.
		100....	*Mineralogy and Geology.
		100..	*Mineralogy, Practical.

The III. year candidates are also required to take the following papers of the I. and II. years :—

	Value.	Subject.
I. Year.—	100.....	Statics.
	100.....	Dynamics.
II. Year.—	100.....	Spherical Trigonometry and Geodesy.
	100.....	Strength of Materials.
	100.....	Rigid Dynamics.
	100.....	†Theory of Mechanism.

Examinations held during the Session.

Value.	Subjects.
300.....	Drawings.
100.....	*Field Notes.
100.....	Construction Notes.
100.....	Experimental Physics.
100.....	Thesis (at beginning of Session).

Lectures close April 4th, 1890.

Examinations begin April 10th, 1890.

* Civil Engineering only.

† Mechanical Engineering only.

REGULAR COURSES FOR THE DIPLOMA

See regulations 2, 3, 4, 5, 8, 9, 10 : pp. 12 and 13.

The fees (payable through the Secretary to the Provincial Treasurer) for instruction in any of the Departments, are as follows :—

First Session : Thirty Dollars.

Second Session : Forty Dollars.

Third Session : Fifty Dollars.

These are payable in two instalments, one at the beginning of each term. There is no extra fee for Diploma.

The following are the Departments in which the Diploma is granted :—

- (1) Engineering.
 - (a) Civil Engineering (including Mining Engineering).
 - (b) Mechanical Engineering (including Electrical Engineering).
 - (2) Assaying and Mining Geology.
 - (3) Analytical and Applied Chemistry.
-

FORM OF DIPLOMA.

THE

School of Practical Science,

PROVINCE OF ONTARIO.

(ESTABLISHED 1878.)

THIS IS TO CERTIFY *that*

.....
 of the.....in the.....
has completed the Regular Course
 of this School for the Diploma in the.....
 extending over a period of three years, and comprising theoretical and practical
 instruction in the following subjects, viz. :

WHEREFORE the said.....
 becomes duly entitled to receive this Diploma, having fulfilled to the satis-
 faction of the Faculty of the School all the requirements thereunto relating.

IN WITNESS whereof we have signed this Diploma at Toronto, in the
 Province of Ontario, this.....day of.....
One thousand eight hundred and.....
 and have caused the Seal of this School to be hereunto affixed.

[L. S.]

.....Chairman.

.....Secretary.

5

ESTIMATED EXPENSES IN THE DEPARTMENT OF ENGINEERING.

NOTE.—Each Student is required to furnish himself with the following drawing instruments and materials, viz. :—

One drawing-board, 23" × 31"; 1 T square, 31 inch; 2 set squares, 60° and 45°, not less than 6" on the side; 1 6" (or larger) protractor; 1 12" triangular scale, containing 10, 20, 30, 40, 50 and 60 chain scales; 1 12" triangular scale, containing $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$; 1, 2; $\frac{3}{8}$, $\frac{3}{4}$; $1\frac{1}{2}$, 3; $\frac{1}{2}$, $\frac{1}{16}$ open divided scales; 1 drawing pen; 1 pair dividers; 1 pair compasses with ink and pencil points, lengthening bar, etc.; 1 set spring bows, crow-quill pens, French curves, 1 2ft. pocket rule, Arkansas oil stone, thumb-tacks, paper, tracing vellum, pencils, rubber, colors, sponge, brushes, nest of saucers, water mug, etc., and one portfolio for drawings.

The expenses for the Regular Course in the Department of Engineering are approximately as follows :—

Sessional Fees	\$120 00
Books, instruments, drawing materials, laboratory fees, etc.	120 00
	<hr/>
Total	<u>\$240 00</u>

These expenses are divided equally between the three sessions.

Each student in this department is required to deposit \$1 per annum for the purpose of covering breakages and losses occurring to apparatus and furniture.

Making this deposit will, however, not free any student from the liability to make good any loss or damage to instruments or furniture, arising from want of proper care on his part, when the above fund may prove insufficient for the purpose.

DEPARTMENT OF

TIME TABLE OF REGULAR

Instruction will be given during the Session of

FIRST YEAR.		
HOURS.	MONDAY.	TUESDAY.
9-10.....	} Elementary Chemistry.	} Drawing.
10-11.....		
11-12.....		
12-1.....	*Geometry & Trigonometry	Descriptive Geometry.
1-2.....	Statics.	
2-3.....	} Drawing.	
3-4.....		
4-5.....		
SECOND YEAR.		
9-10.....	Strength of Materials.	*Astronomy.
10-11.....	{ *Physics (Hydrostatics and Optics).	{ *Physics (Hydrostatics and Optics).
11-12.....		
12-1.....	Drawing.	Chemistry.
1-2.....	{ *Experimental Physics.	} Drawing.
2-3.....		
3-4.....		
4-5.....	El. Mineralogy & Geology.	Applied Chemistry.
		Field Work.
THIRD YEAR.		
9-10.....	{ Drawing.	} Applied Chemistry.
10-11.....		
11-12.....		
12-1.....	Theory of Internal Stress.	Astronomy and Geodesy.
1-2.....	Drawing.	Constructive Design.
2-3.....	Constructive Design.	Mineralogy.
3-4.....		
4-5.....		
	Drawing.	Thermo-dynamics.
		Field Work.

*In University College.

Additional lectures are given at hours not specified in above time-table and when the weather will not permit of field work.

ENGINEERING.

COURSE IN CIVIL ENGINEERING.

1889-90, according to the subjoined Programme.

FIRST YEAR.		
WEDNESDAY.	THURSDAY.	FRIDAY.
<div> <div></div> Drawing. </div>	<div> <div></div> Drawing. </div>	<div> <div></div> Drawing. </div>
<div> <div></div> Statics. </div>	<div> <div></div> *Conics. </div>	<div> <div></div> *Algebra & Trigonometry. Dynamics (b). </div>
<div> <div></div> Elementary Chemistry. </div>	<div> <div></div> Drawing. Field Work. </div>	<div> <div></div> Drawing. Field Work. </div>
SECOND YEAR.		
<div> <div></div> Strength of Materials. </div>	<div> <div></div> *Astronomy. </div>	<div> <div></div> *Calculus. </div>
<div> <div></div> *Calculus. Chemistry. </div>	<div> <div></div> Descriptive Geometry. </div>	<div> <div></div> *Physics (Hydrostatics and Optics). </div>
<div> <div></div> Applied Chemistry. </div>	<div> <div></div> *Physics (Hydrostatics and Optics). Spherical Trigonometry. </div>	<div> <div></div> Practical Chemistry. </div>
<div> <div></div> Rigid Dynamics. </div>	<div> <div></div> Applied Chemistry. </div>	<div> <div></div> Theory of Surveying Instruments. </div>
<div> <div></div> Drawing. </div>	<div> <div></div> Practical Mineralogy (b). </div>	<div> <div></div> Field Work. </div>
<div> <div></div> El. Mineralogy & Geology. </div>	<div> <div></div> Field Work (a). </div>	
THIRD YEAR.		
<div> <div></div> Drawing. </div>	<div> <div></div> Drawing. </div>	<div> <div></div> Applied Chemistry. </div>
<div> <div></div> Hydraulics (b). </div>	<div> <div></div> Practical Mineralogy. </div>	<div> <div></div> Astronomy & Geodesy. </div>
<div> <div></div> Descriptive Geometry. </div>	<div> <div></div> Drawing. </div>	<div> <div></div> Constructive Design (a). Hydraulics (b). Drawing. </div>
<div> <div></div> Rigid Dynamics. </div>	<div> <div></div> Thermo-dynamics. </div>	<div> <div></div> Experimental Physics (b) </div>
<div> <div></div> Drawing. </div>	<div> <div></div> Field Work. </div>	<div> <div></div> Field Work (a). </div>

(a) During First Term.

(b) During Second Term.

This time-table is subject to modification, when necessary, to prevent conflict of hours.

DEPARTMENT OF
TIME TABLE OF REGULAR COURSE

Instruction will be given during the Session of

FIRST YEAR.		
HOURS.	MONDAY.	TUESDAY.
9-10.....	} Elementary Chemistry. *Geometry & Trigonometry Statics.	} *Experimental Physics. Drawing. Descriptive Geometry.
10-11.....		
11-12.....		
12-1.....		
1-2.....	} Drawing.	} Surveying (lecture). Drawing.
2-3.....		
3-4.....		
4-5.....		
SECOND YEAR.		
9-10.....	Strength of Materials.	Drawing.
10-11.....	*Physics.	*Physics.
11-12.....	} Drawing.	} Chemistry.
12-1.....		
1-2.....	} Drawing.	} Applied Chemistry.
2-3.....		
3-4.....		
4-5.....		
	*Experimental Physics.	Drawing.
THIRD YEAR.		
9-10.....	} Drawing.	} Applied Chemistry. Machine Design.
10-11.....		
11-12.....		
12-1.....		
1-2.....	} Theory of Internal Stress. Drawing.	} Drawing.
2-3.....		
3-4.....		
4-5.....		
	*Experimental Physics.	Thermo-dynamics. Drawing.

*In University College.

This time table is subject to modification, when necessary, to prevent
conflict of hours.

ENGINEERING.

IN MECHANICAL ENGINEERING.

1889-90, according to the subjoined Programme.

FIRST YEAR.		
WEDNESDAY.	THURSDAY.	FRIDAY.
{ Drawing. Statics. Elementary Chemistry.	{ *Experimental Physics. Drawing. *Conics. Drawing.	{ Drawing. *Algebra & Trigonometry. Dynamics (b). Drawing.
SECOND YEAR.		
Strength of Materials. *Calculus. Chemistry. Practical Chemistry. Rigid Dynamics. Drawing.	Theory of Mechanism. Descriptive Geometry. *Physics. Spherical Trigonometry. Applied Chemistry. Drawing.	*Calculus. *Physics. Practical Chemistry. Theory of Mechanism. Drawing.
THIRD YEAR.		
Drawing. Hydraulics (b). Descriptive Geometry. Drawing. Rigid Dynamics. *Experimental Physics.	Drawing. Mechanics of Machinery. Drawing. Thermo-dynamics. Drawing.	Applied Chemistry. Machine Design. Hydraulics (b). Drawing. *Experimental Physics.

(b) During Second Term.

I. DEPARTMENT OF ENGINEERING.

CIVIL ENGINEERING.

This Department is intended to afford the necessary preliminary preparation to students intending to become Civil Engineers (including under this term Mining Engineers).

Students who wish to devote themselves to the practice of Mining Engineering are allowed to take the work specially mentioned under this head, in the Third Year, and to omit the work in Experimental Physics.

They are advised, however, to take, if possible, the regular course in Civil Engineering and the special work subsequently as Special Students.

SUBJECTS OF THE FIRST YEAR.

MATHEMATICS.

Euclid, Algebra, Plane Trigonometry, Analytical Geometry of two dimensions.

MECHANICS.

Statics and Dynamics (with special reference to Structures and Machines).

DRAWING.

Copying from the Flat. Lettering. Topography.

Original Surveys.

Graphics.

Descriptive Geometry in its application to plane sided solids.

Orthographic (including Isometric) and Oblique Projection.

SURVEYING.

Field and Office Work—Chain and Compass Surveys—Topography—Preliminary Instruction in use of the Transit and Theodolite—Plotting, Mensuration.

CHEMISTRY.

Elementary Chemistry, with Laboratory Practice.

SUBJECTS OF THE SECOND YEAR.

MATHEMATICS.

Differential and Integral Calculus.

Spherical Trigonometry.

PHYSICS.

Hydrostatics.
Geometrical Optics.
Plane Astronomy.

EXPERIMENTAL PHYSICS.

Light: Use of the Heliostat and Spectroscope. Experiments with Lenses and Mirrors. Theory of the Telescope and Microscope, and Reflecting instruments.

DRAWING.

Subjects of First Year continued.
Coloring and shading applied in both topographical and construction drawing.
Descriptive Geometry in its application to solids bounded by curved surfaces. The various projections of the sphere and principles of map construction.
Machines and Structures. (Drawings made from both copies and original notes).

ENGINEERING AND SURVEYING.

Theodolite Surveying (including laying out Railway Curves).
Principles of Geodesy (considering the Earth a Sphere).
Statics and Dynamics. (Pure and applied).
Theory of Strength of Materials.
Materials of Construction.
Methods and Processes.
Theory of the Theodolite, Transit-Theodolite, Level, and Sextant.

CHEMISTRY.

General Chemistry.
Practical Chemistry.
Chemistry (Applied).
Combustion, Fuel, and Furnaces.
Metallurgy of Iron and Steel.

MINERALOGY AND GEOLOGY.

Elements of these Sciences.
Blowpipe Practice.
Determination of Minerals.

SUBJECTS OF THE THIRD YEAR.

EXPERIMENTAL PHYSICS.

Heat: Use of the Cathetometer, Dividing Engine, and Spherometer, Thermometry and Calorimetry. Principle of Least Squares.

DRAWING.

Subjects of previous years continued.

Descriptive Geometry.

Shades and Shadows.

Stone cutting.

Perspective Projection.

Original Designs—Bridges, Roofs, Floors, Arches, etc.

ENGINEERING AND SURVEYING.

Subjects of previous years continued.

Levelling. Setting out Excavation, Cross-sectioning, Calculation of Quantities.

Applied Mechanics.

Thermodynamics and Theory of the Steam Engine.

Hydraulics.

Application of Principles to practical problems connected with the design and construction of various Structures and Machines, *e.g.*, Foundations, Retaining Walls, Arches, Roofs, Bridges, Roads, Railways, Canals, Sewers, Water Wheels, Steam Engines, Hydraulic Machinery, Mining Machinery, etc.

Practical Astronomy.

Geodesy (Considering the Earth a Spheroid.)

CHEMISTRY (APPLIED.)

Artificial Lighting.

Photography.

Explosives.

Mortars and Cements.

Bricks and Artificial Stones.

Preservation of Wood, Iron and Stone.

Water, Air and Sewage.

*Metallurgy, with special reference to Copper, Lead, Silver and Gold.

* Mining Engineering only.

MINERALOGY AND GEOLOGY.

Economic Minerals of Ontario.

Blowpipe Analysis and Determinative Mineralogy.

*Assaying and Mining Geology, Mining Calculations.

*Crystallography and Palæontology.

MECHANICAL ENGINEERING.

This Department is intended to afford the necessary preliminary preparation to students intending to become Mechanical Engineers (including under this term Electrical Engineers.)

SUBJECTS OF THE FIRST YEAR.

MATHEMATICS.

Euclid, Algebra, Plane Trigonometry.

Analytical Geometry of two dimensions.

MECHANICS.

Statics and Dynamics (with special reference to Structures and Machines).

EXPERIMENTAL PHYSICS.

Light : Use of the Heliostat and Spectroscope.

Experiments with Lenses and Mirrors.

Theory of the Microscope and Reflecting Instruments.

DRAWING.

Copying from the Flat, Lettering.

Graphics.

Descriptive Geometry in its application to plane sided solids.

Orthographic (including Isometric) and Oblique Projection.

CHEMISTRY.

Elementary Chemistry with Laboratory Practice.

* Mining Engineering only.

SUBJECTS OF THE SECOND YEAR.

MATHEMATICS.

Differential and Integral Calculus.
Spherical Trigonometry.

PHYSICS.

Hydrostatics.
Optics.
Magnetism.
Electricity.

EXPERIMENTAL PHYSICS.

Heat: Use of the Cathetometer, Dividing Engine, and Spherometer, Thermometry and Calorimetry.
Principle of Least Squares.

DRAWING.

Subjects of first year continued.
Coloring and Shading applied in construction drawing.
Descriptive Geometry in its application to solids bounded by curved surfaces. The various projections of the sphere.
Machines and Structures. (Drawings made from both copies and original notes.)

ENGINEERING.

Statics and Dynamics (Pure and Applied).
Theory of Mechanism.
Theory of Strength of Materials.
Materials of Construction.
Methods and Processes.

CHEMISTRY.

Theoretical Chemistry.
Practical Chemistry.

CHEMISTRY (APPLIED).

Combustion, Fuel and Furnaces.
Metallurgy of Iron and Steel.
Laboratory Practice.

SUBJECTS OF THIRD YEAR.

EXPERIMENTAL PHYSICS,

Acoustics.

Electrical Measurements and Testing.

DRAWING.

Subjects of previous years continued.

Descriptive Geometry :

Shades and Shadows.

Stone cutting.

Perspective Projection.

ORIGINAL DESIGNS.

Engines, Water Wheels, Shafting, Belting and Gearing,
Machines, etc.

ENGINEERING.

Subjects of previous years continued.

Applied Mechanics:

Mechanics of Machinery.

Machine Design.

Thermodynamics and Theory of the Steam Engine.

Hydraulics.

Application of Principles to Practical Problems connected with
the design, construction and testing of various Prime Motors
and Machines.

CHEMISTRY (APPLIED).

Artificial Lighting.

Photography.

Explosives.

Preservation of Wood, Iron and Stone.

Metallurgy.

In addition to taking the course of instruction in the School and passing the requisite examinations, a candidate for the diploma in Mechanical Engineering will be required to present satisfactory evidence of having had at least one year's good practical experience in one or more of the principal occupations connected with mechanical work, such as machinist, pattern-maker, moulder, steam-engineer, etc. There is no restriction as to the place where the candidate may have gained such practical experience.

DOMINION AND PROVINCIAL LAND SURVEYORS.

Courses of instruction will be given in accordance with the requirements of the Statutes relating to the Dominion and Provincial Land Surveyors, which will enable the students, who, after examination, obtain certificates therein and who have otherwise fulfilled the provisions of the said Statutes, to present themselves for final examination before the proper Boards, at an earlier period in their apprenticeship than would otherwise be permitted.

Extracts from the Provincial Act respecting Land Surveyors and the Survey of Lands.

12. (2) Any person who has followed a regular course of study at the Ontario School of Practical Science in the subjects of drawing, surveying and levelling, and geodesy and practical astronomy, and who has thereupon received, after due examination, a certificate of having passed one session, two sessions, or three sessions, as the case may be, in the study of the aforesaid subjects, may, after having passed the preliminary examination hereinbefore required for admission to apprenticeship with a land surveyor, be received as an apprentice by any practising land surveyor, and shall thereupon, if he has received a certificate of having passed three sessions in the study of the said subjects, be only holden to serve as such apprentice during twelve successive months of actual service; or, in case he has only received a certificate of having passed only one or two sessions, as the case may be, in the study of the said subjects, then for such time of actual service as, with the period spent by him at such session or sessions, suffices to make up the full term of three years.

(3) After such actual service, such person shall, subject to the other provisions of this Act, have the same right to present himself for and to undergo the examination required by law, and if found qualified, then to be admitted to practice as a land surveyor, as if he had served the full three years' apprenticeship otherwise required by law.

14. The privilege of a shortened term of apprenticeship shall also be accorded to any graduate of the Military College at Kingston and of the Ontario School of Practical Science, and such person shall not be required to pass the preliminary examination hereinbefore required for admission to apprenticeship with a land surveyor, but shall only be bounden to serve under articles with a practising land surveyor duly filed as required by section 17 of this Act, during twelve successive months of actual practice, after which, on complying with all the other requirements, he may undergo the examination by this Act prescribed.

Extract from the Dominion Lands Act.

Every graduate in surveying of the Royal Military College of Canada, and every person who has followed a regular course of study in all the branches of education required by this Act for admission as a Dominion Land Surveyor, through the regular sessions, for at least two years in any College or University where a complete course of theoretical and practical instruction in surveying is organized, and who has thereupon received from such College or University a Diploma as Civil Engineer, shall be exempt from serving three years as aforesaid, and shall be entitled to examination after one year's service under articles with a Dominion Land Surveyor, at least six months of which service has been in the field, on producing the affidavit required by the next preceding clause as to such service; but it shall rest with the Board to decide whether the course of instruction in such College or University is that required by this clause.

The fee for special students in Surveying is \$30 per session.

The attention of Candidates for the Diploma of D.T.S., given by the Dominion Board of Examiners, is directed to the facilities afforded for preparation in the School.

DEGREE OF C.E.

The attention of regular students in the Civil Engineering course is directed to the following Statute, passed by the Senate of the University of Toronto in 1884:—

DEGREE OF C.E.

BY THE SENATE OF THE UNIVERSITY OF TORONTO.

Be it enacted:

- I. That all previous Statutes of the University relating to Degrees or Diplomas in Civil Engineering, be hereby repealed.
- II. That the degree of C.E. be hereby established, to be granted subject to the following conditions and regulations:—
 1. Candidates for the said degree shall hold the Diploma in Civil Engineering of the Ontario School of Practical Science.

3 (P. S.)

2. Candidates shall have spent three years after receiving the said Diploma in the actual practice of the profession of Civil Engineering.
3. Candidates shall have spent at least two years of the said period in the construction and operation of engineering works, as distinguished from surveys merely.
4. Satisfactory evidence shall be offered as to the periods spent on the different classes of engineering employment, and intervals during which the candidate was not engaged in the construction or operation of engineering works, or in the prosecution of surveys, shall not be included as portions of the aforesaid period of three years.
5. It shall not be necessary that the several intervals required to make up the period of three years be consecutive.
6. Each candidate shall prepare for the approval of the Senate, an original essay on some engineering subject, accompanied with detailed explanations, drawings, specifications and estimates; he shall also be examined on the subject of the essay as well as on the work or works on which he has been engaged, unless exempted therefrom on the special recommendation of the examiners.
7. The subject of the said essay shall be forwarded to the Registrar for the approval of the Senate, not later than the first day of February.
8. Candidates shall notify the Registrar of their intention of proceeding to the degree of C.E., not later than the first day of April.
9. The evidence required in section 4, together with the essay, drawings and estimates, shall be sent to the Registrar not later than the first day of May.
10. The examination of the essay, drawings and estimates, and any further examination of the candidate that may be considered necessary, may be held in May.
11. The fee for the degree of C.E. shall be \$20, and shall be paid to the Registrar not later than the first day of May.
12. The essay, drawings and estimates, submitted by the candidate, shall be the property of the University.

2. DEPARTMENT OF ASSAYING AND MINING GEOLOGY.

In this Department the student is fully prepared in all the methods of analysis necessary to render him a competent Assayer. He is also qualified to survey and report upon the value of mineral lands.

SUBJECTS OF FIRST YEAR :

1. Elementary Mathematics, including Mensuration and Plane Trigonometry.
2. Elements of Natural Philosophy, including Mechanics and Hydraulics.
3. Inorganic Chemistry.
4. Elementary Mineralogy and Blowpipe Practice.
5. Elementary Biology.
6. Physical Geography, Paleontology and Geology.
7. Drawing.

SUBJECTS OF SECOND YEAR :

1. Higher Mathematics, including Spherical Trigonometry, etc.
2. Chemistry, with Laboratory practice in Qualitative Analysis.
3. Blowpipe Analysis and Determinative Mineralogy.
4. Geology and Economic Minerals of Canada.
5. Surveying and Levelling.

SUBJECTS OF THIRD YEAR :

1. Quantitative Chemical Analysis.
2. Metallurgy.
3. Assaying.
4. Study of Metallic Veins and other Mineral Deposits, Mining Calculations, Examinations of Mineral Lands.

3. DEPARTMENT OF ANALYTICAL AND APPLIED CHEMISTRY.

This Department is under the charge of the Professor of Applied Chemistry.

The course is intended to render the student proficient in all the methods of Analytical Chemistry, and to fit him for such positions as that of Public Analyst, Consulting Chemist in regard to Manufactures, or Resident Chemist in manufactories where such is required.

SUBJECTS OF FIRST YEAR :

1. Algebra, Euclid and Plane Trigonometry.
2. Natural Philosophy, with work in Laboratory.
3. Elementary Biology.
4. Inorganic Chemistry, Elementary and Advanced, with work in the Laboratory.

SUBJECTS OF SECOND YEAR :

1. Elementary Mineralogy and Geology.
2. Blowpipe Practice and Assaying.
3. Organic Chemistry with Applied Chemistry, Laboratory work in Qualitative and Quantitative Analysis.

SUBJECTS OF THIRD YEAR :

Candidates are expected to be able to read Chemical Works in the French and German languages.

1. Applied Chemistry.
 2. Inorganic Chemistry, including Thermo-Chemistry and the study of Mendeleeff's Periodic Law. Advanced Organic Chemistry, Historical Development of Chemical Theory, and Physiological Chemistry.
 3. Laboratory Works, including Technical Analysis, Quantitative Mineral Analysis, a prescribed course in Physiological Chemistry, and in Chemistry in its relations to Hygiene and Forensic Medicine.
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Synopsis of the Courses of Lectures


AND PRACTICAL INSTRUCTION GIVEN IN EACH DEPARTMENT,

WITH FEES FOR SPECIAL STUDENTS.

Special Students are advised to enter at the beginning of the Session (October 1st), as many subjects begun in the First Term are continued through the Second, and Lectures cannot be repeated.

I. ENGINEERING.

(Reductions will be made to Special Students taking Several Courses.)

 Text-books for the First Year marked (a); for Second Year, (b); for Third Year, (c).

(I.) DRAWING.

Model Drawing, Machines and Structures, Map and Topographical Drawing, Designs and Estimates, Graphical Calculations.

Descriptive Geometry, including Practical Geometry (Plane and Solid); Orthographic, Oblique and Perspective Projections; Intersections of Surfaces, Shades and Shadows, Stone Cutting, Theory of Mechanism, Theory of Mapping, etc.

Text Books and Books of Reference.—Davidson's Projections.

Angel's Plane and Solid Geometry.

Binn's Orthographic Projection.

Church's Descriptive Geometry (a), (b), (c).

Warren's Stone Cutting (c).

McCord's Lessons in Mechanical Drawing.

Worthen's Topographical Drawing (a), (b), (c).

Fees for Special Students, \$10.

(II.) SURVEYING AND LEVELLING.

LAND SURVEYING—

Chain Surveys.
 Compass and Theodolite Surveys.
 Methods of keeping Field Notes.
 Determination of Heights and Distances.
 Plotting.

LEVELLING—

Longitudinal and Cross sections.
 Plotting.

SETTING OUT—

Setting out Straight Lines and Curves.
 Setting out Levels.

MENSURATION—

Lines, Surfaces and Solids.
 Timber, Masonry, Iron and Earthwork.
 Capacities of Reservoirs, etc.

Lectures will also be given on the distinctive features of Mining and Hydrographic Surveying.

Text Books.—Murray's Manual of Land Surveying (a).
 Gillespie's Higher Surveying (b), (c).
 Henck's or Trautwine's Railway Curves (b).
 Fees for Special Students, \$10.

(III.) GEODESY AND PRACTICAL ASTRONOMY.

GEODESY—

Field Work.
 Computation of the Triangles (considering the Earth, 1st as a Sphere ; 2nd, a Spheroid).
 Determination of the Figure of the Earth.

PRACTICAL ASTRONOMY—

Methods of determining Latitude, Local Time, Direction of the Meridian, and Difference of Longitude.
 Theory of the Theodolite, Transit-Theodolite, Level, Sextant, and Solar Compass.

- Text Books.*—Gillespie's Higher Surveying (b), (c).
 Chauvenet's Spherical and Practical Astronomy (c).
 Nautical Almanac for 1890 (c).
 Chambers' Practical Mathematics (c).
 Fee for Special Students, \$15.
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(IV.) APPLIED MECHANICS.

STATICS—

The Calculation of the Stresses in Framed Structures, Solid and Rivetted Beams, Stone Arches, etc. Both Graphical and Analytical Methods used.

THEORY OF THE STRENGTH AND ELASTICITY OF MATERIALS—

DESIGNING OF STRUCTURES in Timber, Iron and Masonry—Arches, Retaining Walls, Foundations, Roofs, Bridges, etc.

DYNAMICS—

Representation and Measurement of Forces and Motions.
 Principles of *Work* and *Energy*.
 Efficiency of Machines. Friction.
 Transmission of Energy—Belts, Shafts, Crank and Connecting Rod, etc.
 Fly-Wheels, Governors.
 Balancing of Machinery.
 Etc., etc.

STRENGTH OF THE PARTS OF MACHINES,

MACHINE DESIGN.

HYDRAULICS—

Discharge of Water through Orifices, Notches, etc. Flow in Pipes, and Open Channels. Water Power. Water Wheels, Turbines, Pumps, etc.

THERMO-DYNAMICS AND THEORY OF THE STEAM ENGINE.

- Text Books and Books of Reference.*—Von Ott—Graphic Statics (a).
 DuBois—Graphical Statics.
 “ Strains in Framed Structures.
 Wood—Resistance of Materials.
 “ Bridges and Roofs.
 Rankine—Applied Mechanics (b), (c).
 Rankine—Steam Engine and other
 Prime Movers.
 Unwin—Elements of Machine Design
 (c).
 Shann—Elementary Treatise on Heat
 (c).
 Kennedy—Mechanics of Machinery
 (b), (c).
 Jackson—Hydraulic Manual (c).
 Neville—Hydraulic Tables and For-
 mulæ (c).

Fee for Special Students, \$15.

(V.) PRINCIPLES OF MECHANISM.

Principles of the Transmission of Motion without reference to Force :—

Pitch Surfaces, Spur Wheels, Bevel Wheels, Skew-bevel Wheels,
 Trains of Wheelwork, Teeth of Wheels, Cams, Cranks,
 Eccentrics, Links, Bands and Pulleys, Hydraulic Con-
 nections, Frictional Gearing, Link Motion for Slide Valves,
 etc., etc.

- Text Books and Books of Reference.*—Rankine—Machinery and Millwork.
 Camus—Teeth of Wheels.
 MacCord—Slide Valve and Eccentric.
 Goodeve—Elements of Mechanism (b).
 Kennedy—Mechanics of Machinery
 (b).

Fee for Special Students, \$15.

The foregoing comprises the work to which the lectures and practical instruction will be principally confined. In addition, the Student will be required to obtain, by reading and observation during his course, a certain amount of information regarding the processes and details of Engineering Works, as below :—

(VI.) ENGINEERING WORKS.

Roads and Bridges.
 Canals and Harbours.
 Water and Sewage Works.
 Workshop and Foundry Practice.
 Mining Machinery and Processes.

Since information on these subjects is given in a plain and intelligible manner in the various treatises relating thereto, which can always be consulted by the Engineer when engaged in the actual practice of his profession, it has not been deemed expedient that much time should be given to them in the School.

(VII.) MATHEMATICS.

The Pure Mathematics included in this course will be taught in University College.

The Applied Mathematics will be taught partly in University College and partly in the School.

(VIII.) VACATION WORK.

THESIS AND CONSTRUCTION NOTES.

A subject will be given at the end of each session on which the student will be required to write a Thesis (accompanied with drawings and specifications when necessary) during the subsequent vacation.

The student will also be required to make, during the vacation, full and clear notes of various constructions of engineering interest that may fall under his notice.

The value of both the Thesis and the construction notes will be taken into account in determining his standing at the next following examination.

CIVIL ENGINEERING.

Subject of Thesis for Second Year.—Roads, Streets and Pavements.

“ “ *Third* “ Sanitary Drainage.

Books of Reference.—Gilmore—Roads, Streets and Pavements.
 Waring—Sanitary Drainage of Houses and Towns.
 Latham—Sanitary Engineering.

MECHANICAL ENGINEERING.

Subject of Thesis for Second Year.—Machine-shop Practice.
 “ “ *Third* “ Foundry Practice.

Books of Reference.—

Any other works on the above subjects may be consulted, and results of original observation should be given.

II. CHEMISTRY.

All the instruction in this subject is given in the School of Practical Science.

COURSES OF LECTURES.

I. Inorganic Chemistry.—A course on Elementary Inorganic Chemistry suited to the Pass Examination, University of Toronto; to the Medical Examination, First Year, University of Toronto; and to the Second Year, Engineering Course, School of Practical Science.

A Course on Elementary Chemistry for the First Year, Engineering Course.

A Course on Advanced Inorganic Chemistry for the Second Year, Honour Science Examination, University of Toronto.

A Course on the Theory of Qualitative Analysis for the Second Year, Honour Science Examination, University of Toronto.

II. Organic Chemistry.—A Course on Organic Chemistry for the Third Year, Honour Science Examination, University of Toronto.

A Course on Elementary Organic Chemistry, for the Medical Examination, Second Year, University of Toronto.

III. Historical Development of Chemical Theory.—A Course for the Fourth Year Examination in Science, University of Toronto.

IV. *Physiological Chemistry*.—A Course for the Fourth Year Examination in Science, University of Toronto.

V. *Applied Chemistry*.—A Course on the Chemistry of Combustion, Fuel, Furnace, Artificial Lighting and Explosives, Building Materials, Water, Air and Sewage, and on Metallurgy, suited to the Examination for Third Year, Engineering Course.

PRACTICAL WORK IN THE LABORATORY.

I. Courses including Qualitative Analysis, suited to the Examinations for

- (a) First Year, Engineering Course.
- (b) Second Year, Honour Science, University of Toronto.
- (c) First Year, Medicine, University of Toronto.

II. Courses including Quantitative and Qualitative Analysis for

- (a) Second Year, Engineering Course.
- (b) Third Year, Honour Science, University of Toronto.

III. Chemistry Applied to Medicine, for Second Year Examination in Medicine, University of Toronto.

IV. A Course for Fourth Year Examination in Science, University of Toronto.

III. MINERALOGY AND GEOLOGY.

COURSES OF LECTURES.

1. Elementary Course.—Rudiments of Mineralogy.
Geology and Palæontology.
Physical Geography.

Text Books and Books of Reference.—Chapman's Mineralogy and Geology of Canada, 3rd edition.

Dana's Manual of Mineralogy.

Dana's Text Book of Geology.

Page's Physical Geography.

Johnston's Elementary Physical Atlas.

2. Advanced Course.—Mineralogy and Crystallography.
 Geology and Palæontology.
 Mathematics of Crystallography.
 Physical Geography.
 Geology and Palæontology of Canada.

Text Books and Books of Reference.—Dana's System of Mineralogy.
 Chapman's Geology of Canada.
 Nicholson's Palæontology.
 Chapman's Synopsis.

PRACTICAL COURSES.

1. Use of Blowpipe—Chapman's Blowpipe Practice.
2. Blowpipe Analysis, Determinative Mineralogy. Economic Minerals of Canada.
 Kerl's Leitfaden bei qual. u. quant. Lothrohr-Untersuchungen, etc.
 Aufl. 2. Plattner's Blowpipe Treatise. Von Kobell's Tafeln. Chapman's Mineral Tables.
3. Assaying.—Mitchell's Assaying, by Crooks.
 Kerl's Probirkunst.
 Chapman's Assay Notes, 2nd edition.
4. Mining Geology.—*Books of Reference*—Burat's Géologie Appliquée and Cours d'Exploitation des Mines. Niederist's Bergbaukunde. Von Cotta's Erzlagerstätten.

IV. BIOLOGY.

Those students of the School of Practical Science who are required to take Biology as part of their course join the Arts Classes of the University of Toronto, which will be conducted henceforward in the New Building of the University Biological Department.

The following is the University Course in Biology for Art Students. That for Medical Students will be found in the Calendar of the Medical Faculty.

The following arrangements will be in force during the year 1889-90 :

1. A course of Elementary Lectures on Biology will be given on Tuesdays and Thursdays at 12 noon to prepare Candidates for the University Examination of the First Year.

2. A course of more advanced Lectures on Animal Physiology for Honor Students of the Second Year will be given three times a week at an hour to be arranged.

Text-Book—Yeo's Manual of Physiology.

3. Candidates for the Second Year Honor Examination in addition to attending the above Lectures will study Thomé's *Lehrbuch der Zoologie* as an introduction to the Zoology of the Vertebrata.

4. The Practical Course for Honor Students of the Second Year will be devoted to the methods of Biological Investigation, and to the study of typical forms of plants and animals, such as are treated of in Huxley and Martin's *Elementary Practical Biology*, new edition. Necessary Works of Reference will be found in the Laboratory. There will also be opportunities for the study of the Canadian Vertebrate Fauna (*Text-book* Jordan's *American Vertebrates*), and for a revision of the Canadian Flowering Plants, but the student is expected to have familiarized himself with the Canadian Flora during the preceding long vacation.

For Reference—Spotton's Canadian Flora or Gray's Manual.

5. Honor Students of the Third Year will study Cryptogamic Botany and Vegetable Physiology twice a week during the Michaelmas Term, and during the Easter Term the Zoology of the Invertebrata.

Books of Reference—1. Goebel's *Outlines of the Classification of Plants*.

2. Vines' *Lectures on the Physiology of Plants*.

3. Claus' *Zoology*, translated by Sedgwick.

6. The practical course for Third Year Students will be devoted to the study of typical forms of Cryptogamic Plants and Invertebrate Animals. In addition to the text-books referred to above Brook's *Invertebrate Zoology* will be required.

7. Wiedersheim-Parker's *Elements of Comparative Anatomy of the Vertebrata*, and Foster's *Physiology*, last English edition, are recommended for Honor Students of the Fourth Year, and the following works will be required in the Practical Course:

1. Klein's *Elements of Histology*.

2. Parker's *Zootomy*.

3. Foster and Balfour's *Embryology*.

4. Charles' *Physiological Chemistry*.

Works of reference on Bacteriology and the other subjects specified in the University Curriculum will be found in the Laboratory.

8. Students of all years are required to provide themselves with dissecting instruments, slides, cover-glasses, etc., and to pay a Laboratory fee for the use of microscopes and material for study.

V. MATHEMATICS AND PHYSICS.

The ordinary course embraces Euclid, Algebra, Plane Trigonometry, Statics of Solids and Fluids, Dynamics of a Particle, Geometrical Optics, Sound, Heat, Electricity, and Plane Astronomy.

The lectures in Physics will be fully illustrated by experiments.

The advanced course embraces Spherical Trigonometry, Analytical Geometry (Plane and Solid), Differential and Integral Calculus, Theory of Equations, Statics of Solids and Fluids, Particle and Rigid Dynamics, Hydrodynamics, Optics, Acoustics, Thermo-Dynamics, Electricity, and Astronomy.

VI. ETHNOLOGY.

Anthropology. The Skull, its bones and sutures. Structure and functions of the brain. Typical race-forms of head. Hair, color and other distinctive ethnical elements. Succession of races. The Prehistoric Unhistoric, and Historic races.

Physical evidences of diversity of race.

Philological evidence.

The lectures are illustrated by means of maps, drawings, specimens of typical skulls, primitive implements, etc.

Text-Books.—Tylor's Anthropology : an introduction to the study of Man and Civilization.

Brace's Manual of Ethnology.

Latham's Ethnology of British Isles.

“ Ethnology of Europe.

“ Man and his Migrations.

Max Müller's Science of Language, 1st Series.

Additional Books of Reference—Pritchard's Researches into the Physical History of Man.

Pritchard's Eastern Origin of the Celtic Language (Latham's Ed.)

Latham's Varieties of Man.

Neibuhr's Ethnography.

Wilson's Prehistoric Man (3rd Ed.)

PHYSICAL LABORATORY AND WORKSHOP.

The Physical Laboratory which has been lately established in connection with University College is furnished with a large collection of apparatus for lecture experiments in the departments of Mechanics, Sound, Light, Heat and Electricity. It is also well supplied with instruments of precision for individual work in the same departments. In addition to an Elementary Laboratory, there are several special Laboratories, which offer unusual facilities for the conduct of experiments in the various branches of Physics.

The electrical apparatus include Electrometers, Galvanometers, Resistance Coils and Bridges, Testing Keys, Batteries, Electrical Machines (Holz and Carré), Ruhmkorff Coils, Crooke's Tubes, Telephones, etc., etc.

The workshop contains a gas engine, lathes and other tools.

MODERN LANGUAGES.

Students in the regular courses are admitted, without extra charge, to the French and German classes in University College (see regulation 10). No special examinations are held in these languages, but it is expected that every student of a regular course should be able to acquaint himself with the contents of any of the works necessary to his profession, written in these languages. Such books may be prescribed for the terminal examinations.

LIBRARIES, MUSEUMS, Etc.

The Library, Museums and Herbarium of the University of Toronto are open to regular students.