DOCUMENT RESUME

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SPONS AGENCY	North Dakota State Board for Vocational Education, Bismarck. Research Coordinating Unit.
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ABSTRACT

Under a grant from the North Dakota State Board for Vocational and Technical Education, a project in vocational research in the field of Environmental Science Technology was conducted for the purpose of developing vocational education curricula. The resulting curricula is for a two year program. The proposal is divided into suggested courses to be taken in each of three quarters for the two years. The document outlines the program by listing which courses are to be taken during a particular quarter, the number of periods a week to be spent in each course, the units of credit to be earned for each course, and the total units of credit earned each quarter (seventeen to nineteen). Each course cited in the program outline is then considered in a separate outline where the subject, the course objective, its description, and its major divisions are enumerated. While most of the courses are from the area of environmental science technology or civil engineering technolcgy, courses in communications, sociology, physical education, and psychology are included in the program. Outlines are not available for courses in the two latter areas. Tests and references are suggested for most of the courses. (AG)

FINAL REPORT

ENVIRONMENTAL TECHNOLOGY

[redacted]

Bismarck, North Dakota 58501

I N D E X

The pages in this report are not numbered.

The following items are to be found in this report in the order that they appear in this listing:

- PREFACE AND ACKNOWLEDGEMENTS
  (A Project in Vocational Research)

- SUGGESTED PROGRAM FOR ENVIRONMENTAL SCIENCE TECHNOLOGY
  (First Year and Second Year)

The material follows the course name as shown in the suggested program for each quarter of college study; i.e.

Fall Quarter (1st term)
  Engineering Drawing (CT 101)
  Communications (Eng 107)
  Mathematics (Math 117)
    etc. for each successive quarter

PREFACE AND ACKNOWLEDGEMENTS

A PROJECT IN VOCATIONAL RESEARCH

In contract with the North Dakota State School of Science through the North Dakota State Board for Vocational and Technical Education

The Research Coordinating Unit of the North Dakota State Board for Vocational and Technical Education entered into a contract with the North Dakota State School of Science at Wahpeton on April 29, 1971 for the purpose of developing vocational education curricula for new careers and occupations in North Dakota in the field of Environmental Science Technology.

The Environmental Science Technology curriculum developed under this grant is oriented towards the "hands-on" engineering approach rather than the biological science approach.

The original contract called for use of the grant money in FY 1971. The original project was funded for the period June 1 - June 30, 1971. It was soon evident that this one month period would not provide sufficient time to develop the type of curriculum needed and desired. The State Board for Vocational and Technical Education extended the completion date of the project.

Phase I was completed during the summer of 1971. During this initial phase, various individuals working separately and together, and with professional advice from the North Dakota State School of Science administrative staff: (1) Visited other institutions with similar programs, (2) Inspected water and waste-water plants, (3) Had consultations with various city and state health representatives, (4) Gathered pertinent material; and, (5) Developed general outlines for courses.

Phase II was completed during the summer of 1972. During this phase, further work was done by those individuals who worked on the project in the summer of 1971. Additional people were involved in the project during this phase. More visits were made to water and waste-water plants and further consultations were held with the ND State Department of Health personnel. Conferences and seminars were

attended and time was spent in the ND State Health Laboratory studying procedures, and the methods used in the tests being run. Specialists in the environmental field were called in or were visited as consultants.

During Phase II of the project, the group working as a committee evaluated the program and finalized the outlines. Some of the first proposed courses were combined. Although the individuals worked as a group, each one was assigned certain areas of responsibility. In some cases an individual was called on for advice and ideas as a consultant; then later was retained to help develop the final outlines. This procedure has resulted in what the group felt was a strong program designed to train practical environmental technicians for North Dakota and the immediate area.

The specific areas of responsibility were as follows:

Coordinator Federal Aid:	Alvin C. Eckre, Director Special Services Division North Dakota State School of Science
General Supervisor:	James Horton, Vice-President Academic Affairs North Dakota State School of Science
President:	Clair T. Blikre, President North Dakota State School of Science
Program Advisor:	Sam Schimelfenig, Dean Technical Education Division North Dakota State School of Science
Project Director:	Harold F. Bruschwein Department Chairman Civil Engineering Technology North Dakota State School of Science
Biology Outlines:	Stanley Graf, Instructor Neal Johnson, Instructor Biology Department North Dakota State School of Science
Chemistry Outlines:	Donald Fulp, Instructor Chemistry Department North Dakota State School of Science
Air Pollution Outlines:	Darwin Schults State Department of Health Bismarck, North Dakota

Solid Wastes Outlines:

Russell Kastelle. Instructor
Civil Engineering Technology Department
North Dakota State School of Science

Water Supply and Sanitary Engineering:

Harold F. Bruschwein
Department Chairman
Civil Engineering Technology
North Dakota State School of Science

Consultants:

Gordon Dwiggins
Fayetteville Technical Institute
Fayetteville, North Carolina

Gene Christianson and other personnel of Department of Health
Bismarck, North Dakota

C. Petlon Steele, Mr. Kook, and other laboratory personnel of State
Bismarck, North Dakota

Mr. Chandler
Millipore Corporation
Bedford, Massachusetts

Dr. Scoby
North Dakota State University
Fargo, North Dakota

Eugene A. Wellman
Oregon Technical Institute
Klamath Falls, Oregon

Lyle Mitzel, Water Plant Operator
Wahpeton, North Dakota

Mr. Sowden, Sanitary Engineer
Fergus Falls, Minnesota

Special thanks should be given to all those that assisted and are not here named. A special thanks to Mr. Larry Selland and Mr. Benjamin Doutt from the North Dakota State Department for Vocational and Technical Education, Bismarck, who gave us help and encouragement.

Report prepared and submitted by:

Harold Bruschwein
Department Chairman
Civil Engineering Technology
North Dakota State School of Science
Wahpeton, North Dakota 58075

SUGGESTED PROGRAM FOR ENVIRONMENTAL SCIENCE TECHNOLOGY

FIRST YEAR	Periods Per Week	Units of Credit
Fall Quarter (1st term)		
Engineering Drawing (CT 101)	10	4
Communications (ENG 107)	3	3
Mathematics (MATH 117)	3	3
Surveying (CT 121)	10	4
Construction Materials (CT 161)	3	3
Orientation (PSYC 101)	1	0
Intro to Pollution Control (AP 201)	2	2
	32	19
Winter Quarter (2nd term)		
Technical Drafting (CT 103)	10	4
Communications (ENG 108)	3	3
Mathematics (MATH 118)	3	3
Surveying (CT 122)	10	4
Concrete Technology (CT 214)	5	3
Physical Education (PE 101)	2	1
	33	18
Spring Quarter (3rd term)		
Mathematics (MATH 119)	3	3
Surveying (CT 123)	10	4
Computer Theory (CT 204)	2	2
Technical Drafting (CT 211)	10	4
Soils and Materials Testing (CT 212)	10	4
	35	17
SECOND YEAR		
Fall Quarter (4th term)		
General Chemistry (SCI 121)	8	5
Water Supply & Sanitation I (CT 241)	5	3
Communications III (ENG 109)	3	3
Human Relations (PSYC 127)	3	3
General Physics I (SCI 141)	8	5
	27	19
Winter Quarter (5th term)		
Survey of Chemistry (SCI 122)	8	4
Water Supply & Sanitation II (ES 243)	6	3
Air Pollution Control I (ES 202)	6	3
Microbiology I (SCI 133)	6	4
Drainage Technology (CT 242)	5	3
	31	17
Spring Quarter (6th term)		
Sanitary Chemistry & Biology (ES 207)	10	5
Air Pollution Control II (ES 203)	6	3
Solid Waste Disposal (ES 206)	3	3
Sociology (SSCI 121)	4	4
Surveying (CT 223)	3	3
	26	18

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Engineering Drawing I (CT 101)

Objective:

The principle objectives are: to obtain a working knowledge and appreciation of the many different types of drawings, their history and characteristics; the use and care of drawing instruments; to learn the proper lines to use for visible edges, invisible edges, center lines, construction lines, extension lines and dimension lines; apply proper geometric construction procedures; to develop a basic understanding of orthographic projection; and emphasize basic dimensioning considerations.

Description:

Instruction and practice in use of drawing instruments, orthographic projection, auxiliary views, dimension techniques, sectional views, pictorial projection and drawing conventions. Emphasis on orthographic projection problems.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction to Engineering Drawing	6
II.	Drawing Instruments	10
III.	Alphabet of Lines	8
IV.	Applied Geometry	15
V.	Orthographic Projection	14
VI.	Isometric Principles	10
VII.	Orthographic Projection (con't.)	22
VIII.	Dimensioning	16
IX.	Auxiliary Views	19
	Total	120

Division I - Introduction to Engineering Drawing 6 periods

A. History of engineering drawing
   1. Early instruments
   2. Early drawings
   3. Need for universal graphical language
   4. American Drafting Standards Association

B. Types of drawings and their uses
   1. Freehand drawings
   2. Instrument drawing
      (a) Pictorial drawings
         (1) Angular perspectives
         (2) 2 and 3 point perspectives
         (3) Oblique
         (4) Cabinet
         (5) Isometric
      (b) Detail drawings
         (1) Orthographic
         (2) Auxiliaries
         (3) Structural
      (c) Assembly drawings
         (1) General
         (2) Exploded
         (3) Installation
         (4) Sub-assembly
         (5) Working-drawing assembly
      (d) Pipe drawings
      (e) Sheet metal drawings
      (f) Welding drawings
      (g) Electronic drawings
      (h) Patent drawings

Division II - Drawing Instruments — 10 periods

A. T-square
   1. Terminology of parts
   2. Checking for trueness
   3. Use of T-square

B. Triangles
   1. Types (45°, 30°, 60°, adjustable)
   2. Checking for trueness
   3. Correcting misalignment
   4. Use of triangles
   5. Use of triangles and T-square in combination

C. Scales
   1. Types
   2. Reading the scale

D. Irregular curves
   1. Types
   2. Use of irregular curve

E. "Case" instruments
   1. Correct name of each instrument
   2. Terminology of parts
   3. Use of each instrument
      (a) Large bow
         (1) Bow pencil
         (2) Fast-action bow
         (3) Center wheel bow
         (4) Attachments
      (b) Small bow
         (1) Pen bow
         (2) Pencil bow
         (3) Dividers
         (4) Attachments
      (c) Drop bow
      (d) Compass
         (1) Spring
         (2) Friction
         (3) Attachments
      (e) Beam compass
      (f) Lengthening bar
      (g) Proportional dividers
      (h) Pens
         (1) Standard
         (2) Contour
         (3) Border
         (4) Railroad
         (5) Pen attachments
         (6) Pen holders
      (i) Spare parts
      (j) Miscellaneous equipment
         (1) Pencils
         (2) Paper
         (3) Drawing boards
         (4) Fasteners
         (5) Erasing shield
         (6) Erasers
         (7) Sharpeners

Division III - Alphabet of Lines 8 periods

A. Pencil and ink lines

B. Construction and weights
   1. Object
   2. Hidden

3. Section
4. Center
5. Dimension
6. Extension
7. Break (long and short breaks)
8. Panthom
9. Cutting planes
10. Construction lines

Division IV - Applied Geometry 15 periods

A. Parallel lines

B. Perpendicular lines

C. Bisect a line

D. Bisect an angle

E. Bisect a circular arc

F. Tangents
1. Tangent point
2. Circle tangent to a line
3. Circle tangent to an arc
4. Arc tangent to two lines
5. Arc tangent to two circles

G. Divide a line into equal parts

H. Divide a line into proportional parts

I. Layout an angle

J. Divide an angle into equal parts

K. Draw an equilateral triangle

L. Draw an isosceles triangle

M. Circumscribe a circle about a triangle

N. Inscribe a circle in a triangle

O. Draw a square

P. Draw a petagon

Q. Draw a hexagon

R. Draw an octagon

S. Draw a parrellogram

T. Transfer a polygon to a new base

U. Construct an ellipse
   1. Major and minor diameters
   2. Conjugate diameters
   3. Trammel methods
   4. Concentric-circle method
   5. Four-corner approximate method
   6. Draw a tangent to an ellipse

V. Draw a conic helix

W. Circles
   1. Draw circle through three points
   2. Find center of a circle

X. Draw an ogee curve

Y. Construct an involute curve

Division V - Orthographic Projection 14 periods

A. Planes of projection
   1. Frontal
   2. Horizontal
   3. Profile

B. Selection of views

C. Position of views

D. Six principal views

E. Theory of view revolution

F. Point projection

G. Plane projection

H. View alignment

I. Spacing views

J. Order of drawing

K. Projection of a curved boundary

L. Hidden features

Division VI - Isometric Principals — 10 periods

A. Isometric axes

B. Isometric drawing (box method)

C. Isometric lines

D. Non-isometric lines

E. Points of intersection

F. Line measurementation

G. Isometric curves and arcs

H. Normal surfaces

I. Inclined surfaces

J. Irregular objects

Division VII - Orthographic Projection (con't.) — 22 periods

A. Straight line projection
   1. Normal pictorials
   2. Normal surfaces
   3. Inclined surface pictorials
   4. Normal and inclined surfaces
   5. Oblique surfaces

B. Curved line projection
   1. Cylindrical surface pictorials
   2. Cylindrical surfaces
   3. Contour elements of a cylinder

C. Continuity of surfaces

Division VIII - Dimensioning — 16 periods

A. Selection of dimensions

B. Dimensioning techniques
   1. Lines
   2. Arrowheads

3. Fractional and decimal dimensions
4. Leaders
5. Fillets and rounds
6. Finish marks
7. Notes

C. Rules for dimensioning

D. Placement of dimensions

E. Dimensioning systems

Division IX - Auxiliary Views 19 periods

A. Function of auxiliary views

B. Classification of surfaces

C. Primary auxiliary views - width, depth, height
1. Direction of sight
2. Reference plane
3. Projection technique
4. Transfer of measurements
5. Auxiliary view from a principal view
6. Principla view from an auxiliary view
7. Dihedral angles
8. Plotted curves
(a) Circles
(b) Ellipses

D. Partial auxiliaries

E. Half auxiliary views

F. Secondary auxiliaries

TEXT AND REFERENCES:

French and Svensen, Mechanical Drawing, War Department Education Manual, New York, McGraw-Hill Book Company, Inc.

Frence and Vierdk, Engineering Drawing, New York, McGraw-Hill Book Company, Inc.

Giesecke, Mitchell and Spencer, Technical Drawing, New York, The MacMillan Company

Levens, A.S., Graphics in Engineering and Science, New York, John Wiley and Sons, Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

Subject: Communications I (English 107), Technical Division

Periods required: Class 3, Laboratory 0

Objectives:

The student by beginning on of a series of three courses, will begin acquisition of further knowledge in the four basis communication skills: reading, writing, speaking and listening.

In addition, this integrated program provides that student with materials in speaking and reading. Writings by popular authors will further basic communication skills.

Description:

This one quarter course is designed to provide personal enrichment to the student in addition to providing him with experience in basic English skills centered around the concepts of critical thinking and thought organization through experience with the integrated exercises in reading, writing, speaking, listening and thinking. The student's ability in these skills is improved so as to better prepare him for his place in society as well as for advancement in the technical field of his choice.

Major divisions:		Class periods
I.	Introduction and motivation	2
II.	Critical thinking	5
III.	Reception skills	8
IV.	Transmission skills	18
V.	Review and testing	3
	TOTAL	36

Division I. Introduction and motivation — 2 periods

- A. Basic premises of general semantics
- B. Necessity of clear communication.

Division II. Critical thinking — 5 periods

- A. Non-identity
- B. Non-allness
- C. Self-reflexiveness
- D. The scientific method
  - 1. Application to life
  - 2. Use in understanding others
- E. Propaganda in communication.
- F. Outlining for thought organization.

Division III. Reception skills — 8 periods

A. Reading
   1. Library resources
   2. Types of readings
   3. Readings for speeches and reports
B. Listening

Division IV. Transmission skills — 18 periods

A. Types of skills
   1. Reading from manuscript
   2. Persuasive
   3. Informative
   4. Introductory
   5. Impromptu or extemporaneous
B. Critique
   1. Check list
      a. Organization
      b. Purpose
      c. Point of view
      d. Subject
      e. Theme
      f. Materials to support theme
      g. Methods of beginning and ending speech
C. Rating sheet on delivery
D. Oral discussion of speech
E. Questions on speeches

Division V. Review and testing — 3 periods

A. Mid-term test
B. Final test
C. Various evaluations (instructor's preference)

TEXTS AND REFERENCES

IMPACT, Stansbury--Prentice Hall

CONTACT, Thomas and Howard--Prentice Hall

ROGETS' POCKET THESAURUS, Mawson--Pocket Books, Inc. (Optional)

THE NEW MERRIAM-WEBSTER POCKET DICTIONARY, Pocket Books, Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

CIVIL ENGINEERING TECHNOLOGY

Subject: Mathematics I (Math 103)

Objective:

This course provides the student with the knowledge necessary to operate the devices used by engineers and the basic mathematical background essential to a civil engineering technician.

Description:

A sufficient amount of problem solving is given so that the student will acquire the amount of proficiency necessary to allow him to profitably make immediate use of these computation devices.

A review of high school mathematics introducing the fundamentals of algebra, and numerical trigonometry.

MAJOR DIVISIONS		CLASS PERIODS
I. The Slide Rule		6
II. The Rotary Calculator		6
III. Mathematical Tables		3
IV. Review of Arithmetic		9
V. Numerical Trigonometry		12
	TOTAL	36

Division I - The Slide Rule — 6 periods

A. Mechanics of the slide rule
   1. Body
   2. Care
   3. Scales
   4. Purpose
   5. Use
   6. Types

B. Division
   1. Slide movements
   2. Establishing decimal point
      a. approximate method
      b. scientific method
      c. characteristic method

C. Roots
   1. Squares and square roots
   2. cubes and cube roots

D. Multiplication
   1. slide settings
   2. establishing decimal point

E. Combined operations
   1. Division and multiplication
   2. square roots and products
   3. locating decimal points

F. Special Scales
   1. Reciprocal or inverted scales
   2. Logarithmic
   3. Trigonometric

Division II - Rotary Calculators 6 periods

A. The machine
   1. Types
   2. Care
   3. Functions

B. Operation
   1. Addition
   2. Subtraction
   3. Multiplication
   4. Accumulative multiplication
   5. Division
   6. Square root

Division III - Mathematical Tables 3 periods

A. Logarithmic tables

B. Trigonometric tables.

Division IV - Review of Arithmetic 9 periods

A. Number systems

B. Fundamental operations of arithmetic

C. Square root

D. Fractions

E. Percentages

F. Denominate numbers

G. Numerical Geometry

Division V - Numerical Trigonometry 12 periods

A. Introduction

B. Trigonometric ratios

C. Definitions of trigonometric functions

D. Use of tables for trigonometric functions

E. Solution of right triangles

Text and References:

Bassin and Brodsky, Statics and Strength of Materials, New York, McGraw Hill Book Co., Inc.

C.R.C. Standard Mathematical Tables, Cleveland, Chemical Rubber Publishing Co.

James and James, Mathematics Dictionary, New York, D. Van Nostrand Co., Inc.

Leach, H. W., Elementary Problems in Engineering, New York, The Macmillian Co.

Sparks, Fred W., A Survey of Basic Mathematics, New York, McGraw Hill Book Co., Inc.

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NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Surveying 1 (CT 121)

Objective:

This course is designed to provide a good basic knowledge of the principles and theory of surveying. It should enable the student to become proficient in level work and chaining and give him a substantial introduction to the use of the transit.

Description:

Types of surveys, units of measure, elementary leveling, transit problems, field notes, bench marks, bearings and chaining procedures. Actual surveying practice in the field depending on time, weather.

MAJOR DIVISIONS		CLASS PERIODS
I.	Fundamental Concepts and Definitions	6
II.	Measurement of Distance	20
III.	Measurement of Differences in Elevation	50
IV.	Measurement of Angles and Directions	44
	Total	120

Division 1 - Fundamental Concepts and Definitions 6 periods

A. Class
1. Surveying
2. Uses of surveys
3. The earth and spheriod
4. Plane surveying - geodetic surveying
5. Kinds and operations of surveying
6. Definitions
7. Units of measurement-precision of measurements
8. Principles involved
9. Practice of surveying
10. Requisites of a good surveyor

Division 11 - Measurement of Distance 20 periods

A. Class
1. Pacing
2. Stadia

3. Direct measurement
   (a) Chaining
      (1) Tapes, chaining pins, range poles
      (2) Chaining of smooth, level ground
      (3) Horizontal measurements of uneven or sloping ground
      (4) Measurements on slope-correction for slope
      (5) Errors in chaining-correction for errors-tape too long or too short
      (6) Surveys with tape
         a. Measurement of angles with tape
         b. Erecting a perpendicular to a line
         c. Obstructed distances
      (7) Numerical problems, including a study of pythagorean theorem and right triangles
      (8) Demonstration and practice in throwing, coiling and uncoiling a chain

B. Field
   1. Determining average number of steps per 100 ft.
   2. Pacing and chaining a 4-sided figure
   3. Determining an obstructed distance by the swing-offset method
   4. Determining an obstructed distance by the method of similar triangles
   5. Laying out a perpendicular by the 3-4-5 triangle method

Division III - Measurement of Differences in Elevation 50 periods

A. Class
   1. Definitions
   2. Curvature and refraction
   3. Barometric leveling - indirect leveling
   4. Direct leveling
      (a) General
      (b) Instruments
         (1) Dumpy level
         (2) Sye level
         (3) Demonstration of appearance and use of instruments
         (4) Locke hand level
         (5) Leveling rods-types and construction-rod vernier
   5. Differential leveling
      (a) General
      (b) Bench marks
      (c) Definitions
      (d) Procedure
      (e) Balancing backsight and foresignt distances
      (f) Differential level notes
      (g) Mistakes in leveling
      (h) Precise differential leveling
      (i) Errors in and precision of differential leveling

(j) Profile leveling, cross sections and grades
  (1) Profile level notes
  (2) Cross section levels
  (3) Preliminary route cross sections
(k) Plotting profiles and cross sections

B. Field
1. Running levels from bench mark at rear of Engineering Technology Building to golf course fireplace and back
2. Reciprocal leveling across Dietz's gravel pit or across a ravine on golf course
3. Making a profile survey of a road and plotting profile
4. Checking accuracy of bench mark at rear of Engineering Technology Building by leveling from U.S.C.G.S. bench mark at Indian School
5. Making a cross-section survey of a section of county road

Division IV - Measurement of Angles and Directions 44 periods

A. Class
1. Location of points
2. Meridians
  (a) True
  (b) Magnetic
3. Magnetic needle-magnetic declination-isogonic chart-variations in magnetic declination-local attraction
4. Establishing the meridian
5. Angles and directions-bearings, asimuths, deflection angles, angles to the right, interior angles
6. Traverses-triangulation-methods of determining angles and directions
7. Directions with magnetic compass-pocket compass-surveyor's compass
8. The engineer's transit
  (a) Types-classroom demonstration of appearance, construction and use
  (b) Setting up the transit
  (c) Measuring a horizontal angle-laying off a horizontal angle
  (d) Measuring an angle by repetition-laying off an angle by repetition
  (e) Measuring a vertical angle
  (f) Double sighting-index error
  (g) Prolonging a straight line
  (h) Prolonging a line past an obstacle
  (i) Running a straight line between two points
  (j) Determining an inaccessible distance

B. Field
1. Measuring angles about a point by use of transit and by taking compass bearings
2. Measuring angles about a point by repetition

TEXT AND REFERENCES:

Davis and Foote, Surveying, New York, McGraw-Hill Book Company, Inc.

Philip Kissam, Surveying Practice, New York, McGraw-Hill Book Company, Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

CIVIL ENGINEERING TECHNOLOGY

Subject: Materials of Construction (CT 161)

Objective:

This course provides the student with working knowledge of the various materials used in construction.

Description:

This course includes a study of all the usual construction materials such as wood, stone, clay, portland cement concrete, natural cements, and metals. Their uses, manufacture, and properties are also studied.

MAJOR DIVISIONS		CLASS PERIODS
I.	Wood	5
II.	Masonry	5
III.	Concrete	5
IV.	Clay	3
V.	Metals (Ferrous)	4
VI.	Non-Ferrous Metals	4
VII.	Petroleum Products	5
VIII.	Soils	5
	TOTAL	36

Division 1 - Wood — 5 periods

A. General Characteristics

B. Physical Properties

C. Principal Native woods

D. Wood products

E. Indentification

F. Deterioration and preservation

G. Mechanical properties of timber

Division II - Masonry 5 periods

A. Building stone
   1. Uses and production
   2. Important stones for structural purposes
   3. Durability
   4. Physical and mechanical properties
   5. Geology of stone

B. Other masonry materials
   1. Clay products such as brick
   2. Concrete products such as block

Division III - Concrete 5 periods

A. Portland Cement
   1. Definition
   2. Nature
   3. Method of manufacture
   4. Portland cement products

B. Natural Cements
   1. Manufacture
   2. Uses

C. Limes and plasters
   1. Manufacture
   2. Uses

D. Concrete
   1. Proportioning
   2. Mixing
   3. Placing
   4. Curing
   5. Physical properties
   6. Methods of testing
   7. Products
   8. Uses

Division IV - Clay Products 3 periods

A. Introduction, examples and uses

B. Materials, manufacture, testing and uses
   1. Brick
   2. Tile

3. Terra Cotta
4. Clay pipe

Division V - Metals (Ferrous) 4 periods

A. Reduction of iron from its ores
   1. Blast furnace
   2. Pig iron
   3. Chemical Transformation

B. Manufacture of iron and steel
   1. Processes
   2. Formation of structure of alloys
   3. Properties of wrought iron
   4. Effect of composition on properties of steel
   5. Effect of impurities on iron and steel
   6. Tempering
   7. Structural shapes and their uses
   8. Fatigue

Division VI - Non-Ferrous Metals 4 periods

A. Important non-ferrous metals and alloys
   1. Uses in industry
   2. Properties
   3. Extraction and manufacture

Division VII - Petroleum Products 5 periods

A. Asphalts
   1. Definition
   2. Occurance
   3. Uses
   4. History
   5. Products
   6. Properties
   7. Tets

B. Asphalt pavements and surface treatments
   1. Specifications for asphalts
   2. Grading of aggregates
   3. Classification of paving mixes
   4. Design of asphalt paving mixes
   5. Control

a. Mixing or spraying
b. Weather conditions
c. Temperature

Division VIII - Soils 5 periods

A. Definition and origin
   1. Soil texture
   2. Soil structure
   3. Water and air in soil
   4. Engineering properties of soil

B. Aggregates
   1. Definition and origin
   2. Occurance
   3. Uses
   4. Grading
   5. Properties
   6. Where to look for aggregates

C. Classification systems

Test and References:

Withey, M. O. and Washa, G. W., Materials of Construction, New York, John Wiley and Sons, Inc.

Murphy, Glenn, Properties of Engineering Materials, Scranton 15, PA, International Textbook Company

Introduction to Asphalt, Manual Series No. 5, The Asphalt Institute Soils Manual. Manual Series No. 10, College Park, MD, the Asphalt Institute

6-6-72
MS

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: Introduction to Pollution Control (ES 201)

DESCRIPTION:

Introduction to Pollution Control is an introductory interest and information course. The materials covered range from basic concepts in Ecology to current events of the pollution "crises" The manner of presentation follows a logical and scientific approach in an effort to clearify and avoid the hysteria presently associated with the environmental problem. Whenever possible, and appropriate, films, filmstrip slides, tapes, transparencies, models, guest speakers and tours will be used to implement instruction.

OBJECTIVE:

1. To investigate the sources and kinds of environmental pollutants

2. To create an awareness for the necessity of environmental conservation in everyday living

3. To introduce Environmental Science Technology as a career option

4. To establish a background of terminology and techniques used by the Environmental Technologist and Ecologist.

COURSE HOURS PER WEEK: Class - 2 Laboratory - 0

QUARTER HOURS OF CREDIT: 2

PREREQUISITE: None

COURSE BREAKDOWN BY MAJOR TOPIC:

		PERIODS
I.	Introduction	1
II.	Basic Ecology	5
III.	Radioactivity	2
IV.	Water Pollution	4
V.	Air Pollution	4
VI.	Solid Wastes	1
VII.	Agriculture, Pesticides and Heavy Metals	2
VIII.	Population	2
IX.	Political Aspects of Environmental Conservation	1
X.	Test, Review, ETC.	2

LECTURE TEXTS:

Ecology, Pollution and Environment, Turk, Turk and Wittes, Saunders Co., 1972

Air Pollution Primer, National Tuberculosis Disease Association, 1969

I. INTRODUCTION — 1 period

(80 slides taken by Dr. Severson on Pollution in North Dakota)

II. BASIC ECOLOGY — 5 periods

A. Nature of Ecosystems
   1. Abiotic componets
   2. Biotic componets
      a. autotrophic organisms
      b. hetrotrophic organisms
         1) primary consumers
         2) secondary consumers
         3) tertiary consumers
         4) decomposors

B. Energy Flow in an Ecosystem
   1. Source and nature of solar radiation
      a. fusion reaction
      b. electromagnetic spectrum
      c. solar flux
      d. fate of solar radiation
         1) before reaching earths surface
         2) after reaching earths surface

   2. Energy Fixation by autotrophs
      a. measuring primary production
         1) harvest method
         2) CO_2 assimitation
         3) O_2 production
         4) using radioisotopes
      b. estimating primary production

   3. Energy flow beyond the producers

C. Biogeochemical Cycles in the Ecosystem
   1. The hydrologic cycle
   2. The gaseous nutrient cycles
      a. the carbon cycle
      b. the nitrogen cycle
   3. Sedimentary nutrient cycles
      a. sulfur cycle
      b. phosphorus cycle

D. Ecological Communities and Food Chains

III. RADIOACTIVITY, RADIOACTIVE WASTES and NUCLEAR POWER — 2 periods

A. Atomic Structure and Radioactivity
   (Film strip - living things and radiation)

B. Production of isotopes, Radioisotopes and Nuclear Power
   1. History and supply of natural resources
   2. Methods (fission, fussion, etc)
   3. Controls and dangers

C. Measuring Radioactivity
   1. Units of radioactivity
   2. Sampling and detection devices
   3. Isotope labelling as a research tool

D. Half-Life and radioactive waste disposal

IV. WATER POLLUTION — 4 periods

A. Introduction to water
   1. Natural distribution
   2. Water consumption
   3. The water cycle reviewed
   4. The physiological role of water

B. Characteristics and composition of clean waters
   1. Pure water
   2. Rain water
   3. Sea Water
   4. Fresh Water

C. Limnology
   1. Pond or lake
      a. stratification
      b. formation & morphometry
      c. water movements
      d. zones

   2. Streams

D. Polluted water
   1. Indexes of pollution
   2. Effects of pollution
   3. Control of pollution

E. Water Purification
   1. Coagulation
   2. Filteration
   3. Demineralization
   4. Chlorination
   5. Fluoridation

F. Waste Water Treatment
   1. 1° treatment plants
   2. 2° treatment plants
      a. active sludge
      b. chemical
      c. trickeling filter
   3. 3° treatment plants
   4. lagoons

V. AIR POLLUTION — 4 periods

A. Introduction
   1. Composition of air and the atmosphere
   2. The sun's energy
   3. Formation of winds
   4. Air temperature
      a. adiabatic laps - rate
      b. mixing depths
      c. inversions
         1) subsistence inversions
         2) radiation inversions
      d. fog
      e. heat islands - dust domes

B. The Processes of Pollution
   1. Attrition
   2. Vaporization
   3. Combustion
      a. The furnace or incinerator
      b. the gasoline engine
      c. the diesel engine
      d. the jet engine

   4. Photochemical reactions

C. Air Pollutants
   1. Physical states
      a. as particulates
         1) solids
         2) liquids
      b. as gases

   2. Sources of pollutants (major classes-automobiles, industry, etc.)

   3. Chemical composition and properties of Air Pollutants
      a. SO_2 and SO_3
      b. H_2S
      c. CO and CO_2
      d. hydrocarbons
      e. NO and NO_2
      f. photochemical products
         1) O_3
         2) PAN
         3) aldehydes
      g. heavy metals (Pb, Cd, Be, As, etc.)
      h. Asbestos

D. Health Effect of Air Pollution
   1. History and research
   2. Effects in the respiratory track
   3. Other effects

E. Controlling Air Pollution

VI. SOLID WASTE (GARBAGE) MANAGEMENT — 1 period

A. Scope

B. Kinds of Solid Wastes
   1. Urban refuse
      a. glass
      b. metals
      c. organic materials
      d. plastics
      e. others
   2. Mineral wastes
   3. Aqricultural wastes

C. Solid Waste Disposal (Advantages vs Disadvantages)
   1. Open dumps
   2. Sanitary landfills
   3. Incineration
   4. Litter

D. Method of Recycling
   1. Composting
   2. Rendering
   3. Pyrolysis
   4. Salvage

VII. AGRICULTURE, PESTICIDES AND HEAVY METALS — 2 periods

A. The Agricultural Ecosystem

B. The Farm and the Environment
   1. Soil conservation and misconservation
   2. Wet land drainage and the federal farse
   3. Ag chemicals (heros or villans)
   4. Artificial fertilization vs organic agriculture
   5. feed-lots

C. Insect Control
   1. Chemical poisons (Pro & Cons)
      a. DDT and the deadly seven
      b. Parathion and others
   2. Alternate Control measures
      a. steril male techniques
      b. sex attractants
      c. insect hormones
      d. monogammy factor
      e. virus and antibodies
      f. natural enemies

D. Herbicides and Defoliants
   1. Types or classes
   2. Uses and misuses
   3. Mode of action and ecological dangers
   4. Alternate methods of foliage control

E. Heavy Metal in the Environment
   1. Kinds and Sources (Hg, Cd, Pb, etc.)
   2. Health hazards
   3. Detection and control

VIII. POPULATION — 2 periods

A. Introduction and Terminology
   1. Reasons for concern
   2. Reason for study of population
   3. Fallacious statements concerning population

B. Characteristics of Population Growth
   1. Growth curves and growth rates
      a. sigmoid growth curve
      b. J-shaped population curves
      c. Law of population growth
         1) biotic potential
         2) influence of death rate

      d. demography

   2. Age structure

C. Survival and Equilibrium Level of Population
   1. Abiotic factors
   2. Interspecific relationships and niches

D. Methods for Control of Populations
   1. animal
   2. human

IX. ECONOMIC AND POLITICAL ASPECTS OF ENVIROMNENTAL CONSERVATION — 1 period
A. Industrial Influence

B. Federal and State Legislation

C. Consumer Pressure

D. Environmental Action Groups and Clubs

E. The Small Town Economic Growth vs Environmental Conservation

   (A class project)

REFERENCES:

Concepts of Ecology, Kormondy, P-H, 1969

The Biosphere, Scientific American Book, Freeman, 1970

Chemistry for Changing Times, Hill, Burgess, 1972

The Social Responsibility of the Scientist, Free Press, 1971

Limnology, Wm. Amos, LaMotte Chemical Co., 1969

FILMSTRIPS:

Living Things and Radiation
Natures Cycles
Life & Death of Fresh Water Lakes } Popular Science Publishing Co.

TAPES:

Distruction of North Dakota, Robert Burgess, NDSU

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Technical Drafting I (CT 103)

Objective:

The objective of this course is for the student to obtain a working knowledge and appreciation of auxiliaries, sections and convections, intersections and developments, pipe drawings and to develope an ability to choose the proper method of representing an engineering object or project clearly and concisely.

Description:

This course is a continuation of the basic concepts in the use of drawing instruments as learned in Engineering Drawing I and leads into drawings specifically related to the Civil Engineering industry. Auxiliaries, sections and convections, intersections and developments together with the basic concepts of pipe drafting are studied and developed through a selective group of drawing problems.

MAJOR DIVISIONS		CLASS PERIODS
I.	Auxiliaries	40
II.	Sections and Convections	40
III.	Intersections and Developments	40
IV.	Drawings of Piping	40
	Total	120

Division I - Auxiliaries 40 periods

A. Need for auxiliary views

B. Positioning of auxiliary views

Division II - Sections and Convections 40 periods

A. Full sections

B. Half sections

C. Offset, revolved, removed and auxiliary sections

Division III - Intersections and Developments 40 periods

A. Plotted intersections

B. Development of intersections

Division IV - Drawings of Piping 40 periods

A. Symbols

B. Diagram drawings

C. Layout drawings

TEXT AND REFERENCES:

French and Vierck, Engineering Drawing, New York, McGraw-Hill Book Co., Inc.

Hoelscher, Springer, and Dobrovolny, Basic Drawing for Engineering Technology New York, John Wiley & Sons, Inc.

Giesecke, Mitchell, and Spencer, Technical Drawing, New York, MacMillian Book Co.

Forrest Woodworth, Graphics Simulation, Scranton, Pennsylvania, International Textbook Company

Giachine and Beukema, Drafting and Graphics, Chicago, Illinois, American Technical Society

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

TECHNICAL DIVISION

Subject: Communications II (ENG 108)

Objective:

The student will acquire knowledge in the four basic communication skills, but the application of these skills is toward technical "on the job" situations.

This integrated program provides the student a broadening effect by utilizing the work of great authors and current world events to serve as source material for reading, speaking and listening experiences.

Description:

A continuation of Communications I, stressing the four basic communication skills, with application of these skills. Integrated program providing a broadening effect by utilizing the work of great modern authors and current world events to serve as source material for reading, speaking and listening experiences.

MAJOR DIVISIONS	CLASS PERIODS
I. Introduction and Motivation	2
II. Reception Skills	18
III. Critical Writing and Speaking	7
IV. Reading	6
V. Review and Testing	3
Total	36

Division I - Introduction and Motivation — 2 periods

A. Course Schedule

B. Necessity for Clear Written and Oral Communications

Division II - Reception Skills — 18 periods

A. Assigned Reading
   1. A novel by a well-known author
   2. Articles from associated research

B. Listening
   1. Lapse of attention
   2. Forgetting

a. Note taking
b. Outlining
c. Association

Division III - Critical Writing and Speaking — **7 periods**

A. Writing
1. Requirements
a. Unity
b. Coherence
c. Emphasis
2. Forms
a. Sentence
b. Paragraph
c. Theme
3. Types
a. Reactionary papers
b. Descriptive themes
c. Speech introduction and conclusion

B. Speaking
1. Types
a. Conference leadership
b. Discussion applications
(1) Panel
(2) Symposium
(3) Forum
(4) Round table

Division IV - Reading — **6 periods**

1. Technical style
2. Outlining
3. Dictionary
4. Vocabulary
5. Library research

Division V - Review and Testing — **3 periods**

1. Summary
2. Mid-term examination
3. Drop tests

TEXTS

A novel selected by the instructor from .75 to 1.25

Dictionary carried over from Communications I

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

CIVIL ENGINEERING TECHNOLOGY

Subject: Mathematics II (Math 104)

Objective:

This course is a continuation of Math 103 and provides the student with the mathematical background essential to a Civil Engineering Technician.

Description:

A continuation of Math I with further study of algebraic operations, logarithms, and trigonometry through oblique triangle solutions.

Major Divisions	Class Periods
I. Numerical Trigonometry	8
II. Fundamental Operations	8
III. Mental Multiplication	4
IV. Factoring	8
V. Logarithms	8
TOTAL	36

Division I - Numerical Trigonometry — 8 periods

A. Review material of Math I

B. Unit circle

C. Trigonometric ratios of angles over 90°

D. The oblique triangle

E. The law of sines

F. The law of cosines

G. The law of sines - ambiguous case

Division II - Fundamental Operations — 8 periods

A. Definitions

B. Negative numbers

C. Addition

D. Subtraction

E. Multiplication

F. Division

G. Symbols of Grouping

Division III - Mental Multiplication 4 periods

A. Introduction

B. Product of two binomials

C. Square of polynomials

D. Product of sum and difference of same two numbers

E. Products of special trinomials

Division IV - Factoring 8 periods

A. Introduction

B. Common Factors

C. Difference of two squares

D. Sum and difference of two cubes

E. Quadratic trinomials

Division V - Logarithms 8 periods

A. Introduction

B. Properties of logarithms

D. Scientific notation

E. Characteristic and mantissa

F. Use of tables

G. Logarithmic computation

Text and References:

Bassin and Brodsky, Statics and Strength of Materials, New York, McGraw-Hill Book Company, Inc.

C.R.C. Standard Mathematical Tables, Cleveland, Chemical Rubber Publishing Company

James and James, Mathematics Dictionary, New York, D. Van Nostrand Company, Inc.

Leach, H. W., Elementary Problems in Engineering, New York, The Macmillian Co.

Sparks, Fred W., A Survey of Basic Mathematics, New York, McGraw-Hill Book Co.,Inc.

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NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Surveying II (CT 122)

Objective:

This course is designed to cover much of the mathematical theory and the calculations to be found in surveying work and to enable the student to work many of the office problems which he is likely to meet during a career as a surveyor.

Description:

Transit-tape surveys, triangulation, map plotting, latitudes and departures, open and closed traverses, plotting profiles and cross-sections, route surveys, contour lines and maps and calculation of areas of land. Little, if any, outdoor work.

MAJOR DIVISIONS	CLASS PERIODS
I. Map Drafting and Plotting	30
II. Coordinates, Latitudes and Departures, and Related Topics	30
III. Calculation of Areas of Land	60
Total	120

Division I - Map Drafting and Plotting — 30 periods

A. General discussion

B. Map projections, and symbols
   1. Mercator projection
   2. Conic projection
      a. Lambert conformal conic projection
   3. Use of beam compass
   4. Use of road pen
   5. Use of contour pen

C. Process of making a map
   1. Methods of plotting horizontal control
      a. Protractor method
      b. Tangent method
      c. Chord method
      d. Method of rectangular coordinates
   2. Contour lines
      a. Characteristics
      b. Interpolation between elevations to locate contour lines
      c. Plotting cross-sections from contours
      d. Contour maps drawn from grid survey

3. Latitudes and departures
4. Error of closure
5. Balancing the survey
   a. Adjustment of angular error
   b. The compass and transit rules for balancing a survey

D. Problems
1. Plotting a traverse by the protractor method
2. Plotting a traverse by the tangent method
   a. Use of the tangent-square method
3. Plotting a traverse using the meridian and base line method
4. Contour maps drawn from random elevations, from cross-sections, and from grid maps

Division II - Coordinates, Latitudes and Departures, and Related Topics — 30 periods

A. General Discussion of Latitudes and Departures
1. Error of closure
2. Balancing a survey
   a. The compass rule
   b. The transit rule
3. Use of chart form for computing latitudes and departures

B. Problems
1. Plotting a traverse and distributing the error of closure
2. Computing azimuths from field notes
3. Open deflection-angle traverse
4. Plotting transit survey from field notes and balancing by compass and transit rules
5. Plotting traverse and computing length and bearing of unknown side
6. Determining unknown quantities in a closed traverse

Division III - Calculation of Areas of Land — 60 periods

A. Methods of Determining Area
1. By triangles
2. By coordinates

B. Principles of Double-Meridian-Distance Method
1. Computation of D.M.D.
2. Area within a closed traverse by D.M.D. method
   a. Double parallel method

C. Area of Tract with Irregular or Curved Boundaries
1. Trapezoidal rule
2. Simpson's one-third rule

D. Partition of Land
   1. Area cut off by a line between two points
   2. Area cut off by a line running in a given direction
   3. To cut off a required area by a line through a given point
   4. To cut off a required area by a line running in a given direction

E. Written Problems
   1. Area problems
   2. Finding angles and lengths of sides of a parallelogram shaped field
   3. Calculation of area by coordinate method
   4. Latitudes, departures, coordinates, and area by coordinate method
   5. Comparison of area by D.M.D. and coordinate methods
   6. Balancing a survey and finding area by D.M.D. method

TEXT AND REFERENCES

Davis and Foote, Surveying, New York: McGraw-Hill Book Company, Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Concrete Technology (CT 214)

Objective:

This course is designed to provide the student with the knowledge of concrete, its ingredients and the various testing methods.

Description:

A study of the materials, proportioning and field control necessary in the preparation and placing of concrete, along with basic tests, precautions and special processes.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction to Concrete	4
II.	Components of Concrete	5
III.	Concrete Selection, Design, Sampling & Testing	4
IV.	Mixing, Placing and Finishing Concrete	5
V.	Placing and Curing Concrete	8
VI.	Concrete Joints, Reinforcement and Estimating	10
VII.	Special Concreting Conditions	4
	Total	40

Division I - Introduction to Concrete 4 periods

A. Job opportunities in the concrete industries
   1. Construction outlook
   2. Manpower requirements

B. Getting acquainted with concrete
   1. Properties desired in fresh or plastic concrete
   2. Properties desired in hardened concrete
   3. Variables that influence concrete quality

C. Concrete uses
   1. Reinforced concrete
   2. Pre-stressed concrete

3. Pre-cast concrete
4. Light weight concrete
5. Thin shells
6. Shotcrete
7. Tilt-up construction
8. Sandwich wall
9. Lift slab

Division II - Components of Concrete — 5 periods

A. Portland cement
   1. History
   2. Raw materials
   3. Manufacturing process
   4. Packing and storage
   5. Classification or types
   6. Availability

B. Mixing water for concrete
   1. Effect of impure mixing water

C. Aggregates for concrete
   1. Characteristics of aggregates
   2. Good aggregates essential
      a. Hard and durable
   3. Clean aggregates desireable
   4. Testing aggregates for quality
   5. Types of aggregates
      a. Fine
      b. Coarse
      c. Bank run
   6. Gradation of aggregates
   7. Handling and storing aggregates

Division III - Concrete Selection, Design, Sampling, Testing — 4 periods

A. Air-entrained concrete
   1. Air-entraining materials
   2. Factors effecting air content
   3. Measurement of air content

B. Selection and design of concrete mixtures
   1. Trial mix method

C. Sampling and testing plastic concrete
   1. Test of consistency
   2. Ball penetration test

3. Unit weight test
4. Testing for air content
5. Strength test cylinder (ASTM-C 31)

Division IV - Mixing, Placing, and Finishing Concrete — 5 periods

A. Quality, ready mixed concrete
   1. Production
   2. Advantages
   3. Specifications
   4. Remixing
   5. Preparing for ready mix delivery
   6. Dangers of adding water to ready mix
   7. Availability of ready mix

B. Job mixing concrete
   1. Objectives of concrete mix
   2. Determining exposure conditions
   3. Water-cement ratio for exposure conditions
   4. Proper consistency of slump
   5. Water-cement ratio for compressive strength
   6. Selecting good ingredients
   7. Allowing for moisture in sand
   8. Proporation the materials
   9. Measure all materials
   10. Cleaning equipment

C. Tools for placing and finishing concrete slabs
   1. Straightedge
   2. Hand tamper
   3. Darby
   4. Bull float
   5. Edger
   6. Jointer or groover
   7. Hand power floats
   8. Hand and power trowels

Division V - Placing and Curing Concrete — 8 periods

A. Placing concrete
   1. Placing in forms
   2. Using a drop chute
   3. Consolidating concrete in forms
   4. Vibrators

B. Finishing concrete slabs
   1. Striking off
   2. Edging and jointing
   3. Floating
   4. Final finishing
   5. Broom finish
   6. Burlap or belt finish
   7. Hand float finish
   8. Troweling
   9. Patterned and textured finishes
   10. Finishing air-entrained concrete

C. Curing concrete
   1. Effect
   2. Methods
   3. General curing requirements

Division VI - Concrete Joints, Reinforcements, and Estimating 10 periods

A. Joints for flat concrete work
   1. Isolation joints
   2. Construction joints
   3. Combination control and construction joints

B. How to estimate concrete for a job

C. Reinforcement for concrete
   1. Kinds of reinforcement
   2. How reinforcement works
   3. Placement of steel
   4. Splicing reinforcement
   5. Slab reinforcement
   6. Concreting around steel
   7. General rules for steel reinforcement
   8. Reinforced concrete accessories
   9. New development in reinforcement

Division VII - Special Concreting Conditions 4 periods

A. Concreting during hot weather
   1. Preventing rapid evaporation
   2. Temperature, relative humidity and wind
   3. Cement temperature
   4. Use of admixtures

B. Concreting in cold weather
   1. Effect of concrete temperatures
   2. How to get high-early-strength concrete
   3. Use of chemical accelerators
   4. Before placing and finishing concrete
   5. Curing methods

C. Concrete today and tomorrow
   1. Paving with concrete
   2. Concrete for airports
   3. Soil-cement paving
   4. Better homes with versatile concrete
   5. Structural and architectural uses
   6. Agricultural uses of concrete
   7. Water resources
   8. Concrete-the building material of the future

TEXT AND REFERENCES:

Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois 60610.
Concrete Technology, U.S. Edition, Delmar Publishers, Inc.

Giese, Henry, A Practical Course in Concrete, Portland Cement Association,
ASTM, Selected ASTM Standards for Civil Engineering students, ASTM, Philadelphia.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

CIVIL ENGINEERING TECHNOLOGY

Subject: Mathematics III (Math 105)

Objective:

This course is a continuation of Math 104 and provides the student with the mathematical background essential to a civil engineering technician.

Description:

A continuation of Math II with further study of algebraic operations.

Major Divisions		Class Periods
I.	Algebraic Fractions	8
II.	Linear and Fractional Equations	7
III.	Graphs and Functions	2
IV.	Simultaneous linear equations	7
V.	Exponents and radicals	6
VI.	Quadratic equations	6
	TOTAL	36

Division I - Fractions — 8 periods

A. Introduction

B. Reduction to lowest Terms

C. Lowest common denominator

D. Multiplication of fractions

E. Division of fractions

F. Addition of fractions

G. Complex fractions

Division II - Linear and Fractional Equations — 7 periods

A. Introduction

B. Definitions

C. Equivalent equations

D. Linear equations in one unknown

E. Fractional equations

F. Applied problems

Division III - Graphs and Functions — 2 periods

A. Rectangular Coordinate system

B. Graph of function

Division IV - Simultaneous linear equations — 7 periods

A. Introduction

B. Elimination by addition or subtraction

C. Elimination by substitution

D. Inconsistent and dependent equations

E. Applied problems

Division V. - Exponents and Radicals — 6 periods

A. Introduction

B. Negative exponents

C. Roots of numbers

D. Fractional exponents

E. Simplification of radicals

F. Rationalizing nominal denominators

G. Addition of radicals

Division VI - Quadratic Equations — 6 periods

A. Introduction

B. Solution by factoring

C. Solution by completing the square

D. The quadratic formula

E. Radical equations

Text and References:

Bassin and Brodsky, Statics and Strength of Materials, New York, McGraw-Hill Book Company, Inc.

C.R.C. Standard Mathematical Tables, Cleveland, Ohio, Chemical Rubber Publishing Company

James and James, Mathematics Dictionary, New York, D. Van Nostrand Company, Inc.

Leach, H. W., Elementary Problems in Engineering, New York, The Macmillan Co.

Sparks, Fred W., A Survey of Basic Mathematics, New York, McGraw Hill Book Co.,Inc.

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MS

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Surveying III (CT 123)

Objective:

This course is designed to develop the students' skills in field surveying.

Description:

Traverse surveys, the planimeter, the plane table, stadia surveying, grid and contour surveys, open and closed traverse, topographic surveying and earthwork. Field practice depending on time, weather.

MAJOR DIVISIONS		CLASS PERIODS
I.	Traverse Surveys - Deflection-Angle and Radiation Types	60
II.	The Trapezoidal Rule and Simpson's One-Third Rule	6
III.	The Planimeter	8
IV.	The Plane Table	6
V.	Stadia Surveying	10
VI.	Grid and Contour Surveys	14
VII.	Open Traverses and Horizontal Curves	8
VIII.	Topographic Surveying	8
	Total	120

Division I - Traverse Surveys - Deflection - Angle and Radiation Types — 60 periods

A. Class — 30 periods

1. Continuation and completion of any necessary traverse and D. M. D. problems left over from previous quarter
2. Write-ups in field notebooks of field problems involving surveying of traverses by deflection angles or radiation
3. Drawing of scale maps of traverses surveyed in field
4. Computation of areas of traverses surveyed, using the method called for by the type of survey

B. Field — 30 periods

1. Problems
   a. Surveying a traverse by the deflection-angle method - turning each deflection angle 3 times
   b. Surveying a traverse by radiation
   c. Surveying a traverse as a chain of triangles
      (1) field problems 1, 2, and 3 may all use the same traverse - this facilitates checking
   d. Traverse by angles to the right
   e. Surveying a traverse by azimuths
   f. Surveying a traverse by interior angles

Division II - The Trapezoidal Rule and Simpson's One-Third Rule — 6 periods

A. Class
1. Theory and derivation of these rules
2. Applied problems

Division III - The Planimeter — 8 periods

A. Class
1. Theory and use of planimeter
   a. Assignment of problem sheets involving use of planimeter to solve area problems
   b. Earthwork uses of planimeter
      (1) finding volumes by contour lines
      (2) finding areas of cross-sections

Division IV - The Plane Table — 6 periods

A. Class — 2 periods
1. Study, lecture, and discussion
   a. General discussion
   b. Relation between transit and plane table
   c. Types of tables
      (1) coast survey
      (2) Johnson
      (3) traverse
   d. Alidades
      (1) peep sight
      (2) telescopic
   e. Setting up and orientating table
   f. Types of surveys
      (1) radiation
      (2) traversing
      (3) intersection
      (4) graphical triangulation
   g. Advantages and disadvantages of plane table
2. Classroom demonstartion

B. Field — 4 periods
   1. Problems
      a. Survey traverse by radiation
      b. Survey traverse by intersection

Division V - Stadia Surveying — 10 periods

A. Class — 4 periods
   1. Study of chapter in text on stadia surveying
      a. Reading assignments in text, followed by classroom discussion
   2. Classroom reading of stadia measurements, using transits and level rods set up indoors

B. Field — 6 periods
   1. Reading of stadia measurements outdoors
   2. Surveying of a traverse, using stadia measurements only

Division VI - Grid and Contour Surveys — 14 periods

A. Class — 6 periods
   1. Theory of grid surveys and their application to the drawing of contour maps
      a. Use of textbook references to grid surveys, contour lines, and maps
      b. Use of textbook problems involving grid surveys
   2. Computations involved in the grid survey in field problems
      a. Computation of the necessary volume to excavate to a known depth below existing ground, as shown in survey notes
   3. Drawing of contour map from grid survey in field problem

B. Field — 8 periods
   1. Staking out a grid system on a piece of sloping ground in preparation for making a grid survey using transit and chain
   2. Grid survey field problem of finding elevation of each grid point, using surveyor's level and rod

Division VII - Open Traverses and Horizontal Curves — 8 periods

A. Class
   1. Uses and practical applications of open traverses, particularly as applied to highway and railroad construction
   2. Open traverse and coordinate problems
   3. Horizontal curves
   4. Derivation of various curve formulas and their application to highway work

5. Problems involving horizontal curves - application and use of formulas and drawing of scale maps of various curves

Division VIII - Topographic Surveying — 8 periods

A. Class — 2 periods
   1. Introduction to topographic surveys and maps
   2. Study of topographic surveying and ampping and discussion in class

B. Field — 6 periods
   1. Making a topographic survey, using an approved method of note-keeping, so that the notes may later be plotted into a map

TEXT AND REFERENCES:

Davis and Foote, Surveying, New York, McGraw-Hill Book Company, Inc.

Kissam, Surveying Practice, New York, McGraw-Hill Book Company, Inc.

Rayner and Schmidt, Elementary Surveying, New York, D. Van Nostrand Co., Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Introduction to Data Processing (DP101)

Objective:

The objective of this course is to teach the student the application of the computer to solve civil engineering problems through FORTRAN (FORmula TRANslation), the automatic coding system which arranges mathematical engineering problems for computer solution; and COGO (COordinate GeOmetry), which is the system specifically suited to civil engineering problems.

Description:

An insight into the subject of data processing systems and devices so as to identify the various units of a computer and their functions, to describe various numbering systems, and to discuss the basic elements of programming and programming languages.

MAJOR DIVISIONS		CLASS PERIODS
I. FORTRAN Programming		30
II. COGO Programming		30
	Total	60

Division I - FORTRAN Programming

A. Fundamental concepts

B. The programming language

C. Control statements and flow charts

D. Sub-programs

E. Memory arrays

F. Addition capabilities

Division II - COGO Programming

A. General concept

B. Basis of system - sample problem

C. System makeup

D. Systems operation - general

E. Description of technique - How COGO works

F. Input/output
   1. Data specification
   2. COGO plug decks and associated routines
   3. Input/output specifications

BOOKS REQUIRED:

Harvill, John B., Basic FORTRAN Programming, Englewood Cliffs, New Jersey, Prentice-Hall, Inc.

File Number 1620-25, Form C26-5619-4, IBM 1620 FORTRAN (with FORMAT), through IBM branch offices.

COGO Manual supplied by Science

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Technical Drafting II (CT 211)

Objective:

It is intended that the student will develope through this course an understanding of and an ability to draw structural, map and topographical drawings.

Description:

This course is a continuation of the basic drawing concepts and techniques used to develope graphical descriptions as learned in Engineering Drawing I and Technical Drafting I. Emphasis is on technical drafting problems as specifically related to the Civil Engineering industry.

MAJOR DIVISIONS		CLASS PERIODS
I.	Drawing of Structures	40 periods
II.	Map and Topographic Drawing	50 periods
III.	Commerical Practices	30 periods
	Total	120

Division I - Drawing of Structures — 40 periods

A. Structural terminology

B. Methods of representation

Division II - Map and Topographic Drawing — 50 periods

A. Plats

B. Topographic maps

C. Plan and profile

Division III - Commercial Practices — 30 periods

A. Charts, graphs and diagrams

B. Renderings

C. Models

TEXT AND REFERENCES:

French and Vierck, Engineering Drawing, New York, McGraw-Hill Book Company, Inc.

Hoelscher, Springer and Dobrovolny, Basic Drawing for Engineering Technology, New York, John Wiley & Sons, Inc.

Giesecke, Mitchell and Spencer, Technical Drawing, New York, MacMillan Book Co.

Forrest Woodworth, Graphical Simulation, Scranton International Textbook Co.

Giachino and Beukema, Drafting and Graphics, Chicago, Illinois: American Technical Society

Bacon, Design of Cities, New York, The Viking Press

Greenhood, Mapping, Chicago, The University of Chicago Press

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Soils and Materials Testing (CT 212)

Objectives:

1. This course is designed to acquaint the student with the behavior of earth structures.

2. The student will acquire knowledge and practice in the testing of soils, metals, concrete and wood.

Description:

Laboratory tests on soils and other construction materials. Soils analysis. Soil texture and structure for stability of slopes and bearing capacities.

MAJOR DIVISIONS		CLASS PERIODS
I.	Origin and Nature of Soils	10
II.	Soil	70
III.	Soil Cements	12
IV.	Concrete	6
V.	Metals	10
VI.	Wood	4
VII.	Structures	8
	Total	120

Division I - Origin and Nature of Soil

A. Class
   1. Soil as a structural material
   2. History of soil engineering
   3. Definition of soil
      (a) Geological classifications
      (b) Types of soils
      (c) Formations and occurrences
      (d) Special soils
   4. The soil profile
      (a) The A,B,C, and subhorizons

(b) Pedological classification
(c) Distribution of soils in the United States
(d) Zonal, introzonal and azonal soil groups

5. Soil structure and texture
   (a) Shape and size of soil particles
   (b) Grading of soils
6. Soil density
   (a) Factors affecting density
7. Soil surveys and sampling
8. Problems of soil analysis and classification
9. Physical characteristics of soil groups as affecting construction of foundations

Division II - Soil Tests — 70 periods

A. Laboratory
   1. Standard method of determining per cent moisture
   2. Finding hygroscopic moisture
   3. Taking samples of disturbed soil
   4. Preparing samples of disturbed soil
   5. Field moisture content
   6. Field moisture equivalent (FME)
      (a) Clay soils
      (b) Sandy soils
   7. Liquid limit
      (a) Hand method
      (b) Mechanical method
   8. Plastic limit
      (a) Standard method
      (b) Special method for sandy soils
   9. Plasticity index
   10. Mechanical analysis of soils
      (a) Sieve analysis
      (b) Laboratory hydrometer test
      (c) Specific gravity
      (d) Field hydrometer tests
   11. Classification of soils (ASTM) (AASHO)
   12. Group index
   13. Compaction and penetration resistance standard
      (a) Proctor test
      (b) Modified AASHO standard
   14. Density of material in place
      (a) Sand-funnel method
      (b) Rubber-balloon method

Division 111 - Soil Cements 12 periods

A. Class
   1. Construction
      (a) History
      (b) Types of soil cement
      (c) Materials needed
      (d) Mixing
      (e) Weather conditions
      (f) Thickness
      (g) Curing
      (h) Construction problems
      (i) Road preparation
      (j) Finishing
      (k) Inspecting and field control

B. Laboratory
   1. Soil identification tests
      (a) L.L., P.L., P.I.
   2. Soil-cement tests
      (a) Moisture density relations
      (b) Wetting and drying
      (c) Freezing and thawing
      (d) Undonfined compressive strength

Division 1V - Testing Concrete 6 periods

A. Laboratory
   1. Compression tests

Division V. -Testing Metals 10 periods

A. Laboratory
   1. Compression
   2. Bending

Division V11 - Structures 8 periods

A. Class
   1. Stability of slopes
   2. Permeability
   3. Embankments
   4. Levees
   5. Earth dams
   6. Retaining walls
   7. Pressures on retaining walls
   8. Piles and pile driving

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: SCI 121 - A Survey of Chemistry

DESCRIPTION:

This course is intended to be a limited - mathematical overview of chemistry as it applies specifically to the technology program. This course has no prerequisites and will not serve as a prerequisite for any chemistry course other than SCI 122. The laboratory portion of this course is specific and essential to the Environmental Technology curriculum; therefore, no substitutions can be made for the laboratory.

OBJECTIVES:

1. To introduce the chemical concepts used by environmental technicians.

2. To provide the necessary chemical background and prerequisites needed for the environmental technology curriculum.

3. To familiarize the student with the significance and application of some physical and chemical measurements used in clean (fresh) water analysis.

COURSE HOURS PER WEEK: 3 Class 4 Lab

QUARTER HOURS OF CREDIT: 4

PREREQUISITE: None

COURSE BREAKDOWN BY MAJOR TOPIC:	LECTURE PERIODS
I. Physical Measurements	3
II. Nature of Matter	8
III. Structure of Matter	8
IV. Chemical Nomenclature	4
V. Inorganic Substances	7
VI. Tests, ETC.	6

LABORATORY: 48 periods

Standard Physical and Chemical Methods for Fresh or Clean Water Analysis--Techniques and Objectives

LECTURE TEXT: Introduction to Chemistry, T. R. Dickson, John Wiley, 1971

LABORATORY TEXT: Standard Method for Water and Waste Water Analysis - APHA

I. Lecture #1 1 period

A. Course requirements
1. Text-Introduction to Chemistry - T. R. Dickson, John Wiley 1971
2. Math background - college math or h. s. algebra
3. Attendance
4. Grading and texts
5. Periodic table (Sargent-Welch)
6. Safety glasses (in Lab)
7. Working knowledge of lab safety rules

B. Safety
1. Film - "It's Up To You", American Optical Corp. - Dept. 4618, Southbridge, MA - Mr. Robert White
2. Lab tour for safety devices and uses - sign safety agreement

C. Safety Check List
1. I know the location of and proper use of: (answer yes or no)
   a. the eye wash
   b. the safety shower
   c. the first aid kit
   d. the fire extinguishers
   e. the boric acid solution
   f. the sodium bicarbonate solution
   g. the universal antidote
2. I agree to wear protective glasses at all times in the chemistry lab
3. I agree to never eat, drink or smoke in the Chemistry lab
4. I know that strong acids are always added to water and never vice versa
5. I agree to never mouth-pipet liquids in chemistry lab
6. I agree to act in a business like manner in chemistry lab

II. Lecture #2, #3 2 periods

A. Metric Measure
1. define micro, milli, centi, deci, deca, kilo °
2. weight (or mass)
   a. basic unit: gram
   b. english equivalent 454 gm=1 lb)
3. length
   a. basic unit: meter
   b. most common used unit by chemist: centimeter
   c. English equivalent (2.54 cm= 1 inch
4. Volume (V=l x w x h)
   a. basic unit: liter=quart
   b. common unit: milliliter= 1 cubic cm

B. English to metric conversion (method)
   1. use of unit cancelling method
      a. list known and unknown data
      b. cancel and solve algebraically
      c. be sure answer has correct unit
   2. consider the reasonableness of the answer

III. Lecture #4 — 1 period

A. Density
   1. Demonstration material
      a. hydrometer
      b. mohr balance
      c. balance grad. cyc. and piece of chalk
      d. 1 liter of H_2O and 1 kgm. wt.

B. Other important physical properties
   1. m.p. - slide of m. p. apparatus
   2. b.p. - overlay of fractional distillation tower
   3. R.I. - pyrex glass demonstration
   4. coler
   5. Sp.Ht.

C. Heat v.s. Temp.
   1. centigrade - fahrenheit
   2. calorie as basic unit of heat

IV. Lecture #5 — 1 period

A. States of Matter
   1. solid
   2. liquid
   3. gaseous

B. The gaseous state
   1. effect of pressure (Boyle's Law)
      a. $PV=k$ @ any temp.
      b. $P_1V_1=P_2V_2$ @ const. temp.
   2. effect of temperature (Charles' Law)
      a. $V/T=k'$ @ const. pressure

V. Lecture #'s 6,7,8,9,10 & 11 — 6 periods

A. Nature of Matter
   1. chemical properties
   2. physical properties
   3. elements
   4. compounds
   5. mixtures

6. solutions
7. conservation of mass
8. the law of definite proportions

B. Atomic Theory - Dalton

C. Law of Combining Volumes

D. Atoms and Molecules
1. Atomic weights
2. Molecular weights
3. Avogadro's number
4. Mole concept
5. Chemical symbols
6. Chemical equations

E. Thermal Chemistry
1. Heat of reaction
   a. exothermic
   b. endothermic
2. Heat of solution
3. Change of State
   a. heat of fusion
   b. heat of vaporization

VI. Lecture #'s 12, 13 & 14 3 periods

A. Subatomic Structure
1. electrons
2. protons
3. neutrons

B. Atomic Structure
1. the bohr atom
   a. the nucleous
   b. energy levels
   c. electronic configuration
2. Atomic number
3. Isotopes
   a. stable
   b. radioactive
      1. α - emitters
      2. β - emitters
      3. γ - emitters
4. Ions

VII. Lecture #'s 15, 16, 17, 18 & 19 5 periods

A. Chemical Bonding
1. Covalent (octet rule)
2. Coordinate - Covalent
3. Electrocovalent

B. Solution Process
   1. Polar compounds
   2. Electrolytes - nonelectrolytes
      a. ions in solution
      b. hydrogen bonds
   3. solubilities
      a. effect of heat
      b. effect of solvent
      c. effect of stirring
      d. saturated solutions
      e. unsaturated solutions
      f. supersaturated solutions

VIII. Lecture #'s 20, 21, 22 & 23 4 periods

A. Nomenclature
   1. the elements
   2. binary compounds
   3. naming complex compounds
   4. naming acids and bases
   5. naming hydrates
   6. multiple oxidation states

B. Periodic Properties
   1. families
   2. periods
   3. metals - nonmetals v.s. nobel gases

IX. Lecture #'s 24, 25, 26 & 27 4 periods

A. Acids and Bases
   1. bronsted - Lowery theory
   2. strong acids and bases
   3. weak acids and bases
   4. pH
   5. Polybasic acids
   6. neutralization

B. Salts
   1. products of neutralization
   2. hydrolysis
      a. pH
   3. crystal structure
      a. m.p.
      b. solutions of salts
      c. solution process

C. Electrochemistry
   1. oxidation
   2. reduction
   3. half-reaction concept
   4. electrolysis cells
   5. voltic cells

X. Lecture #'s 28, 29 and 30 — 3 periods

A. Introduction to H_2O Chemistry
   1. Natural distribution
      a. oceans 97%
      b. ice caps 2%
      c. lakes and rivers 1%
      d. atmosphere 0%
   2. Water consumption
      a. comestic 250 gal/day person
      b. industrially
      c. developing nations
      d. agriculture
   3. Water supply conservation
      a. use of salt H_2O
         1. advantages
         2. disadvantages
      b. desalination
      c. recycling
   4. the water cycle
   5. the physiological role of H_2O

B. Pure H_2O
   1. Structure
   2. Reactivity
   3. Hydrogen bonding and B.P.
   4. The solution process reviewed
   5. Dielectric constant
   6. Methods of preparation
   7. Electrolysis and overpotential
   8. Physical states and AH for transitions
   9. Densities and various temperatures
   10. Polywater

C. Environmental Water
   1. Rain
      a. solids (2-5 ppm)
      b. disolved gases
   2. Sea water
      a. chemical composition
      b. ionic strength and fish life
      c. reactions
      d. role in CO_2 balance
   3. Fresh water
      a. potable H_2O defined
      b. hardness
      c. composition

d. purification
1. physical treatment
2. chemical treatment
3. chlorination
4. florination

4. Polluted fresh water
a. types of pollutants
b. indexes of pollution
1. BOD
2. DO
3. turbity
4. coliforms
5. phytoplankton
6. taste and odor

D. Waste Water
1. Composition of sewage
2. Testing raw sewage
a. coliform
b. nitrogen
1. as ammonia
2. as organic bound
3. as nitrates and nitrites
4. as albuminoid
c. BOD
d. COD
e. H_2S
f. PH
g. chlorine demand

3. Treating sewage
a. lagoons
b. primary treatment
c. secondary treatment
1. activated sludge
2. chemical method
d. tertiary treatment

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

Laboratory Outline

Laboratory outline for Environmental Technology Option to SCI 101 (General Chemistry) or SCI 121 (Survey of Chemistry)

I. General Laboratory Methods (3 - two hour labs) — 6 periods

A. Check-in, Safety, Glassware & Glass Fabrication

B. Measurement Techniques
1. using a meter stick
2. using the laboratory balances

C. Volumetric Techniques
1. using a graduate cylinder
2. using a transfer pipet
3. using a buret

D. Density
1. finding the density of a regular shaped object
2. finding the density of a irregular shaped object
3. finding the density of a liquid

II. Physical Test on Fresh (Clean) Water - (5 - two hour labs) — 10 periods

A. Color
1. preparation of $K_2 PtCl_6$ color standards
2. measuring natural water color

B. Temperature

C. pH
1. measuring pH with test papers
2. measuring pH colormetrically with indicators
3. measuring pH with a glass electrode potentiometrically

D. Turbidity
1. preparation of a standard solution
2. measuring turbidity with a Jackson candle turbidimeter
3. measuring turbidity with a Seccia Disc
4. measuring turbidity spectro-photometrically

E. Conductivity

III. Chemical Test* on Fresh (Clean Water - (14 - 2 hr. labs.) 28 periods

A. Hardness (EDTA Volumetric Titration)

B. Chloride (Mohr Volumetric Titration)

C. Iron (Orthophenanthroline Method - Colorimetric)

D. Manganese (Periodate Method - Colorimetric)

E. Fluorides (Alizarin Yellow Method - Colorimetric)

F. Dissolved Oxygen (Winkler Method)

IV. Laboratory Tests and Check-In 4 periods

* When ever possible all solutions will be made and standardized by the student.

* Also, together with the accepted procedures taught in the laboratory, the use of field methods and test kits will also be taught and evaluated.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Water Supply and Sanitation (CT 241)

Objective:

The student will develop an understanding of the various treatment methods of water supply and sanitation.

Description:

A complete study of water sources and treatment for city, industrial and domestic use; material on distribution systems and pumps, with the second half of the course dealing with sewage collection and purification.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction-Quantity of Water and Sewage	3
II.	Sources, Collection, and Distribution of Water	16
III.	Treatment of Water Supplies	12
IV.	Sewage-General Considerations	1
V.	Design of Sewage Systems	10
VI.	Treatment of Sewage	15
VII.	Miscellaneous Sewage Treatment Problems	2
VIII.	Financing and Management	1
	Total	60

Division I - Introduction - Quantity of Water and Sewage — 3 periods

A. Introduction-The Work of the Sanitary Engineer
   1. Water supply and sewage
   2. Effects of sanitary engineering upon city life

B. Quantity of water and sewage
   1. Forecasting population
   2. Consumption for various purposes
   3. Characteristics of the population
      a. Industries and commerce
      b. Metering water
      c. Density of population, zoning

4. Periods of design of water systems and sewer systems
5. Relation of amount of sewage to water consumption

C. Problems as assigned

Division II - Sources, Collection, and Distribution of Water 16 periods

A. Rainfall and runoff
   1. Precipitation and measurement
   2. Types of storms
   3. Measurement of runoff-the hydrograph
   4. Infiltration
      a. Determination of infiltration rates
   5. Evaporation and transpiration
   6. Yield and consumptive use
      a. Flood flows

B. Ground water
   1. Aquifers, wells, and ground-water flow
      a. Specific capacity of a well
      b. Recharge of aquifers
      c. Well construction
         (1) Shallow and deep wells
         (2) The ranney method
         (3) Springs
   2. Problems as assigned

C. Aqueducts and water pipes
   1. Open channels and aqueducts
   2. Stresses in pipes
   3. Types of pipe used
      a. Cast iron
      b. Steel
      c. Concrete
      d. Asbestos cement
      e. Plastic
      f. Wood stave
   4. Corrosion of metal pipes
      a. Prevention of corrosion

D. Collection and distribution of water
   1. Intakes
      a. Impounding reservoirs
      b. Lake intakes
      c. River intakes

2. The distribution system
    a. Methods of distribution
        (1) Storage necessary
        (2) Pressure zones
    b. Fire prevention and control
    c. The two-main system, service pipes, meters, valves, fire hydrants
    d. Construction and maintenance of distribution systems
    e. Disinfection of new and old water mains
    f. Leak and pipe location and cleaning of water mains
3. Problems as assigned

E. Pumps and pumping stations
1. Classification of pumps; their work and efficiency
    a. Positive displacement
    b. Reciprocating
    c. Rotary
    d. Centrifugal
2. Comparison of pumps for water supply
3. The choice of prime mover
    a. Steam power
    b. Diesel
    c. Steam turbines
    d. Gasoline engine
    e. Electric motor
4. Pumping stations-location and architecture
    a. Capacity and operation
    b. Types of pumps used, and their characteristics
5. Problems as assigned

Division III - Treatment of Water Supplies 12 periods

A. Quality of water supplies
1. Impurities in water
    a. The communicable water-borne diseases
    b. Fluorine and radioactivity in water
    c. Water bacteria and viruses
    d. Turbidity and color
    e. Alkalinity and acidity
    f. Soluble mineral impurities
2. Public health certification of water
3. Liability of unsafe water

4. Watershed and reservoir sanitation
    a. Lake overturns
5. Pumping plant, pipes, and reservoirs
    a. Plumbing defects, including cross-connections
    b. Drinking fountains
6. Methods of tracing pollution

B. Water clarification
1. Storage
2. Plain sedimentation
3. Design of sedimentation tanks
    a. Purpose and action of coagulants
    b. Feeding methods for coagulants
    c. Flocculation and clarification
    d. Color removal

C. Water filtration
1. The rapid sand filter
    a. Theory of filtration through sand
    b. Design of a filter
2. The slow sand filter
    a. Design
    b. Operating methods

D. Miscellaneous water treatment methods
1. Chlorine in water
    a. The orthotolidin test
    b. Use of chlorine gas, hypochlorination and other disinfecting methods
2. Removal of iron and manganese
3. Importance of water softening
    a. The lime-soda method
    b. The cation exchange method
    c. Hydrogen exchange
4. Desalting of water
5. Treatment of boiler waters
6. Synthetic detergents and radioisotopes in water

E. Problems as assigned

Division IV - Sewage - General Considerations — 1 period

A. Definitions and general considerations
   1. Combined vs. separate sewers
   2. Liability for damage caused by sewage

B. Amount of storm sewage
   1. The rational method
   2. Runoff coefficient
   3. Rainfall intensity
   4. The hydrograph method
   5. Gaging
   6. Problems as assigned

Division V - Design of Sewage Systems — 10 periods

A. Types of sewer pipe
   1. Vitrified clay pipe-strength and properties
   2. Plain concrete pipe-strength and properties
   3. Reinforced concrete pipe-strength and properties

B. Design of concrete and brick sewers built in place

C. Flow in sewers
   1. Flow formulas and the hydraulic grade line
   2. Required velocities
   3. Flow diagrams
   4. Sewer shapes

D. Sewer appurtenances
   1. Manholes
   2. Inlets
   3. Catch basins
   4. Flushing devices
   5. Sand, grease, and oil traps
   6. Regulators, junctions, and outlets
   7. Inverted siphons and sewer crossings
   8. Pumping of sewage

E. Design of sewer systems
   1. Preliminary investigations; the underground survey
   2. Layout the system
   3. Design of sanitary and storm sewer systems and combined sewers

F. Sewer Construction
   1. Lines and grades
   2. Classification of excavation
      a. Sheeting and bracing
   3. Dewatering of trenches
   4. Pipe laying
   5. Backfilling

G. Maintenance of Sewers
   1. Protective ordinances
   2. Maintenance equipment
   3. Cleaning and inspection
   4. Making repairs and connections
   5. Cleaning catch basins

Division VI - Treatment of Sewage 15 periods

A. Characteristics of sewage
   1. Physical and chemical characteristics
   2. Bacteriology of sewage and sewage treatment
      a. Coliforms and other bacteria
   3. Biochemical oxygen demand
   4. Importance of tests
   5. Sewage treatment methods, their efficiencies and problems

B. Sewage disposal
   1. Effects of pollution
   2. Self-purification
   3. Dilution as a method of treatment
   4. Sewage reclamation
      a. Irrigation with sewage

C. Screens and skimming tanks
   1. Screening devices, coarse and medium racks
   2. Cutters and shredders
   3. Fine screens
   4. Grease removal

D. Sedimentation of sewage
   1. Theory of sewage sedimentation
      a. Types of sedimentation
   2. Design of sedimentation devices
      a. The septic tank and imhoff tank
   3. Chemical sludge

E. Sewage filtration
   1. The intermittent sand filter
      a. Theory
      b. Design
      c. Construction
   2. Contact beds and trickling filters
      a. Design
      b. Construction
      c. Operation

F. Activated sludge
   1. Theory of activated sludge and aeration
   a. a. Methods of aeration
      b. Operation and control
   2. Final sedimentation
   3. Characteristics of activated sludge plants

G. Sludge treatment and disposal
   1. Amount and characteristics of sludge
   2. Sludge digestion
      a. Optimum conditons
      b. Design of digestion tanks
      c. State and high-rate digestion
   3. Sludge processing and disposal

Division VII - Miscellaneous Sewage Treatment Problems — 2 periods

A. Chlorination and Disinfection
   1. Reduction of B. O. D.

B. Garbage disposal with sewage

C. Industrial wastes and common wastes

D. Sewage disposal in unsewered sections

Division VIII - Financing and Management — 1 period

A. How water works are obtained - financing

B. First, operating and overhead costs

C. Charges for service

D. Administration of the sewer system

E. Problems as assigned

TEXT AND REFERENCES:

Steel, E. W., Water Supply and Sewage, New York, McGraw-Hill Book Company, Inc.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

TECHNICAL DIVISION

Subject: Communications III (ENG 109)

Objective:

This course is designed to acquaint the students with the fundamentals of business correspondence, technical reports and speeches of a technical nature, with reading and listening being correlated with the student's technical field. The student will receive instruction and practice in discussion topics of both a current and a technical nature.

Description:

A communications course stressing business correspondence, technical reports and speeches of a technical nature, with reading and listening correlated with the student's area of interest. Instruction and practice through discussion of both current and technical topics.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction and Motivation	2
II.	Technical Writing	15
III.	Technical Speaking	16
IV.	Review and Testing	3
	Total	36

Division I - Introduction and Motivation 2 periods

A. Course Schedule

B. Necessity for Clear Communication in the Technical World
   1. Technicians need
   2. Use in advancement

Division II - Technical Writing 15 periods

A. Business Letters
   1. Form
   2. Tone
   3. Types

B. Technical Reports
   1. Scientific method
   2. Report preparation
   3. Technical style

4. General writing traits
5. Related problems
   a. Spelling
   b. Vocabulary
   c. Mechanics
6. Research paper involving library research and formulation of gathered ideas and materials

Division III - Technical Speaking — 16 periods

A. Types of Oral Communication
   1. Interviewing
   2. Informal speaking
   3. Discussion group applications in seminar work

Division IV - Review and Testing — 3 periods

A. Mid-term Examination

B. Drop Tests

TEXTS AND MATERIAL

Typing paper and envelopes

Dictionary carried over from Communications I and II

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

TECHNICAL DIVISION

Subject: Human Relations (PSYC 127)

Objective:

The student will have a better understanding of himself in group relations.

The student will have a better understanding of his fellow employees in a working situation.

The student will have a better understanding of the hierarchy of the social and labor system.

The student will have a better understanding of the mental and physical disorders which affect our social system.

Description:

A development of the psychological principles basic to the formation and improvement of human personality, such as theories of learning, motivation, emotion, and mental health. Applications of these principles to the personal and vocational needs of the students stressed. For students who are in terminal programs.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction	2
II.	How To Get Along With Yourself	4
III.	Understanding Human Behavior	15
IV.	Group Dynamics	7
V.	Success in Getting Along With Others	5
VI.	Summary and Evaluation	3
	Total	36

Division I - Introduction — 2 periods

A. Course Content and Schedule

B. Motivation
1. What human relations involve
2. Personal problems in dealing with co-workers
3. Dealing with employees

Division II - How To Get Along With Yourself — 4 periods

A. Getting To Know Yourself Through

1. Self actualization
2. Self esteem
3. Self realization
4. Aspirations

B. Getting to Like Yourself Through Developing a Positive Image of Self

Division III - Understanding Human Behavior — 15 periods

A. Why People Act the Way They Do in Various Conditions
   1. Escape from reality
   2. Social stress
   3. Social tension
   4. Goal manipulation

B. Needs That Affect Behavior
   1. Biological needs
      a. Want for life
      b. Thirst
      c. Hunger
   2. Psychosocial needs
      a. Safety needs
      b. Belongingness and love needs
      c. Esteem needs
      d. Self-actualization needs

C. Behavior as Related to Personality
   1. Drives
   2. Needs
   3. Hemostatic principle
   4. Cultural influences

Division IV - Group Dynamics — 7 periods

A. Group Relationships

B. Working in the Group

C. Teamwork Experiences

D. Group Member Evaluations

Division V - Success in Getting Along With Others — 5 periods

A. Getting to Know Your Fellow Man as a Fellow Worker
   1. Understanding the various types of personalities which make up a group

B. Trust as an Integral Part of Human Relations in a Group

C. Giving and Following Instructions

Division VI - Summary and Evaluation 3 periods

A. Mid-Term Examination

B. Drop Examinations

TEXTS AND REFERENCES

Duvall, Sylvanus M. The Art and Skill of Getting Along With People Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 1961

Zener, Anthony E. and Wheeler, Garth A. Thiokol Human Relations Kit St. Louis, Missouri, McGraw-Hill Book Company, 1970

Hopner, H. W. Psychology Applied to Life and Work, Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 1966

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

ELECTRICAL TECHNOLOGY
ELECTRONIC TECHNOLOGY
CIVIL ENGINEERING TECHNOLOGY
MECHANICAL DRAFTING TECHNOLOGY

Subject: Physics I (SCI 141)

Objective:

This course is designed to give the students an opportunity to learn those concepts of physics which are related to their course of study.

Description:

Classical and modern physics. Practical examples of the application of each area with problems demonstrating the fundamental principles involved.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction and Orientation	2
II.	Measurement	8
III.	Structure and Properties of Matter	12
	Major Test I	2
IV.	Mechanics of Solids	40
	Major Test II	2
	Major Test III	2
V.	Mechanics of Liquids	6
VI.	Mechanics of Gases	8
	Major Test IV	2
VII.	Heat	20
	Major Test V	2
VIII.	Electrochemistry	6
	Major Test VI	2
	Total	114

Division I - Introduction and Orientation — 2 periods

A. Aims of Course and Content of Course

B. Ground Rules for Operation

C. Laboratory Procedure
   1. Conduct
   2. Care of Equipment
   3. Write up on Experiments

D. Pre-Test Over Material to be Covered

Division II - Measurement — 8 periods

A. Significant Figures
   1. Go over hand out on rules
   2. Work out problems

B. Scientific Notation
   1. Go over hand out on rules
   2. Work out problems

C. Metric System
   1. Go over hand out
   2. Work out problems on conversions

D. Fundamental and Derived Quantities

E. Weight and Mass Compared

F. Systems of Measurement

G. Accuracy and Precision Compared

H. Measuring Instruments

I. Scaler and Vector Quantities

Division III - Structure of Matter — 12 periods

A. Three States of Matter

B. Atomic Composition of Matter; Electrons, Protons, Neutrons

C. Organization of Matter; Elements, Compounds, and Mixture

D. Kinetic Theory of Matter; Diffusion of Solids, Liquids and Gases

E. General Properties of Matter
   1. Extension, mass and gravitation
   2. Indestructibility, inertia and colesion

F. Special Properties of Matter
   1. Impenetrability, porosity and adhesion
   2. Ductility, elasticity, hardness
   3. Tenacity malleability
   4. Surface tension and capillary actions

G. Density and specific gravity

H. Laboratory

1. Experiment 1--Using the metric system
2. Experiment 2 & 3--Vernier and micrometer coliper
3. Experiment 4 & 15--Density of solids and Hookes Law

Major Test I - Measurement and Structure of Matter — 2 periods

Division IV - Mechanics of Solids — 40 periods

A. Forces - Statics
   1. Forces as vectors
   2. Resultants and equilibrants
   3. Solutions to vector problems
      a. Graphic method
      b. Parallelogram method
      c. Polygon method
      d. Resolution into components
   4. Law of universal gravitation
   5. Center of gravity and stability
   6. Laboratory
      a. Experiment 5--parallelogram of forces
      b. Experiment 6--resolution of forces

B. Motion - Kinematics
   1. Velocity compared to speed
   2. Uniformly accelerated motion
      a. Velocity and acceleration
      b. Distance and time
   3. Free falling objects
   4. Experiment 6 - free fall apparatus
   5. Projectiles and pendulums
   6. Experiment 7 - the pendulum
   7. Rotary motion

C. Force and Motion - Dynamics
   1. Newton's laws of motion
   2. Momentum

Major Test II - Force and Motion — 2 periods

D. Work = Force x Distance
   (handout on work)

E. Power
   (handout on power)

F. Energy
   (handout on energy)

G. Machines
   1. Law of machines
   2. Ideal mechanical energy
   3. Actual mechanical energy

4. Efficiency
5. Levers + experiment 8 - law of moments
6. Experiments 9 & 10 - center of gravity and parallel forces
7. Pulleys + experiment 11 - pulleys
8. Wheels + axles + experiment 12
9. Inclined plane and screw + experiment 14

H. Friction
1. Coefficient of friction
2. Kinds of friction - static, kinetic, fluid
3. Methods of reducing friction
   a. Change materials
   b. Smooth out surfaces
   c. Change sliding to rolling friction
   d. Lubricate surfaces
4. Causes of friction
   a. Cohesion - high in solids - low in fluids
   b. Adhesion - high in fluids - low in solids
5. Effects of lubricants
   a. Oils great cohesive properties
   b. Movement of one surface over another
   c. Viscosity of an oil-grade
6. Choice of lubricants for bearings
   a. Correct grade or viscosity
   b. Rubbing speed - linear feet/minute
   c. Clearance between bearing and journal
   d. Load - pressure per square inch of bearing area
7. Function of lubricant
   a. Maintain an unbroken oil film between the moving surfaces
   b. To prevent excessive generation of heat
   c. To carry away the heat normally developed during bearing operation
8. Laboratory tests of lubricants
   a. Ramsbottom carbon test-determination of the amount of residue remains after heating the oil
   b. Gravity test-determination of the specific gravity of oils with water chosen as a standard of 10. Gasoline 50-60, oils 20-30
   c. Color test 1-8, white-red. Not an indicator of quality
   d. Viscosity tests-thickness or body. High viscosis-thick. Measure of the time of a certain oil to flow through a capillary tube at a specified time
   e. Flash and fire test-the temperature at which an oil will first burn (flash point) and that temperature which it will continue to burn (fire point)
   f. Neutralization value test-determination of the acid present in an oil. Some of these acids are harmful, other harmless. Some

cause corrosion

g. Saponification test-an attempt to determine the amount of fatty oils or soaps are present in the oil. Some of these soaps may cause corrosion

h. Melting point test for greases-a test to find the temperature at which a grease becomes fluid enough to flow. This does not indicate the lubricatory quality of the lubricant

i. Penetration test-an attempt to find out how a metal cone will penetrate a sample of grease. This determines the effectiveness of a grease to reach and lubricate a bearing

Major Test III - Work, Power, Energy, Machines, Friction, and Lubricants — 2 periods

Division V - Mechanics of Liquids — 6 periods

A. Pressure in Liquids
   1. Pressure related to depth
   2. Pressure related to shape of vessel
   3. Pascal's law and hydraulic presses

B. Buoyancy in Fluids
   1. Archimedes principle
   2. Law of Floatation

C. Specific Gravity
   1. Weight of substance/weight of equal volume of water
   2. The hygrometer principle
   3. The displacement method

D. Experiments on Liquids
   1. Experiment 16-pressure of liquids
   2. Experiment 17 & 18-archimedes and law of floatation

Division VI - Mechanics of Gases — 8 periods

A. The Atmosphere and Barometers Demonstrate
   Experiment 22-Atmospheric Pressure

B. The Gas Laws
   1. Boyle's Law-experiment 24
   2. Charles Law-heat and volume
   3. Gay-Lussac's Law-pressure and temperature
   4. Combined Gas Law
   5. Dalton's Law of Partial Pressures

C. The Bernoulli's Principle

D. Siphons and Pumps

Major Test IV - Mechanics of Liquids and Gases — 2 periods

Division VII - Heat — 20 periods

A. Kinetic Theory of Heat-Contrast Heat and Temperature

B. Thermometry
   1. Types of thermometers
   2. Temperature scales

C. Effects of Heat on Matter
   1. Expansion of solids, liquids, and gases
   2. Coefficient of linear expansion
   3. Demonstrate experiment 26-linear expansion
   4. Abnormal behavior of water

D. Heat Transfer
   1. Convection-demonstrate
   2. Conduction-hand out on conductivity
   3. Radiation-Stefan-Boltzmann Law
   4. Solve problems on the above

E. Specific Heat + Units of Heat Quantities
   1. Method of mixtures
   2. Experiment 27-specifies heat of a metal

F. Heat of Fusion
   1. Quantity of heat needed to change state
   2. Time and temperature cooling curve
   3. Experiments 28 & 29-heat of fusion and cooling curve during solidification
   4. Effect of pressure and solution on melting and freezing

G. Heat of Vaporization
   1. Contrast boiling and vaporization
   2. Cooling effect of vaporization
   3. Effect of pressure and solutions on boiling points
   4. Demonstrate experiment 30-heat of condensation

H. Hygrometry-Water Vapor in the Air
   1. Absolute and relative humidity
   2. Hygrometers
   3. Dew point
   4. Demonstrate experiment 31-dew point and relative humidity

I. Heat Engines and Refrigeration
   1. Steam, gasoline, diesel and turbine

2. Refrigeration
3. Show filmstrip on converting heat into useful work

Major Test V - Heat 2 periods

Division VIII - Electrochemistry 6 periods

A. Review of Basic Electron Role in Bonding

B. Primary Cells
1. The simple voltaic cell
2. The dry cell

C. Secondary Cells
1. The lead storage cell
2. Others--nickel, codmium, silver, zinc

D. Corrosion
1. Simple galvanic action
2. Localized galvanic action
3. Bimetallic galvanic action
4. Ways of preventing corrosion

E. Experiments on Electro Chemistry
1. Experiment 55-lead storage cell
2. Experiment 56-electroplating

Major Test VI - Electrochemistry 2 periods

TEXTS AND REFERENCES

Ahner and Kastan, Review Text in Physics, AMSCO School Publications, New York, 1966

Dull, Metcalfe, & Williams, Modern Physics, Holt, Rinehart, Winston, Inc., New York 1963

Harris and Hemmerling, Introductory Applied Physics, New York, McGraw-Hill Book Company, 1963

Shell Oil Company, Panorama of Lubrication, Shell Oil Company, New York, 1953

White, Manning & Weber, Practical Physics, McGraw-Hill Book Company, New York, 1955

White, Manning & Weber, Basic Physics, McGraw-Hill Book Company, New York, 1968

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: Survey of Chemistry (SCI 122)

OBJECTIVES:

1. To review and mathematically expand the concepts learned in SCI 121.
2. To develop an understanding of the theory and techniques of Quantitative Analytical Chemistry and related instrumental methods of analysis.
3. To familiarize the student with the significance and application of some physical and chemical measurements used in water and waste water analysis.

DESCRIPTION:

This course is a laboratory centered course dealing with standard methods of waste water analysis. The lecture portion of SCI 122 teaches laboratory background and theory together with the sanitary, biological and biochemical significance of each test prepared in the lab.

COURSE HOURS PER WEEK: Class - 2 Laboratory - 6

QUARTER HOURS OF CREDIT: 4

PREREQUISITE: SCI 121 or SCI 101

COURSE BREAKDOWN BY MAJOR TOPIC: LECTURES

I.	Basic Concepts from SCI 121 Reviewed	2
II.	Introduction to Qualitative Analysis	2
III.	Basic Concepts in Quantitative Chemistry	6
IV.	Introduction to Physical Methods of Water and Waste Water Analysis	3
V.	Introduction to Chemical Methods of Water and Waste Water Analysis	7
VI.	Chemical Coagulation Testing Methods for Water Treatment Plant Operations	3
VII.	Tests, Etc.	

LECTURE TEXT: Chemistry for Sanitary Engineers, Sawyer and McCarty, McGraw-Hill Second Ed. 1967

LABORATORY: Standard Physical and Chemical Methods of Waste Water Analysis -- Objectives and Techniques

Lab Texts: Standard Methods of Water and Waste Water Analysis

OUTLINE OF INSTRUCTION

2 lectures

I. BASIC CONCEPTS REVIEWED

A. Atomic Structure
   1. Elements
   2. Symbols
   3. Atomic Weight
      a. protons
      b. neutrons
      c. isotopes
   4. Gram atomic weight

B. Molecular Structure
   1. Compounds
      a. formulas
      b. molecular weight
      c. nomenclature
   2. Bonding
      a. covalent
      b. electrovalent
      c. polarity

C. The Mole Concept
   1. Avogadro's number
   2. Gram molecular weight
   3. Weight relationships

D. Chemical Equations
   1. Percentage yields
   2. Oxidation - reduction
   3. Law of mass action
      a. ionization
         1. ionization constants
      b. activity and activity coefficients

E. Gas Laws

II. INTRODUCTION TO QUALITATIVE ANALYSIS

2 lectures

A. Homogeneous Chemical Equilibrium

B. Heterogeneous Chemical Equilibrium
   1. Solubility product
      a. common ion effect
      b. diverse ion effect

C. Shifting Chemical Equilibrium
   1. Formation of weakly ionized compound
   2. Formation of complex ion
   3. Formation of gaseous product
   4. Oxidation reduction

D. Methods of Qualitative Analysis
   1. Wet Chemistry
   2. Instrumental analysis

III. BASIC CONCEPTS IN QUANTITATIVE CHEMISTRY — 6 lectures

A. Laboratory Equipment and Basic Operations
   1. Sampling
      a. composit
      b. grab
   2. Precipitation
   3. Filtration
   4. Drying
      a. ignition
      b. dehydration
      c. desiccation
   5. The analytical balance

B. Gravimetric Analysis
   1. Precipitation methods
   2. Calculation of results
   3. Scope and application

C. Volumetric Methods of Analysis
   1. Some basic definitions
      a. titration
      b. standard solution
      c. primary and secondary standards
      d. equivalence point and end point
      e. indicator
   2. Acidimetry and alkalimetry
      a. theory of neutralization titrations
         1) acid - base equilibria
         2) pH and pH calculations
         3) buffer solutions
         4) titration curves
         5) end point detection
      b. application of neutralization titrations
         1) laboratory procedures
         2) water analysis methods
   3. Oxidation - reduction titrations
      a. theory of redox titrations
         1) basic electrochemistry
         2) titration curves
         3) indicators and primary standards
      b. application of redox methods
         1) using strong oxidizing agent
         2) using iodine
   4. Complexometric methods
      a. theory of EDTA complex formation
      b. application of EDTA titrations
         1) total hardness in ppm
         2) Ca+2 and Mg+2 hardness in ppm

D. Colorimetric Methods of Analysis
   1. Properties of electromagnetic radiation
   2. Aspects of absorption
      a. beer-lambert law
   3. Methods of measurement of absorbed light
      a. color comparison tubes
      b. filter photometers
      c. spectrophotometers
   4. Application of colorimetric methods

E. Instrumental Methods of Analysis
   1. Optical methods
      a. absorption methods
         1) U. V.
         2) I. R.
         3. visible
      b. emission methods
         1) flame photometry
         2) atomic absorption
         3) emission spectroscopy
      c. dispersion and scattering
      d. fluorimetry

   2. Electrical methods of analysis
      a. potentiometric
         1) pH determinations
         2) specific ion electrodes
         3) oxidation - reduction methods
      b. coulometric methods
         1) electrogravimetric methods
         2) titration methods
      c. polarographic methods
   3. Chromatographic methods
      a. gas chromatography
      b. paper chromatography
      c. thin lager chromatography
      d. ion - exchange chromatography

IV. INTRODUCTION TO PHYSICAL METHODS OF WATER AND WASTE WATER ANALYSIS 3 lectures

A. Turbidity
   1. Constituents
   2. Significance
      a. aesthetic
      b. filterability
      c. disinfection
   3. Method of determination
      a. jackson candle turbidimeter
      b. bottle standards
      c. color discs
   4. Expression and application of results

B. Color
   1. Sources
      a. swamps
      b. iron
      c. dyes

2. Significance
3. Methods of determination
   a. standard color solutions
   b. color discs
4. expression and application of results

C. pH
1. Theory reviewed
2. Measurement
   a. units of measure
   b. colorimetric
   c. electrometric
3. Significance
   a. control of biological processes
   b. control of chemical processes
4. Effect of acidity

D. Conductivity
1. Basic theory
2. Kinds of instrumentation
3. Sampling techniques
4. Methods
5. Data evaluation

E. Solids
1. Kind and composition of solids
   a. dissolved solid
      1) volatile
      2) non-volatile
   b. Suspended solids
   c. Settleable solids
   d. Total solids
2. Sampling techniques
3. Measurement techniques
4. Data evaluation and sanitary significance

F. Sewage Putrescibility
1. Method - Methylene blue
2. Significance

V. INTRODUCTION TO CHEMICAL METHOD OF WATER AND WASTE WATER ANALYSIS 7 lectures

A. Hardness
1. Causes and sources
2. Sanitary significance
3. Methods of determination
   a. soap
   b. EDTA
4. Calculations
5. Types of hardness
   a. Ca / Mg hardness
   b. carbonate and non carbonate hardness

6. Water softening review
   a. methods
      1) chemical
      2) ion-exchange

B. Chlorides
   1. Sources and significance
   2. Chemistry of Mohr determination
   3. Application of data

C. Iron and Manganese
   1. Sources and sanitary significance
   2. Iron analysis chemistry
   3. Manganese analysis chemistry
   4. Colormetric theory and methods reviewed

D. Fluorides
   1. Sources and sanitary significance
   2. Fluoride analysis methods and chemistry
   3. Evaluation and application of Fluoride data

E. Sodium, Sulfate and Phosphate
   1. Sanitary and biological significance
   2. Chemistry of sodium analysis
   3. Chemistry of sulfate analysis
   4. Types and chemistry of phosphates
   5. Sampling techniques and evaluation of results

F. Dissolved Oxygen
   1. Sanitary significance
   2. Sampling techniques
   3. Methods and chemistry for D.O.
      a. Winkler method
      b. modified Winkler method
      c. specific electrode potentiometry

   4. C.O.D.
      a. history and significance vs B.O.D
      b. methods and chemistry
      c. applications and uses

G. Residual Chlorine and Chlorine Demand
   1. Sanitary significance and history of chlorination
   2. Chemistry of chlorination
   3. Significance of chlorine residuals
   4. Methods and chemistry of chlorine analysis
      a. starch iodine method
      b. orthotolidine
      c. O.T.A.
      d. amperometric determination
   5. Evaluation and interpretation of data

VI. CHEMICAL COAGULATION TESTING METHODS FOR WATER TREATMENT PLANT OPERATIONS. — 1 lecture

A. General Considerations

B. Fundamental Reactions and Chemistry of Coagulation and Flocculation

C. Testing Methods and Optimum Conditions

D. Significance of Laboratory Tests.

E. Coagulant Aids

VIII. TESTS, ETC. — 3 lectures

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

LABORATORY OUTLINE
for
SCI 122

LABORATORY OUTLINE FOR ENVIRONMENTAL TECHNOLOGY OPTION TO SCI 122 (Survey of Chemistry)

I. PHYSICAL MEASUREMENTS ON WASTE WATER — 4-3 hr labs

A. Settleable Solids - Im hoff cones

B. Suspended Solids
1. Volatile
2. Non-volatile (stable above 600° C)

C. Dissolved Solids
1. Volatile
2. Non-volatile

D. Total Solids
1. Volatile
2. Non-volatile

E. pH (hydrogen Ion determination)

F. Temperature

G. Putrescibility (methylene blue method)

II. CHEMICAL TEST ON WASTE WATER ** — 9-3 hr. labs.

A. Dissolved Oxygen
1. Prep of .025N Thiosulfate solution
2. Standardization of .025N thiosulfate against primary standard $K_2Cr_2O_7$
3. Determining D.O. by Winkler method
4. Determining D.O. in presence of nitrites by modified Winkler method
5. Electrochemical determination of D.O.

B. Chemical Oxygen Demand
1. Preparation of a standard .25M $K_2Cr_2O_7$ solution
2. Preparation of a standard ferrous ammonium sulfate solution

C. Residual Chlorine - Orthotolidine Colorimetric method

D. Chlorine Demand Test - (hypochlorite source - orthotolidine indicator)

III. CHEMICAL TESTS FOR FLORCULATION RATES AND ION EXCHANGE CAPACITIES 3-8 hr. labs

A. Determining Optimum pH

B. Determining Optimum Flocculant Concentration

C. Effect of Coagulant Aids

D. Determining the exchange Capacities for Commercial Ion Exchange Resins.

IV. MISCELLANEOUS TESTS PREFORMED ON FRESH AND WASTE WATER USING COMMERCIAL DEVICES AND PREFABRICATED KITS. 4-3 hr. labs.

A. Phosphates

B. Sulfates

C. Nitrates

D. Sodium Ions

E. Bicarbonate Ions

F. Detergents

V. LAB CHECK-IN: CHECK-OUT AND LAB TESTS 3-3 hr. labs.

** All solutions will be made and standardized by the student wherever possible.

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

Subject: Water Supply and Sanitation (ES 243)

Periods Required: Class - 5 , Lab - 3

Quarter Hours Credit: 5

Description:

This course is the study of sewage collection and treatment, including all the standard methods of treatment for purification, handling and disposal of sludges and industrial wastes. This includes miscellaneous sewage treatment problems.

Objective:

1. To develop an understanding of the various methods utilized in the treatment of liquid wastes to render it unoffensive.

2. To familiarize the student with the method employed in selecting the proper treatment process.

3. To develop an understanding of the basic design parameters of the treatment processes.

4. To familiarize the student with operational problems associated with various processes.

MAJOR DIVISIONS:	PERIODS
I. Introduction and Review	4
II. Methods of Treatment	16
III. Detail Plant Study	24
IV. Proper Treatment Selection	30
V. Industrial Wastes	10
VI. Rules, Regulations and Forms	7
VII. Tests, Etc.	5
TOTAL	96

I. INTRODUCTION AND REVIEW OF LIQUID WASTE — 4 periods

A. Composition
   1. Domestic
   2. Industrial
   3. Combined storm flow
   4. Concentration
   5. Condition
   6. Mineral - organic
   7. Bacteria

B. Behavior of Liquid Waste
   1. Oxygen demand
   2. Settleability
   3. Toxicity
   4. Physical appearance

II. METHODS OF TREATMENT — 16 periods

A. Review of Basic Processes
   1. Preliminary
   2. Primary
   3. Biological
   4. Complete
   5. Disinfection

B. Inovations of Basic Processes

   1. Neutralization
   2. Roughing filters
   3. Guggenheim process
   4. Kraus process
   5. Extended aeration
   6. Stabilization ponds
   7. Stage aeration
   8. Two stage digestion
   9. Perth gas recirculation
   10. Bioflocculation
   11. Subsurface irregation
   12. Cavitation
   13. Hay's process
   14. Aero clarifier
   15. Other proprietary treating devices

III. DETAIL PLANT STUDY — 24 periods

A. Physical Facilities
   1. General appearance
   2. Sewage flow
   3. Screens
   4. Sedimentation
   5. Intermediate treatment
   6. Secondary settling
   7. Sludge digestion
   8. Sludge disposal

B. Hydraulic Layout of Plant
   1. Pipe sizes
      a. flow
      b. head loss
   2. Recirculation
   3. Pump study
      a. flow

b. head
c. horsepower

4. Special features
   a. sludge lines
   b. sludge gas storage
   c. sludge heating
   d. dried sludge removal

C. Laboratory Efficiency Check
1. B. O. D.: raw, settled, filtered, final
2. Solids: raw, settled, filtered, final
3. Oxygen consumed: raw, settled, filtered, final
4. Nitrogen: raw, settled, filtered, final

IV. PROPER TREATMENT SELECTION — 30 periods

A. Objectives
1. Protect health
2. Avoid nuisance
3. Protect fish life
4. Protect recreational areas

B. Septic Tank and Nutrification field
1. Homes
2. Small institutions
3. Where water courses not available
4. High degree of treatment required
5. Biological activity certain
6. Where odor would be objectional
7. Where soil is porous
8. Minimum maintenance available

C. Septic Tank and Sand Filter
1. Medium size institutions
2. Biological activity certain
3. Where filter can be located remote
4. In dense soil areas
5. Routine maintenance available
6. High degree of treatment required
7. Limited water course
8. Temperature climates

D. Anerobic Lagoons
1. Organic industrial waste
2. Odors not a problem
3. Little maintenance available
4. Followed by aerobic lagoons
5. Where economy a must
6. Where operations are seasonal
7. Can be located remote
8. No sludge handling problems

E. Aerobic Lagoon
   1. Where economy a must
   2. Can be located remote
   3. Sufficient areas available
   4. Little maintenance necessary
   5. Temperate climate
   6. Biological activity certain
   7. No sludge handling problem

F. Extended aeration
   1. Multiple homes
   2. Institutional and industrial
   3. Minimum maintenance
   4. No sludge handling problem
   5. Need minimum water course
   6. Odors not a problem
   7. Locate adjacent to inhabited buildings
   8. Power available
   9. In remote areas without municipal service

G. Complete municipal system
   1. flow exceeds 50,000 galons/day
   2. Adequate operating personnel
   3. Reasonable water course for dilution
   4. Locate in remote area if possible
   5. Anticipating growth

V. INDUSTRIAL WASTES — 10 periods

A. Natures of Wastes
   1. Inorganic
   2. Organic
   3. Mixed

B. Waste Effect
   1. Stream
   2. Acquatic life
   3. Economy

C. Characteristics and Method of Treating
   1. Textile
   2. Food processing
   3. Metal plating wastes
   4. laundry
   5. Soap and detergent
   6. Insecticides
   7. Radio active wastes
   8. Paper and pulp

VI: RULES, REGULATIONS AND FORMS — 7 periods

A. Importance
   1. Protection of utility and operator
   2. Record of accomplishment
   3. Index to efficiency

4. Guide and reminder
5. Future guide for planning and construction

B. Type of Record
1. Daily log
2. Equipment repairs and maintenance
3. Operating cost
4. Operating record
5. Laboratory results
6. Complaints

C. Monthly Forms to North Dakota Department of Health
1. Laboratory
2. Operational

D. Annual Report to Governing Board
1. Performance
2. Major changes
3. Personnel changes
4. Comment
5. Recommendations

VII. Tests, Etc. 5 periods

SUGGESTED TEXT:

Babbitt, Harold E., and Baumann, Robert E., Sewage and Sewage Treatment. New York: John Wiley and Sons, Inc., 1958.

Federation of Sewage and Industrial Wastes Association. Sewage Treatment Plant Design. Washington, D. C.: Federation of Sewage and Industrial Wastes Association, 1959.

SUGGESTED REFERENCE:

Numerow, Nelson L., Industrial Waste Treatment, Reading, Massachusetts: Addison Wesley Publishing Company, Inc. 1963.

Ross, R. D., Industrial Waste Disposal, Reinhold Book Corp.

Camp, T. R., Water and Its Impurities, Reinhold Book Corp.

Hardenborgh, Water Supply and Waste Water Disposal.

Imhoff, Fair, Sewage Treatment.

The Treatment of Industrial Wastes, Besselievre.

PERIODICALS
Journal of Water Pollution
Water and Wastes Engineering
Water and Sewage Works

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

ENVIRONMENTAL SCIENCE TECHNOLOGY

Subject: Air Pollution Control (ES 202)

Periods Required: Class 4 and Laboratory

Description:

This course is a study of the classes, sources, measurements and the meterology of air pollution and its effects on our health, animal and plant life together with methods of its prevention and control.

The student should gain from this course an understanding of the causes and sources of air pollution, the means of detection and control, and the present air quality standards and implementation plans.

MAJOR DIVISIONS		CLASS PERIODS
I.	Introduction	4
II.	Air Pollutants	6
III.	Effects of Air Pollution	7
IV.	Meteorological Effects of Air Pollution	4
V.	Air Pollution Control	7
VI.	Guidelines for Development of Air Quality Standards and Implementation Plans	12
VII.	Air Pollution Control Programs	2
	Tests, Exams., Lyceums, Etc.	6
	Total	48

Division 1 - Introduction — 4 periods

A. Definition of air pollution

1. Ambient atmosphere
2. Results of processes of energy conversion
3. Products and by-products of chemical and biological interaction.

B. The air pollution problem

1. Historical background
2. Ecological background and issues
3. Social and economic issues

Division II. Air Pollutants — 6 periods

A. Causes

1. Natural
   (a) photochemical
   (b) radioactive
   (c) other

2. Man made
   (a) industrial
   (b) radioactive

B. Sources

1. Process industries
2. Automobile
3. Central power plants
4. Individual and multiple burnings by man
5. Natural sources

C. Types of air contaminants

1. Classed as to origin
   (a) primary
   (b) secondary

2. Classed as to physical state
   (a) solid (particulates)
   (b) liquid
   (c) gas

3. Classed as to chemical composition
   (a) organic
   (b) inorganic

Division III. Effects of Air Pollution — 7 periods

A. Effects on man

1. Physiological effects
   (a) solids (particulates
   (b) gases
      (1) organic
      (2) inorganic

2. Organs effected
   (a) eye
   (b) respiratory system
   (c) cardiac implications

3. Specific diseases
   (a) lung cancer
   (b) chronic bronchitis
   (c) bronchial asthma
   (d) emphysema

B. Effects on animals

1. Chronic poisoning
2. Economic significant

C. Effects on vegetation

1. Stunted growth or killed
   (a) lack of sunshine
   (b) chemical gas reactions
   (c) economic aspects

D. Effects on materials

1. Building materials
   (a) stone
   (b) brick
   (c) metal

2. Protective materials
   (a) cloth
      (1) man made
      (2) synthetic
   (b) rubber
   (c) paint

E. Effects on atmospheric visibility

1. Determination of prevailing visibility
2. Pollutants responsible
3. Economic aspects

F. Economic aspects

1. Historical
2. Mechanism of determination
3. Methods of measurement
4. Influencing factors
5. Pollutants of major concern

Division IV. Meteorological Effects of Air Pollution — 4 periods

A. Meteorological fundamentals

1. Temperature
2. Movement (air currents or wind)
3. Humidity
4. Pressure

B. Inversions

C. Meteorological measuring equipment

Division V. Air Pollution Control — 7 periods

A. Gaseous pollutants

1. Absorption
2. Adsorption
3. Thermal oxidation
4. Catalytic oxidation
5. Direct combustion

B. Particulate matter

1. Removal process
2. Collection mechanism
   (a) inertial force's
   (b) gravity settling
   (c) filtration
   (d) electrostatic attraction
   (e) particulate conditioning

3. Disposal of wastes

C. Approaches to air pollution control

1. Dilution in the atmosphere
   (a) tall stacks
   (b) community planning

2. Control at source
   (a) by relocation
   (b) by shut down
   (c) good operating practice's
   (d) process changes
   (e) fuel substitution
   (f) gas cleaning devices
      (1) mechanical
      (2) wet scrubbers
      (3) filter systems
      (4) electrostatic precipitators

Division VI. Guidelines for Development of Air Quality Standards and Implementation Plans — 12 periods

A. Air pollution legistation

1. Federal
2. State of N.D.
3. State of Minn.
   (a) open burning
   (b) SO_2
   (c) particulates
   (d) visible emissions

B. National air sampling stations

1. Sampling stations in N. Dak.

C. Air quality control regions

D. Air quality criterio

E. Air quality standards

F. Source inventory

1. Purpose
2. Emission standards
3. Smoke reading
4. Emission estimates
5. Registration permit
6. Licensing system

Division VII. Air Pollution Control Programs 2 periods

A. Federal government

1. Control documents published
2. Further criteria to be puslished
3. Continuing research

B. State of North Dakota

1. Monitoring systems
2. Control regulations
3. Statistical documentation of samples and collection data
4. Delegation of authority to local governments

C. State of Minnesota

1. Control regulations
2. Delegated authority to local governments

D. Role of the technician

SUGGESTED TEXT:

Air Pollution Control Field Operations Manual, .U.S.D., H.E.W., PHS. Pub. 937

SUGGESTED REFERENCES:

1. Air Pollution and Its Effects (vol. 1)
   Air Pollution analysis Monitoring and Surveying (Vol. II)
   Sources of Air Pollution and Their Control (Vol. III)

   All above by Arthur C. Stern Academic Press, New York 1968

2. Deposition and Retention of Inhaled Aerosols. Hatch, T.F. and Gross, P. Academic Press, New York 1964

3. Air Pollution Handbook, Magill, P.L. Holden F.R. and Ackley, C. McGraw-Hill, New York 1956

4. The Air We Breathe, Kotin, Pl S.M. Farber and R.H.L. Wilson. Editors. Chas. C. Thomas, Springfield, Illinois 1961

5. The Effect of Air Pollution on Plants, Air Pollution, World Health Organization., Monograph Series No. 48, 233-278, 1961

6. Micrometeorology, Sutton, O.G., McGraw Hill 1953, New York

7. Guiding Principles-State Air Pollution Legislation U.S.D., H.E.W., Division of Air Pollution, Washington 25 D.C. May 1, 1962

8. General Meteorologg Byers, H.R., McGraw-Hill, New York, 3rd ed., 1959

9. Atmospheric Diffusion and Air Pollution, Frenkiel, F.N, and Sheppard, P.A., Academic Press, London, 1959

10. The High Cost of Air, U.S.D., H.E.W., PHS, U.S. GPO 1958-0-486591

11. Air Pollution and Respiratory Disease, Helmann, H., U.S.D., H.E.W, PHS 1257, 1964.

12. Human Anatomy and Physiology, Saunders W.B., 4th ed., Philadelphia 1958

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: SCI 133 (Microbiology)

DESCRIPTION:

A study of the characteristics and importance of micro-organisms. Emphasis is placed on the micro-organisms found in water and sewage, micro-organisms and disease and the control of micro-organisms.

OBJECTIVES:

1. To introduce the student to the principles of microbiology.

2. To show the significance of micro-organisms to the welfare of man.

3. To demonstrate the role of micro-organisms in water, soil, and sewage.

COURSE HOURS PER WEEK: 3 lectures, 1-2 hr. lab.

QUARTER HOURS OF CREDIT: 4

PREREQUISITE: None

COURSE BREAKDOWN BY MAJOR TOPIC:	LECTURE PERIODS
I. Introduction to Microbiology	1
II. Microbial Nomenclature and Classification	1
III. Anatomy of Bacteria	2
IV. Growing Bacteria	3
V. Reproduction and Growth	2
VI. The Orders of Bacteria	1
VII. Fungi: Molds and Yeast	2
VIII. The Viruses	2
IX. The Rickettsiae	1
X. Control of Micro-organisms	3
XI. Air-Borne Infections of Man	2
XII. Food and Water Borne Infections of Man	2
XIII. Contact Diseases of Man	2
XIV. Soil Microbiology	2
XV. Water Microbiology	4
XVI. Microbiology of Sewage	4
XVII. Testing	2

LABORATORY: To aquaint the student with the practical aspects of Microbiology.

LECTURE TEXT: Microbiology, Pelczar and Reid.

LABORATORY TEXT: Laboratory Manual for Microbiology and Environmental Health, Department of Bacteriology, North Dakota State University.
Handouts

I. INTRODUCTION TO MICROBIOLOGY 1 period

A. Protista

B. Groups of Microorganisms
1. Algae
2. Bacteria
3. Fungi
4. Protozoa
5. Rickettsiae
6. Viruses

C. Applications of Microbiology
1. Soil microbiology
2. Purification of Wastes
3. Aquatic microbiology
4. History of microbiology
a. pioneer investigators
b. recent developments

II. MICROBIAL NOMENCLATURE AND CLASSIFICATION 1 period

A. Nomenclature and Taxonomy
1. Binomial nomenclature
a. scientific names of bacteria
b. common names of bacteria
2. Classification of microorganisms
a. diagnostic keys

B. Characteristics for Classification
1. Morphology
2. Cultural characteristics
3. Biochemical activities
4. Chemical composition
5. Serological characteristics
6. Genetic information

III. ANATOMY OF BACTERIA 2 periods

A. Shape and Arrangement
1. Cocci
2. Bacilli
3. Helical
4. Vibrio

B. Structure
1. Flagella
2. Fimbrial
3. Capsules
4. Cell wall
5. Cytoplasmic membrane
6. Nucleus or chromatin body

C. Endospores
   1. Genera having endospores
   2. Properties of endospores

D. Protoplasts, Spheroplasts, L Forms

IV. GROWING BACTERIA 3 periods

A. Nutritional Requirements
   1. Energy source
   2. Carbon source
   3. Nitrogen source
   4. Sulfur source
   5. Phosphorus source
   6. Metals (trace elements)
   7. Vitamins
   8. H_2O

B. Autotrophs

C. Heterotrophs

D. Chemoautotrophs

E. Bacteriological Media
   1. Types of media
   2. Preparation of media

F. Physical Conditions Required for Growth
   1. Temperature
      a. psychrophiles
      b. mesophiles
      c. thermophiles
   2. Gaseous requirements
      a. aerobic
      b. anaerobic
      c. facultative
   3. Acidity or alkalinity (pH)
      a. optimum pH range
      b. buffers

V. REPRODUCTION AND GROWTH 2 periods

A. Reproduction
   1. Fission
   2. Budding
   3. Breakup
   4. Spores

B. Total Population Growth
   1. Growth rate
   2. Growth curve
      a. lag phase
      b. log phase
      c. death phase
      d. stationary phase

C. Continuous Culture of Bacteria
   1. Turbidostat
   2. Chemostat

D. Quantitative Measurement of Bacterial Growth
   1. Breed count
   2. Petroff-hauser counter
   3. Plate count
   4. Turbidity
   5. Mold count

E. Preservation and Isolation of Bacterial Cultures
   1. Isolation of a pure culture
      a. streak plate technique
      b. spread plate technique
      c. pour plate technique
      d. enrichment culture technique
      e. serial dilution technique
   2. Preservation of pure cultures
      a. periodic transfer
      b. lyophilization

VI. THE ORDERS OF BACTERIA — 1 period

A. Ten Orders of Bacteria
   1. Pseudomonodales
   2. Chalmydobacteriales
   3. Hyphomicrobiales
   4. Caryophanales
   5. Eubacteriales
   6. Actinomycetales
   7. Beggiatoales
   8. Myxobacteriales
   9. Spirochaetales
   10. Mycoplasmatales

VII. FUNGI: THE MOLDS AND YEASTS — 2 periods

A. Classification of Molds and Yeasts

B. Morphology of Molds and Yeasts

C. Reproduction in Molds and Yeasts
   1. Asexual
   2. Sexual

D. Cultivation of Molds and Yeasts

E. Pathogenic Molds and Yeasts

VIII. THE VIRUSES — 2 periods

A. History

B. Tobacco Mosaic Virus

C. Virus Filterability

D. Classification of Viruses

E. Composition of Viruses

F. Composition of Viruses

F. Morphology of Viruses

G. Reproduction in Viruses

H. Cultivation of Viruses

I. Viral Infections
   1. Immunity
   2. Chemical inhibition
   3. Control of viral infections

J. Bacterial Viruses
   1. Morphology
   2. Reproduction
      a. synthesis
      b. lysis
      c. lysogeny

IX. THE RICKETTSIAE — 1 period

A. Classification of Rickettsiae

B. Pathogenic and Non-pathogenic Rickettsiae

C. Morphology

RECOMMENDED TEXT:

Microbiology, Pelczar, Michael J., Reid, Roger D.

X. CONTROL OF MICROORGANISMS — 3 periods

A. Terminology
   1. Sterilization
   2. Disinfectant
   3. Etco

B. Death Curve Patterns
   1. Logarithmic curve
   2. Arithmetic curve

C. Physical Control of Microorganisms
   1. Temperature
   2. Dessiccation
   3. Osmotic pressure
   4. Radiations
   5. Ultraviolet light
   6. Surface tension
   7. Removal (filtration)

D. Killing and Inhibiting by Chemical Agents
   1. Phenols
   2. Alcohols
   3. Iodine
   4. Chlorine
   5. Heavy metals and heavy metal compounds
   6. Soaps and detergents
   7. Quaternary ammonium compounds
   8. Gaseous sterilization
      a. formaldehyde
      b. ethyleneoxide

E. Control By Use of Antibiotics and Other Chemotherapeutics
   1. Sulfonamide
   2. Antibiotics
      a. penicillin
      b. tetracycline
      c. bacitracin
      d. streptomycin
   3. Non-medical use of antibiotics
      a. growth stimulation
   4. Mode of action of antibiotics
   5. Mode of action of chemotherapeutics

XI. AIR=BORNE INFECTIONS OF MAN — 2 periods

A. Respiratory Diseases (Tuberculosis)
   1. Control
   2. Etiology
   3. Transmission

B. Streptococcal Infections
   1. Etiology
   2. Transmission
   3. Control

C. Diphtheria
   1. Etiology
   2. Transmission
   3. Control

D. Pneumococcus

E. Meningitis

F. Smallpox

G. Other Air-Borne Diseases

XII. FOOD AND WATER BORNE INFECTIONS OF MAN 2 periods

A. Intestinal Infections
   1. Etiology
   2. Transmission
   3. Control and prevention

B. Bacterial Food Poisoning
   1. Salmonella
   2. Clostridium
   3. Staphylococcus

C. Water Borne Infections of Man
   1. Cholera
   2. Polio

XIII. CONTACT DISEASES OF MAN 2 periods

A. Direct Contact Diseases
   1. Syphilis and other veneral infections
   2. Streptococcal infections
   3. Staphylococcal infections

B. Diseases Contacted through Trauma or Injury.
   1. Clostridial infection
      a. gasgangrene
   2. Rabies
   3. Rat bite fever

C. Diseases Transmitted by Arthropods
   1. Plague
   2. Tularemia
   3. Fevers
      a. Q fever
      b. Rocky mountain spotted fever

D. Various Fungal Diseases
   1. Dermatophytoses

XIV. SOIL MICROBIOLOGY — 2 periods

A. Microbial Flora of the Soil
   1. bacteria
   2. fungi
   3. mold
   4. algae
   5. protoza
   6. viruses

B. The Rhizosphere
   1. Symbiosis
   2. Commensalism

C. Biogeochemical Cycles in the Soil
   1. Nitrogen Cycle
      a. proteolysis
      b. ammonification
      c. nitrification

D. Reduction of NO_3 to NH_3

E. N_2 Fixation

XV. WATER MICROBIOLOGY — 4 periods

A. The Water or Hydrologic Cycle

B. Natural Waters
   1. Atomospheric
   2. Ground (aquafers)
   3. Surface water

C. Terminology (aquatic and marine)
   1. Planktonic population defined
   2. Benthic population defined

D. Role of Microorganisms in Biogeochemical Cycle

E. Water Purification
   1. Potable water
      a. purification standards
   b b. purification techniques
   2. Polluted water
      a. indicator organisms

F. Determining Sanitary Quality
   1. Sanitary surveys and standards
   2. bacteriological evidence of pollution
      a. coliform group (bacteriological techniques)
         1) I.M.V.I.C. test
         2) presumptive, confirmed and completed test
         3) standard plate count

G. Microorganisms other than coliforms
   1. Slime-forming bacteria
   2. Algae

H. Swimming places
   1. bromine treatment
   2. chlorine treatment

XVI. MICROBIOLOGY OF SEWAGE 4 periods

A. Characteristics of Sewage
   1. Chemical characteristics
      a. B.O.D.
      b. D.O.
   2. Microbiological characteristics
      a. characteristic species

B. Sewage-Treatment Processes
   1. Primary treatment
   2. Secondary treatment
   3. Tertiary treatment

C. Microorganisms and Sewage-Treatment Operations
   1. Aerobic conditions
   2. Anaerobic conditions

D. Efficiency of Modern Sewage Treatment Plants

E. The Pollution Problems
   1. Pollution zones
   2. Pollution effects on a balanced ecosystem

XVII. TESTING 2 periods

RECOMMENDED TEXTS:

Microbiology, Pelczar, Michael J. and Reid, Roger D.
Fresh-Water Biology, Needham and Needham

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

LABORATORY OUTLINE

MICROBIOLOGY
SCI 133

LAB 1

Use and care of the Microscope.
Widespread distribution of microorganisms in the environment.

LAB 2

Morphology and simple staining of bacteria.
The gram stain.

LAB 3

Pure Cultures
Acid Fast stain
Motility of bacteria

LAB 4

Molds and yeasts

LAB 5

Bacterial viruses
Extracellular enzymes

LAB 6

Influence of Environmental factors on the growth of microorganisms.

LAB 7

Testing of some common antimicrobial chemicals and antibiotics.

LAB 8

Food poisoning
Experimental epidemics

LAB 9

Microorganisms in the soil

LAB 10

Bactericidal effect of ultraviolet irridiation.

Lab 10 (Cont.)

The effect of temperature on microbial growth
Resistance of bacteria to heat.

LAB 11

Clean up lab
Final Lab test

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Drainage Technology (CT 242)

Objective:

The objective of this course is to provide the student with knowledge of the principles of hydraulics which are used to design surface and subsurface drainage systems for both rural and urban areas.

Description:

A study of open drainage and sewer drainage, Studies in: surface, water, rainfall, runoff; the conservation of water resources; storm sewer inlets, manholes, flow grades, pipe size computations and storm sewer outlets.

MAJOR DIVISIONS		CLASS PERIODS
I.	History and Development	1
II.	Hydraulics	10
III.	Application of Drainage Principles	4
IV.	Practical Problems	45
	Total	60

Division I - History and Development — 1 period

A. Hydrology

B. Elementary Hydraulics

Division II - Hydraulics — 10 periods

A. Application to Drainage
   1. Bernouli's theorem
   2. Rational method
   3. Burkli-Ziegler formula
   4. McMath formula
   5. Kutter and Manning formula

B. Construction
   1. Pipe strength and trench loads
   2. Table for selecting pipe sizes
   3. Pipe laying and inspection
      a. Sheeting and bracing
      b. Foundations and bedding

C. Special Problems in Surface and Subsurface Drainage

D. Roadway Drainage
   1. Normal problems
   2. Difficult situations
   3. Airport problems

Division III - Application of Drainage Principles — 4 periods

A. Layout of Drains
   1. Preliminary layout by land contour
   2. Trunks and branches
   3. Decimal numbering system for systematic gathering of quantities
   4. Manhole spacing
   5. Runoff areas

B. Twelve Design and Check Steps

C. Pipe Sizes
   1. By formula or tables
   2. Loss by pipe flow
   3. Losses other than pipe flow

Division IV - Practical Problems — 45 periods

A. Original Ground Level and Suggested Street Layout Given

B. Design of Complete Storm Drain System

TEXT AND REFERENCES

Clay Pipe Engineering Manual. Barrington, Illinois: The Clay Products Association

Seelye, Elwin E., Design. New York: John Wiley and Sons, Inc.

Spindler, W. H., Handbook of Drainage and Construction Products. Chicago, Illinois: R. R. Donnelly and Sons Company

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: Sanitary Chemistry and Biology (ES 207)

DESCRIPTION:

Sanitary chemistry and biology provide the biological, biochemical and bacteriological background specific to the environmental technology curriculum. The laboratory deals with identification of organisms and microorganisms found in various sources of water and with field sampling techniques and analysis. The course is designed in a manner that will permit team teaching.

OBJECTIVES:

1. To provide the bacterialogical methods used in clean water and waste water technology.

2. To aquaint the student with the biology and biochemistry of organisms specific to varied aquatic environments.

3. To provide experience in the sampling, analysis and evaluation of water from real (lakes, rivers, etc.) ecosystems.

COURSE HOURS PER WEEK: Class 4 Laboratory 6

QUARTER HOURS OF CREDIT: 5

PREREQUISITES: SCI 122 and SCI 133

COURSE BREAKDOWN BY MAJOR TOPIC:	LECTURE PERIODS
I. Chemistry and Biochemistry	12
II. Sanitary Biology and Microbiology	14
III. Water Quality Standards and Criteria	6
IV. Tests, Review, Etc.	4
V. Pre Lab Theory and Calculations	12

LABORATORY BREAKDOWN BY MAJOR TOPIC:	LAB PERIODS
I. Check In and Solution Preparation	1
II. B.O.D. Analysis, Organic Chemistry and Biochemical Chomatograph labs	5
III. Clean and Waste Water Microbiology	10
IV. Sampling and Field Work Techniques	7
V. Check Out and Clean Up	1

LECTURE TEXTS: Same as SCI 121, 122 and 133

LABORATORY TEXTS: Same as SCI 121, 122 and 133

I. BIOANALYSIS OF WATER — 2 periods

A. B.O.D.
1. History and significance of biochemical oxygen demands.
2. Chemistry of B.O.D.'s (Winkler method)
   a. effect of incubation period
   b. Interfering substances
3. Methods
   a. sampling techniques
   b. direct analysis
   c. dilution analysis
   d. Winkler modifications
4. Interpetation and application of B.O.D. data

II. CONCEPTS FROM ORGANIC CHEMISTRY — 3 periods

A. History and Introduction

B. Some Classes and Structures of Organic Compounds
1. Alphatic vs Aromatic
2. Functional groups
   a. alcohol
   b. acids
   c. aldehydes and ketones
   d. ethers
   e. alkyl halides
   f. amines
3. Brief introduction to nomenclature

C. Sanitary Significance of Organic Compound
1. Detergents
2. Peroxides and photo chemical smog
3. odors and taste
4. pesticides

III. A BRIEF INTRODUCTION TO BIOCHEMISTRY, BIOCHEMICAL CYCLES AND BIOGEOCHEMICAL CYCLES — 7 periods

A. Compounds of Biological Importance
1. Carbohydrates
2. Lipids
3. Proteins (amino acids)
4. Enzymes
5. Vitamins
6. Hormones
7. Major Nutrients
8. Minor nutrients

B. Important Biochemical Processes
   1. Digestism
   2. Metabolism
   3. Fermentation
   4. Anaerobic decomposition
   5. Aerobic decomposition

C. Important Biogeochemical cycle
   1. Terms
      a. mineralization
      b. immobilization
      c. oxidation
      d. reduction
      e. volatilization
      f. geological deposits

   2. Biogeochemical gaseous cycles
      a. carbon cycle
      b. nitrogen cycle
         1) fixation
         2) denitrification

   3. Biogeochemical sedimentary cycles
      a. Phosphorous cycle
      b. sulfur cycle
      c. iron cycle
      d. calcium cycle

IV. AQUATIC ENVIRONMENTS — 4 periods

A. Pond or Lake (Lentic)
   1. Classification
   2. Stratification
   3. Formation and morphometry
   4. Water movements
   5. Zones

B. Reservoirs
   1. Classification
   2. Stratification
   3. Formation and morphometry
   4. Water movements
   5. Zones

C. Streams (Lotic)
   1. Classification
   2. Stratification
   3. Formation and Morphometry
   4. Water movements
   5. Zones

D. Ground Water
   1. Characteristics
   2. Water movements

V. KINDS OF WATER POLLUTION — 1 period

A. Organic Materials and Wastes
   1. Kinds
   2. Sources

B. Silts
   1. Kinds
   2. Sources

C. Toxic Materials
   1. Kinds
   2. Sources

D. Radioactive Materials
   1. Kinds
   2. Sources

E. Temperature
   1. Sources

VI. EFFECTS OF WATER POLLUTION — 1 period

A. Oxygen Depletion
   1. Stagnation

B. Plant Nutrient Increases
   1. Eutrophication
      a. loss of aesthetic and property values

C. Increases in Temperature and Toxic Substances
   1. Eutrophication
   2. Sterilization

VII. PLANT AND ANIMAL SPECIES ANIMAL SPECIES ASSOCIATED WITH UNPOLLUTED WATER — 4 periods

A. Plant Species
   1. The algae
      a. distribution of algae
      b. morphology
      c. classification
      d. reproduction
      e. economic importance of algae
         1) discolored water
         2) foul tasting and smelling water
         3. soil fertility
         4) nitrogen fixation
         5) algae as food
      f. Lichens

2. Vascular plants

B. Animal Species
1. The protozoa
a. amoebae
1) morphology
2) motility
3) reproduction
4) nutrition and excretion

b. Infusoria
1) morphology
2) motility
3) reproduction
4) nutrition and excretion

c. flagellates
1) morphology
2) economic importance of zooflagellates

d. sporozoa

2. Vertebrates
a. fishes

VIII. PLANT AND ANIMAL SPECIES ASSOCIATED WITH MILDLY POLLUTED WATER — 1 period

A. Plant Species
1. Algaes
2. Vascular plants

B. Animal Species
1. Invertebrates
a. representative species
2. Vertebrates
a. representative species

IX. PLANT AND ANIMAL SPECIES ASSOCIATED WITH POLLUTED WATER — 1 period

A. The Very Tolerant Groups
1. Plant species
a. algaes
b. vascular plants
2. Animal species
a. invertebrates
1) insects
2) protozoans
3) bacteria
b. vertebrates
1) fishes

X. NUISANCE ORGANISMS AND CONTROL OF NUISANCE ORGANISMS ASSOCIATED WITH POLLUTED WATER — 2 periods

A. Organisms
   1. Algae
   2. Vascular plants
   3. Animals

B. Control

   1. Chemical
   2. Harvesting

C. Effectiveness of Control techniques

XI. SAMPLING AND TRANSPORTATION TECHNIQUES — 2 periods

A. For Organisms
   1. Kermmerer water sampler
   2. Sarber plankton sampler
   3. Ekman and peterson dredges
   4. Screens and various sieves

B. For Chemical Tests

XII. INTRODUCTION TO THE STATISTICS OF COLLECTING, ANALYZING AND REPORTING OF DATA AND RESULTS — 3 periods

A. The Random Sample

B. Statistical Terms
   1. mean (arithmetic vs geometric)
   2. median
   3. mode
   4. deviation
   5. standard deviation

C. Rejecting a Result

D. Reports and Record Keeping

XIII. WATER QUALITY STANDARDS AND CRITERIA — 1 period

A. Origin of Standards
   1. State level
   2. Federal level

B. Drinking Water Standards

C. Sewage Effluent Standards

D. Indexs of Pollution
   1. Physical (Turbidity, etc)
   2. Chemical (Hg / Cd levels)
   3. Biochemical (B.O.D.. etc.)
   4. Biological
      a. species diversity
      b. species density

REFERENCES:

Fresh Water Biology, Needham and Needham
The Practice of Water Pollution Biology, MacKenthun, Kenneth
Microbiology for Sanitary Engineers, McKinney, McGraw Hill 1962
Biology and Water Pollution Control, Warren, Saunders Co., 1971
The Biosphere, A Scientific American Book, Freeman, 1970
Chemistry for Changing Times, John Hill, Burgess, 1972

LABORATORY OUTLINE

I. CHEMISTRY LABS:

A. Check-in and Solution Preparations — 1-3 hr lab
   1. Prep of .025N $Na_2S_2O_3$
   2. Prep of NaOH-KI Solution (containing NaN_3)
   3. Prep of $MgSO_4$ Solution

B. Biochemical Oxygen Demand — 3-3 hr. Lab
   1. Standardization of Solutions
   2. Sample Collecting Preparation and Dilution
   3. Determining Initial D.O. and Incubation
   4. Determining Final D.O. and Calculation of BOD

C. Organic Chemistry Laboratory Procedure (a brief introduction) — 1-3 hr. lab
   1. Determining m.p and mixed m.p.
   2. Determining Refractive Index
   3. Distillation of a Mixture

D. Introduction to Chromatograph Using Biochemicals (sugars or amino acids) — 1-3 hr. lab

II. Biology and Microbiology Labs

A. Bacterial Populations by Plate Count Method — 2-3 hr. lab

B. Bacteriological Examination of Water for Population — 2-3 hr. lab
   1. Presumptive test
   2. Confirmatory test
   3. Completed test

C. Biochemical Tests for the Differentiation of Coliform Organisms (IMVIC series) — 2-3 hr. lab

D. Determination of Bacterical Count in Water Using the Milipore Filter Technique — 2-3 hr. lab

E. Invertebrates — 1-3 hr. lab
   1. protozoans
   2. crustaceans
   3. mollusks
   4. insects
   5. annelids

III. CHEMICAL AND BIOLOGICAL TESTS APPLIED TO SAMPLES COLLECTED IN THE FIELD. 7-3 hr. lab

A. Treated Water

B. River Water and Lake Water

C. Well Water

D. Sewage

E. Active Sluge

IV. CHECK-IN AND CLEAN UP 1-3 hr. lab

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, ND 58075

ENVIRONMENTAL SCIENCE TECHNOLOGY

SUBJECT: Air Pollution Control II (ES 203)

PERIODS REQUIRED: Class - 2 Laboratory - 4

DESCRIPTION:

This course is a study of the principles and operation of sampling instruments, surveys and sampling techniques, control devices and the legal aspects of air pollution.

MAJOR DIVISIONS:	PERIODS
I. Introduction	4
II. Hi - Volume Filter	20
III. Extended Sampling	5
IV. Paper Tape Sampler	8
V. Surveillance Network	15
VI. Sampling Train	10
VII. Source Sampling	10
TOTAL	72

Division I: INTRODUCTION 4 periods

A. Hi Volume Sampling
B. Calibration of Hi volume sampler
C. Dustfall bucket
D. Sulfation plates
E. Surveillance network

Division II: Hi Volume Filter 20 periods

A. Total suspended particulates
B. Water extraction
   1. Sulfate concentration determination
   2. Nitrate concentration determination
   3. pH determination
C. Benzene extraction for organics

Division III: Extended Sampling 5 periods

A. Sulfation concentrations from sulfation plate
B. Settled particulates from dustfall

Division IV: Paper Tape Sampler 8 periods

A. Coefficient of haze
B. H_2S concentrations

Division V: Surveillance Network — 15 periods

A. Rubber cracking
B. Settled particulates on sticky paper
C. Nylon deterioration
D. Silver Tarnish

Division VI: Sampling Train — 10 periods

A. Oxidants
B. NO_2
C. NO^2
D. CO
E. Particulate

Division VII: — 10 periods

A. Reason for Source Sampling
B. Methods
   1. Isokenetic
   2. Gas Analysis
   3. Others
C. Advantages
D. Faults

Suggested Bibliography

Air Pollution Engineering Manual - Public Health Service, Publication No. 999-AR40

Selected Methods for the Measurement of Air Pollutants - Public Health Service, Publication No. 999-AP-11

Air Pollutant Emission Factors - Environmental Protection Agency, Research Triangle Park, NC

Air Sampling Instruments for Evaluation of Atmospheric Contaminants, American Conference of Governmental Industrial Hygienists, 1014 Broadway, Cincinnati, Ohio

Meaningful Air Quality Measurements on a Limited Budget - Frank A Bell Jr., APCA Journal, Vol. 13, No. 3 March 1963

Air Pollution Control Rules, Regulations and Air Quality Standards, Minnesota Pollution Control Agency, Air Quality Division, Documents Division, St. Paul MN

Air Pollution Control - ERA Inc., Environmental Science Division, 750 Summer St. Stramford, CT 06901

Air Pollution Control Field Operations Manual - U.S. Dept. of Health, Ed. & Welfare

SUGGESTED EQUIPMENT

1. Hi-Volume samplers and filters
2. Calibration equipment
3. Sampling train
4. Dustfall buckets
5. Surveillance network
6. Paper tape sampler and transmissometer
7. Separator
8. Shaker
9. Sulfation plates and assembly

NORTH DAKOTA STATE SCHOOL OF SCIENCE, WAHPETON, NORTH DAKOTA

ENVIRONMENTAL TECHNOLOGY

Subject: Solid Waste Disposal

Periods Required

Class 4 and Laboratory 0

Description

This course is a complete study of the composition, handling, disposal and decomposition of solid waste together with the influnces to this process and its effects on the community economy and enviornment.

The student should gain from this course an appreciation of the complexity of solid waste disposal problems plus considerable practical information on various handling methods.

MAJOR DIVISIONS		Class Periods
I.	Introduction	2
II.	Composition of Solid Waste	8
III.	Decomposition of Solid Waste	6
IV.	Solid Waste Collection & Handling	6
V.	Aesthetics & Environment Control	4
VI.	Disposal Techniques	6
VII.	Legal Control of Solid Waste	4
VIII.	Management Approaches	4
IX.	Field Problem or Research Project	8
	Total	48

Division I. Introduction — 2 Periods

A. Historical evolution of Solid Waste

B. Demands of Society

Division II. Composition of Solid Waste — 8 Periods

A. Sewage

B. Factory & Industrial Effluents

C. Commercial & Private Garbage

D. Commercial & Private Junk

E. Litter

F. Agricultural Refuse

G. Mineral & Mining Refuse

Division III. Decomposition of Solid Waste — 6 Periods

A. Organic

B. Inorganic

C. Chemical

D. Other

Division IV. Solid Waste Collection & Handling — 6 Periods

A. Methods of Collection
   1. Industrial
   2. Public
   3. Private

B. Equipment
   1. Storage
   2. Handling

Division V. Aesthetics & Environment Control — 4 Periods

A. Aesthetic Control
   1. Natural
   2. Mechanical & Structural

B. Disease, Insect & Rodent Control

C. Oder Control

D. Subsurface Contamination Control

E. Fire Control

Division VI. Disposal Techniques — 6 Periods

A. The Sanitary Landfill
   1. Land requirements and acquisition
   2. Zoning
   3. Land reuse and reclamation

B. Mechanical Methods

C. Incineration

D. Waste Material Recycling & Reclamation

E. Economics

Division VII. Legal Control of Solid Waste — 4 Periods

A. Standards, Rules and Regulations

B. Local & County Ordinances

C. State & Federal Laws

D. Methods of enforcement

Division VIII. Management Approaches — 4 Periods

A. Legal Authority

B. Planning & Organization

C. Design & Operation

D. Financing

E. Public Relations

F. Personnel

Division IX. Field Problem & Research Project — 8 Periods

REFERENCES:

Automobile Disposal, A National Problem: Case Studies of Factors that Influence the Accumulation of Automobile Scrap, Bureau of Mines, U.S. Department of the Interior, 1967.

Bendixen, T.W., Review of the National Solid Wastes Program, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1967.

Black, R. J., Safe and Sanitary Home Refuse Storage, Public Health Service Publication Number 183, U.S. Government Printing Office, 1968.

Cummins, R. L., Effects of Land Disposal of Solid Wastes on Water Quality, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968.

Demonstration Project Abstracts; Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, reprinted 1968.

Demonstration Project Abstracts: Supplement A, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1967.

Ecke, Dean J. and Donald D. Linsdale, "Fly and Economic Evaluation of Urban Refuse Systems, Part I Control of Green Blow Flies (Phaenicia) by Improved Methods of Residential Refuse Storage and Collection."Vector Views, Department of Public Health, Bureau of Vector Control, 2151 Berkeley Way, Berkeley, California, May, 1967.

Experimental Composting Research and Development: Joint U.S. Public Health Service-Tennessee Valley Authority omposting Project, Johnson City, Tennessee, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968.

Gilbertson, W.E., R.J. Black, L.E. Crane, and P.L.Davis; Solid Waste Handling in Metropolitan Areas, Public Health Service Publication Number 1554, U.S. Government Printing Office, 1967

Grant Programs Under the Solid Waste Disposal Act, Bureau of Solid Waste Management, U.S. Department of Health Education and Welfare, 1968.

Hanks, T.G., Solid Waste/Disease Relationships; A Litereature Survey, Public Health Service Publication Number 999-UIH-6, U.S. Government Printing Office, 1967.

Hart, S.A., Solid Waste Management/Composting; European Activity and American Potential, Public Health Service Publication Number 1596, U.S. Government Printing Office, 1967.

Hickman, H.L., Jr., "Planning Comprehensive Solid Waste Management Systems." Journal of the Sanitary Engineering Division, American Society of Civil Engineers, Vol 94. SA6, December , 1966.

Hickman, H.L., Jr., "Solid Waste Costs $3 Billion," Wrecking and Salavge Journal, 2(1):1,6, January 1968, "Wrecking Industry Survey to Evaluate Solid Waste," Wrecking and Salvage Journal, 2(2):2, February, 1968.

Kloe, A.J. and G. A. Garland, "Decision Trees in Solid Waste Planning," Public Works, 99(7):74-77, July, 1968.

Laws of the State of Minnesota, As Amended

Laws of the State of North Dakota, As Amended

Litter Laws, Keep America Beautiful, 99 Park Avenue, New York, New York 10016.

Lonergan, R.P. and E. M. Herson, Solid Waste-A Natural Resource? Bureau of Solid Waste Management, U.S.Department of Health, Education and Welfare, 1967.

McElwee, W.C., and M.J. Wilcomb, "Some Effects of Disposable Plastic Liners on Refuse Handling Efficiency." Journal of Environmental Health 30(5):501-509, March-April, 1968.

Model Collection Contract, National Solid Wastes Management Association, 1022 15th Street, N.W., Washington, D.C. 20005

Muhich, A.J., A. J. Klee, and P.W. Britton, Preliminary Data Analysis: 1968 National Survey of Community Solid Waste Practices, Public Health Service Publication Number 1867, U.S. Government Printing Office.

Muhich, A.J., A.J. Klee, and C.R. Hampel, 1968 National Survey of Community Solid Waste Practices, Public Health Service Publication Number 1866, U.S. Government Printing Office, 1968.

Municipal Refuse Collection and Disposal, New York State Executive Department, Office for Local Government, Albany, New York.

Municipal Refuse Disposal, American Public Works Association, 1966. Price;$10.

Paper Bags for Household Refuse Handling: A Report on Four Field Trials Employing Disposable Paper Containers, Special Report Research Project Number 115, American Public Works Association, August, 1963. Price:$3.

Proceedings of the National Conference on Auto Salvage, Institute of Scrap Iron and Steel, Inc., 1964.

Proceedings of the Symposium: Mineral Waste Utilization, Bureau of Mines, U.S. Department of the Interior and IIT Research Institute, March 1968

Refuse Collection Practice, American Public Works Association, 1966. Price $10.

Refuse and Refuse Disposal, National Conference on Solid Waste Research Chicago 1963

Sanitary Landfills, American Socioty of Civil Engineers, Manual Number 39, 1959.

Sanitary Landfill, How to Construct a Sanitary Landfill Drott Mfg. Corp., Milwaukee 15, Wisconsin.

Solid Waste Demonstration Grants, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968.

Solid Waste Disposal Act, Title II of Public Law 89-272, 89th Congress S. 306, October 20, 1965, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, Reprinted 1968.

Sorg, Thomas J. and H. Lanier Hickman, Jr., Sanitary Landfill Facts, U.S. Public Health Service Solid Wastes Program Publication Number 1792, U.S. Government Printing Office, 1968. Price: $.35.

Sponagle, C.E (ed.), Summaries: Solid Wastes Demonstration Grant Projects-1968, Public Health Service Publication Number 1821, U.S. Government Printing Office, 1968.

State/Interstate Solid Waste Planning Grant Listing, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968

State Solid Waste Planning Agencies, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968.

Status of Solid Waste Management in California, California State Department of Public Health, 2151 Berkeley Way, Berkeley, California 94704, Sept. 1968.

Steiner, R. L. and R. Kantz, Sanitary Landfill: A Biblography, Public Health Service Publication Number 1819, U.S. Government Printing Office, 1968.

Vaughan, R.D. and R.J. Black, the Federal Solid Wastes Program: A Progress Report, Bureau of Solid Waste Management, U.S. Department of Health, Education and Welfare, 1968.

Weaver, L., "Refuse and Litter Control in Recreation Areas," Reprinted from Public Works, U.S. Government Printing Office, 1968.

Sociology 121

Course Outline

Textbook: Principles of Sociology (Revised Ed.)
Freedman, Hawley, Landecker, Lenski & Miner.

I. Introduction to the Field of Sociology
   A. Introduction to Sociology
      1. Study of Human Groups
      2. Pre-sociological interest
      3. Origin and development of sociology
      4. Aims, plans and cautions to beginning students

   B. Methods of acquiring sociological knowledge
      1. Man's search for knowledge
      2. Science and sociology, nature, control and problems
      3. Science and morals

II. Social Structure and Function
   A. Introduction to Human Groups
      1. Biological basis
      2. Nature of human groups
      3. Social catagories and major types of groups
      4. Formation of human groups

   B. Culture
      1. Nature of culture
      2. Problems of cultural differences
      3. Biology and culture
      4. Culture traits

   C. Normative integration
      1. Social norms and integration
      2. Multiple group structure
      3. Convergence of roles
      4. Inconsistencies between law and mores

   D. Functional integration
      1. Definition and position
      2. Basis of functional integration
      3. Coordination, norms and requisites of functional integration

   E. Social stratification
      1. Rank and class systems
      2. Cultural differentiation in class systems
      3. Cultural devices
      4. Stratification and societal integration

III. Social Change and Urbanization
   A. Folk, fedual and urban societies
      1. Characteristics
      2. Economic and technological implications
      3. Feudal society
      4. Urban society

B. Social Change
   1. Basic concepts
   2. Changes in social and physical environment
   3. Internal factors affecting change
   4. The growth of cultural complexity

C. Development of Urban Societies
   1. Comparison of urban and feudal
   2. The emergence of Urban Societies
      a. Population redistribution
      b. Cities, growth and patterns
   3. Diffusion of urban patterns of organization

IV. Structure and Functions in Urban Societies
A. Functional Integration in Urban Societies
   1. Types of specialization
   2. Occupational structure
   3. Problems of integration

B. Normative Integration in Urban Societies
   1. Aspects of urbanism
   2. Social relationships
   3. Deviant behavior
   4. Integrating forces

C. Stratification in Urban Societies
   1. Class crystallization and social change
   2. Vertical mobility
      a. Factors
      b. Effects
      c. Class conflict

D. Social Planning in Urban Societies
   1. Influencing factors
   2. Theories
   3 Social Science and social planning

Required readings are used, basically those included in the test. A very wide range of class discussion, appropriate to the central theme, is used depending upon class size.

1. Types of metes and bounds conveyances
    a. Successive bounds
    b. Strip conveyances and stationing
    c. Conveyance by division line
    d. Conveyance by distance
    e. Conveyance by proportion
    f. Conveyance by exception
    g. Conveyance by acreage
    h. "Of" descriptions

D. Nomenclature and Units Used in Metes and Bounds Descriptions
    1. Monuments and their properties
    2. Straight lines and bearings
        a. Deflection angles and azimuths
        b. Coordinates
            (1) Lambert and mercator grids
    3. Tax deeds
        a. Discussion of land descriptions used in tax deeds
    4. Subdivisions
        a. Description and definition
        b. Federal government subdivisions
        c. Private subdivisions

E. Sectionalized Lands
    1. Summary of present procedure
    2. Principal meridian, base line, standard parallel, guide meridians
    3. Subdivision of townships
    4. Resurveys
    5. Nomenclature for sections

F. Subdivision Systems Under State Laws
    1. General discussion - maps
    2. Minimum requirements

Division II - Transfer of Real Property — 6 periods

A. Real Property Defined
    1. Real property interests
        a. Historical background
    2. Classification of real property interests
        a. Freeholds or fees
        b. Life estates
        c. Leases
        d. Future interest
        e. Estates by severalty and joint estates

B. Written Transfers of Real Property
    1. Transfers in general
        a. Historical background
    2. General requirements of conveyances

NORTH DAKOTA STATE SCHOOL OF SCIENCE
Wahpeton, North Dakota

CIVIL ENGINEERING TECHNOLOGY

Subject: Surveying VI (CT 223)

Objective:

This course is designed to provide the student with skills and knowledge necessary to become a registered land surveyor.

The student will acquire knowledge in the legal aspects of land transfer.

The student will acquire the knowledge of the sectionalized land system of the United States, location of riparian and refersion rights, Federal mining claims, and the rights, responsibilities and duties of a surveyor.

Description:

A study of the laws and systems of land and subdivisions, including; filing and recording deeds; U.S. Coast and Geodetic plane coordinate systems; county and state laws; city surveying procedures; and writing land descriptions.

MAJOR DIVISIONS		CLASS PERIODS
I.	Systems Used to Describe Property	8
II.	Transfer of Real Property	6
III.	Locating Metes and Bounds Conveyances	11
IV.	Locating Subdivisions and Conveyances Lacking Senior Rights	9
V.	The Sectionalized Land System	7
VI.	Locating Reversion Rights	3
VII.	Riparian and Littoran Owners	5
VIII.	Federal Mining Claims	2
IX.	The Surveyor and His Duties	3
X.	Writing Deeds	3
XI.	Glossary of Deed Terms	3
	Total	60

Division I - Systems Used to Describe Property 8 periods

A. General Discussion

B. Control of Location by Monuments

C. Metes and Bounds Descriptions

a. Conveyances defined
b. Deeds - requirements
(1) Parties
(2) After rights
(3) Subject matter
(4) Consideration
(5) In writing
(6) Legal words
(7) Opportunity to read
(8) Execution and delivery

3. Executory contracts
4. Wills

C. Transfers Not in Writing
1. Unwritten conveyances
2. Dedication to public use
a. Statutory dedication
b. Common law dedication
c. Acceptance of dedication
d. Boundary line establishment
3. Adverse possession
a. Requirements
(1) Actual possession
(2) Open and notorious
(3) Continuous
(4) Exclusive
(5) Hostile
b. Boundaries of land adversely possessed

Division III - Locating Metes and Bounds Conveyances 11 periods

A. Statute and Common Law
1. Presumptions at law

B. Definition of Metes and Bounds Description

C. Deeds Must be in Writing and Deemed to be the Whole
1. Terms of the deed
2. Call for a plat
3. Informative and controlling terms

D. Order of Importance of Conflicting Elements
1. Junior and senior rights
2. Intentions of the parties to the deed
3. Aids to interpret the intent of a deed
4. Lines marked and surveyed
5. Control of monuments
a. Control between conflicting monuments
b. Importance of the word "to"
c. Control of distance and bearings
6. Coordinates
7. Area or surface
8. Point of beginning

9. Errors and ambiguous terms
10. Error of closure and direction of the survey
11. Treatment of curves
12. Basis of bearings

E. "Of" Descriptions

F. Overlaps and Gaps

G. Roads as Boundaries and Road Descriptions
1. Road descriptions - strip conveyances
2. Easements

Division IV - Locating Subdivisions and Conveyances Lacking Senior Rights — 9 periods

A. Subdivisions
1. Establishment of boundaries and corners
2. Control of conflicting elements within a subdivision
a. Permanence of lines
b. Control of original monuments
c. Title monuments
d. Identification of monuments
e. Distance, direction, and area
(1) The apportionment principle
(2) Proportionate measure
3. Establishment of streets of block corners
a. By natural monuments
b. By artifical monuments
c. By improvements
d. By the line of a nearby street
e. By plat
f. By city engineer's monuments
4. Establishment of lots within subdivisions
a. Effect of mathematical error
b. Single proportionate measure
c. Distribution of excess and deficiency beyond a monument
5. Establishing lots adjoining subdivision boundaries
6. Proceedings in partition
7. Wills
8. Simultaneous description

Division V - The Sectionalized Land System — 7 periods

A. Legal Principles of Retracements
1. General
2. Conflict between Federal and State laws
3. Proportionate measure
a. Single
b. Double
4. Importance of one line over another

5. Original field notes
6. Closing corners

B. Identification of Corners and Lines
1. Definitions
2. Monuments - identification
3. Map or plat reference by others
4. Testimony of old residents
5. Common usage

C. Restoration of Lost Corners
1. Lost standard corners on standard parallels, correction lines, and base lines
2. Lost township corners on principal meridians and guide meridians
3. Lost corners along township lines
4. Lost meander lines - riparian and nonriparian

D. Subdivision of Sections
1. By protraction
2. Establishment of center lines and center quarter corners
3. Establishment of quarter-quarter section lines and corners
4. Centerline of fractional sections
5. Procedure for retracement surveys

Division VI - Locating Reversion Rights — 3 periods

A. Reversionary Rights
1. Revival of public easements
2. Private rights in easements
3. Ownership of the bed of streets
4. Division of private ownership in streets

B. Apportionment of Reversion Rights
1. Reversion rights of a lot on a curved street
2. Lots at an intersection
3. Lots adjoining a subdivision boundary
4. Lots at an angle point in a road
5. Indeterminate cases
6. Exception and discussion of the rules of apportionment

Division VII - Riparian and Littoral Owners — 5 periods

A. Riparian Rights
1. Definition of terms
a. Riparian and littoral owners
b. Navigable waters
c. Accretion and alluvion
d. Refulsion or avulsion
e. Reliction

f. Thread of a river
g. Bed of a river
h. Meander line

2. Ownership of the bed of fresh water and tide lands
   a. Control of navigation
3. Ownership of land built up by accretion
4. Ownership of land lost by erosion and inundation
5. Ownership of land removed by revulsion
6. Ownership of salt water tidelands
7. Methods of determining ownership of land exposed or built up by reliction or accretion
8. Ownership between states
9. Ownership of islands
10. Interpretation of deeds with respect to ownership of the bed of waters

Division VIII - Federal Mining Claims — 2 periods

A. Definition of a Federal Mining Claim
   1. Land open to appropriation of minerals

B. Veins, Lodes, or Ledges

C. Extralateral or Intralimital Rights

D. Placer Claims, Mills Sites, and Tunnel Locations

E. Size of Claims

F. Procedure for Establishing a Claim
   1. Discovery
   2. Location
   3. Possession

G. Requirements for a Patent

H. United States Mineral Surveyors
   1. Survey of the claim

Division IX - The Surveyor and His Duties — 3 periods

A. Purpose of a Boundary Survey

B. The Land Surveyor
   1. Duties of the land surveyor
   2. Title by possession
   3. Liability of surveyors

C. Question of Law and Facts
   1. The expert witness
   2. Evidence and monuments

D. Initial Steps in Making a Survey

1. Research
2. Legal description
3. Tie-in's
4. Basis of bearing
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6. Oats and parole evidence

E. Quasi-Judicial Functions of Surveyors

Division X - Writing Deeds 3 periods

A. Purpose of a Deed Description
   1. Intent and its Importance
   2. Title identity
   3. Location
   4. Geometric shape and size

B. The Scrivener and His Duties

C. Terms of A Deed
   1. The body of a deed
   2. Qualifying clauses
   3. Basis of bearings
   4. Brevity
   5. Directional calls
   6. Order of importance of conflicting terms
   7. Closing terms
   8. Changing the form of a deed

Division XI - Glossary of Deed Terms 3 periods

TEXT AND REFERENCES

Brown, Curtis M., Boundary Control and Legal Principles, New York: John Wiley & Sons, Inc.