



Republic of the Philippines  
OFFICE OF THE PRESIDENT  
COMMISSION ON HIGHER EDUCATION

CHED MEMORANDUM ORDER

No. 35

SERIES OF 2005

**SUBJECT: MINIMUM POLICIES AND STANDARDS FOR BACHELOR OF  
SCIENCE IN ENVIRONMENTAL SCIENCE (BS ES)**

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In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the "Higher Education Act of 1994," and for the purpose of rationalizing the Bachelor of Science in Environmental Science, the following policies shall be hereby adopted and promulgated by the Commission.

**Article I. Introduction**

**Section 1** One of the most important concerns of the 21<sup>st</sup> century is the environment. The scale and nature of human activities have so degraded the environment that it has become a threat to human society. These concerns have brought out the need for individuals with training on the environment.

Environmental science seeks to study the environment and the impact of human society on it using the tools of science in an interdisciplinary way. There are three characteristics of environmental science. First, its primary objective is to use the various sciences in the study of the environment. Second, it is based in the sciences but its approach is interdisciplinary. Thus, it employs the scientific method as its principal framework, and applies whichever science is needed to the study of the environment. Third, it also recognizes the very important role that human society has in the environment. Environmental science, therefore, is a vital tool in laying down the groundwork for the effective management of the environment.

**Section 2** These policies and standards aim to define the Bachelor of Science in Environmental Science program. It intends to standardize the classification of the program, and systematize the procedures in the evaluation of permits and recognition, and the monitoring of the programs offered in higher education institutions (HEIs).

**Article II. Authority to Operate**

**Section 3** All private higher education institutions (PHEIs) intending to offer the **Bachelor of Science in Environmental Science** must

first secure the proper authority from the Commission in accordance with existing rules and regulations. State universities and colleges (SUCs), and local colleges and universities should likewise strictly adhere to the provisions in this policies and standards.

### Article III. Program Specifications

#### Section 4 Degree Name

The program herein shall be called Bachelor of Science in Environmental Science (BS ES).

#### Section 5 Program Description

##### a) Nature of the Program

The Bachelor of Science in Environmental Science is based on the major disciplines of science, such as biology, chemistry, physics, earth and marine sciences, and mathematics. In addition, the BS ES program includes training in the social sciences in order that its graduates will be equipped to understand the important role of ethics, society and culture in the environment.

##### b) Objectives

The program aims to expose students in an integrated way to environmental processes and phenomena, as well as environmental issues, from the perspective of the natural sciences. It aims to train them to recognize and understand the natural environment, how humans affect the environment, and how the environment impacts on society.

The BS ES graduates should be: 1) equipped with sufficient knowledge on the scientific theories and techniques needed to monitor and understand environmental quality; 2) able to integrate and apply the various disciplines towards the understanding of environmental problems; 3) knowledgeable regarding relevant local, regional and global environmental issues; and 4) able to employ a rational structured approach to solving environmental problems.

##### c) Careers, occupations or trades that the graduates of the BS ES program may enter

Graduates of BS ES program can be employed at the entry-level of science positions. They can engage in work related to air and water quality management, energy and resource management, planning and design, waste management and environmental assessment. In particular they can work as environmental impact assessors, environmental officers, conservation and resource management staff, project planning and assessment and program/project/technical personnel in private companies, non-

government organizations and government agencies. BS ES graduates are also encouraged to pursue graduate education for further specialization.

### **Section 6 Allied Fields and Programs**

The Bachelor of Science in Environmental Science, being a multidisciplinary field, is allied to a number of programs across different disciplines. Specifically, BS ES is closely allied to the biological sciences, earth sciences, and physical sciences. It also relates with mathematics, particularly in modeling and statistics.

It is also allied to fields in agriculture, fisheries, forestry, energy and resource management, information systems, environmental design and planning, and environmental engineering and sanitation. It is distinct from programs in environmental studies (social science-based), environmental management and environmental education.

## **Article IV. Competency Standards**

### **Section 7 Graduates of BS Environmental Science must**

- have the basic skills in biology, chemistry, physics, earth science and mathematics, and must be able to apply these in an integrated way in the analysis of an environmental problem.
- have an understanding of the basic concepts of biology and ecology, qualitative and quantitative chemical analysis, energy and thermodynamics, earth science, mathematics and statistics.
- they must have adequate technical writing and oral communication abilities.

## **Article V. Curriculum**

### **Section 8 Curriculum Description**

Although the BS ES curriculum uses a generalist approach in science, the environmental concepts and tools should be emphasized in the courses. The curriculum should also include subjects which cover ethical, social and legal aspects of the environment.

The curriculum is divided into four sections: General Education (GE), Core Sciences (CS), Environmental Science (ES), and Environmental Studies /Environmental Management (ES/EM). The GE is based on CHED Memorandum No. 4 series of 1997, and has a minimum of fifty-one (51) units.

The Core Science (CS) component has a minimum of forty-six (46) units. It is made up of courses in biology, chemistry, mathematics and physics. Since BS ES is a science program the lecture courses

under CS component must be offered with laboratory courses. The core science disciplines must include these courses:

- **Biology:** Biology I and II, and Ecology
- **Chemistry:** General Chemistry I and II, and Analytical Chemistry
- **Earth science:** Basic Earth Science
- **Mathematics:** Algebra, Trigonometry, Calculus and Statistics
- **Physics:** General Physics (Mechanics)

For Biology, it is recommended that HEIs offer the combined general biology course instead of offering separate zoology and botany courses.

For the basic Earth Science course, it is suggested that this course focus on the fundamentals of land-water-air interactions.

The Environmental Science (ES) component should include higher-level courses in the sciences and mathematics where the CS courses function as their pre-requisites. It should have a minimum of 20 units. However, the number of ES courses should be augmented by the six units of natural sciences under the GE. It is suggested that these be devoted to ES courses instead of being utilized as lower division courses in the early part of the curriculum.

There is a wide range of courses that can be offered under the ES component. The HEIs may choose the ES courses based on the available faculty and facilities, and the selected area of concentration. Course offerings may be based on specific themes such as those in the areas of agriculture, fisheries, analytical sciences, systematics and biodiversity, atmospheric sciences, geophysical sciences, aquatic studies (freshwater, marine, estuarine), and computers (modeling and bioinformatics). The ES course component should include a 5-unit integrative course on Environmental Monitoring (lecture and laboratory).

The minimum number of units for the Environmental Studies (ES) and Environmental Management (EM) course components is twelve (12). ES courses include those topics in the social sciences (such as population and demography), ethics, business, economics, law and policy, advocacy and communication, education, and entrepreneurship. EM courses, on the other hand, may include topics in management, planning and administration.

The Environmental Impact Assessment (EIA) System is one of the most important tools where environmental considerations are integrated into the planning of projects that may affect the environment. This integrative course seeks to study the application of the natural sciences, social sciences and humanities in development projects.

**Section 9 Curriculum outline (138 Units)**

<b>Component</b>	<b>Units</b>
a) General Education*	39
b) Core Science	52
Biology	15
Chemistry	15
Earth Science	5
Mathematics	12 (6)
Physics	5
c) Environmental Science with Environmental Monitoring (lec/lab) as a required course	26 (6)
d) Environmental Studies/ Environmental Management	12
e) The EIA System	3
f) Thesis or Special Project + OJT	6
<b>Total Minimum Units</b>	<b>138</b>

\*Note: The 51-unit GE requirement is met by adding the 12 units of natural science and mathematics distributed in the core science and environmental science components (italicized and in parenthesis in the above outline).

**Section 10 Requirements for Thesis or Special Project + On-the-Job-Training**

HEIs shall have the prerogative to choose a mode of implementing this requirement based on the available resources within the institution and opportunities for collaboration with suitable outside organizations. (Thesis = 6 units; Special Project = 3 units + OJT or practicum = 3 units)

**Section 11 Sample program of study**

<b>FIRST YEAR</b>			
<b>First Semester</b>			
<b>Descriptive Title</b>	<b>Lecture</b>	<b>Laboratory</b>	<b>Total Units</b>
General Chemistry I	3	2	5
GE Math 1	3		3
*GE course 1	3		3
*GE course 2	3		3
*GE course 3	3		3
PE I		(2)	(2)
NSTP I		(3)	(3)
<b>Total</b>	<b>15</b>	<b>2</b>	<b>17</b>

<b>Second Semester</b>			
Descriptive Title	Lecture	Laboratory	Total Units
General Chemistry II	3	2	5
GE Math 2	3		3
*GE course 4	3		3
*GE course 5	3		3
*GE course 6	3		3
PE II		(2)	(2)
NSTP II		(3)	(3)
Total	<b>15</b>	<b>2</b>	<b>17</b>

**SECOND YEAR**

<b>First Semester</b>			
Descriptive Title	Lecture	Laboratory	Total Units
Analytical Chemistry	3	2	5
Calculus	3		3
*GE course 7	3		3
*GE course 8	3		3
*GE course 9	3		3
PE III		(2)	(2)
Total	<b>15</b>	<b>2</b>	<b>17</b>

**Second Semester**

Descriptive Title	Lecture	Laboratory	Total Units
General Biology I	3	2	5
Statistics	2	1	3
*GE course 10	3		3
*GE course 11	3		3
*GE course 12	3		3
GE Information Technology	2	1	3
PE IV		(2)	(2)
Total	<b>16</b>	<b>4</b>	<b>20</b>

**THIRD YEAR****First Semester**

Descriptive Title	Lecture	Laboratory	Total Units
General Biology II	3	2	5
Mechanics and Thermodynamics	3	2	5
Environmental Science course I	2	1	3
GE Science 1	3		3
Total	<b>11</b>	<b>5</b>	<b>16</b>

<b>Second Semester</b>			
Descriptive Title	Lecture	Laboratory	Total Units
Ecology	3	2	5
Earth Science	3	2	5
GE Science 2	3		3
Environmental Studies/ Management courses I	3		3
Environmental Studies/ Management courses II	3		3
<b>Total</b>	<b>15</b>	<b>4</b>	<b>19</b>

<b>FOURTH YEAR</b>			
<b>First Semester</b>			
Descriptive Title	Lecture	Laboratory	Total Units
Environmental Science course II	3		3
Environmental Science course III	3		3
Environmental Studies/ Environmental Management III	3		3
Environmental Studies/ Environmental Management IV	3		3
Thesis I/ Special project or OJT		3	3
<b>Total</b>	<b>12</b>		<b>15</b>

<b>Second Semester</b>			
Descriptive Title	Lecture	Laboratory	Total Units
Environmental Monitoring	3	2	5
Environmental Science course IV	3		3
Environmental Science courses V	3		3
The EIA System	3		3
Thesis II/Special Project or OJT		3	3
<b>Total</b>	<b>12</b>	<b>5</b>	<b>17</b>

**Grand Total: 138**

\*GE courses in the Languages, Humanities, Social Sciences, and Life and Works of Rizal.

## Article VI. Course Specifications

### Section 12

#### A. BIOLOGY COURSES

##### COURSE NAME. GENERAL BIOLOGY I, LECTURE AND LABORATORY

**COURSE DESCRIPTION.** Logic, nature, methods, concepts and principles of biology with emphasis on the molecular, cellular and organismic levels of organization.

**NUMBER OF UNITS.** 5 (3 lecture/2 laboratory)

**PREREQUISITES.** General Chemistry

##### **COURSE OUTLINE**

###### **Lecture**

- I. Introduction
  - A. Scientific Method
  - B. Concepts of Life
  - C. Brief History of Biology
- II. Cellular Structures: Molecules and Organization
  - A. Cell Theory: Its origin, meaning and implications
  - B. General Attributes of the Cell
  - C. Prokaryotic and Eukaryotic Cells
  - D. Organelles and Processes
    1. Cell Membrane: Transport
    2. Cytoplasmic Matrix and Vacuolar System
    3. Chloroplast: Photosynthesis
    4. Mitochondria: Respiration
    5. Nucleus: Control of the Cell Cycle
- III. Differentiation and Development
  - A. Molecular Basis of Differentiation
  - B. Cellular Basis of Differentiation
- IV. Plants: Form and Function
  - A. Plant Cell Types and Tissues
  - B. Plant Organs and Processes
    1. Nutrition
    2. Transport
- V. Animals: Form and Function
  - A. Animal Cell Types and Tissues
  - B. Animal Systems and Processes
    1. Support and Protection
    2. Movement
    3. Digestion and Nutrition



4. Gas Exchange
5. Transport/Circulation
6. Excretion and Osmoregulation
7. Regulatory Mechanism

**Laboratory**

- I. Microscopy
- II. The Cell Organelles and Processes
- III. Energy-Matter Interconversion Reactions
  - A. Photosynthesis
  - B. Respiration
- IV. Cell Division: Mitosis
- V. Plant Cell Types and Tissues
- VI. Plant Processes
  - A. Absorption
  - B. Transport and Nutrition
  - C. Transpiration and Guttation
- VII. Animal Cell Types, Tissues and Organs
- VIII. Animal Forms and Function
  - A. Support and Movement
  - B. Nutrition and Transport
  - C. Coordination and Control

**COURSE NAME. GENERAL BIOLOGY II, LECTURE AND LABORATORY**

**COURSE DESCRIPTION.** Continuation of General Biology I with concentration on reproductive biology, developmental biology, genetics, evolution, taxonomy and ecology

**NUMBER OF UNITS.** 5 (3 lecture/2laboratory)

**PREREQUISITES:** General Biology I

**COURSE OUTLINE****Lecture**

- I. Introduction
- II. Plant Reproductive Biology
  - A. Thallophytes
  - B. Embryophytes
- III. Plant Development Biology
  - A. Morphogenesis
  - B. Growth and Development
- IV. Animal Reproductive Biology
  - A. Invertebrates
  - B. Vertebrates
- V. Animal Development Biology
  - A. Fertilization
  - B. Cleavage and Early Development
  - C. Organogenesis
  - D. Differentiation
- VI. Taxonomy/Systematics
  - A. Concepts

- B. Plant Diversity
- C. Animal Diversity
- VII. Genetics
  - A. Areas and Methods in Genetics Studies
  - B. Cytological and Mathematical Basis of Inheritance
  - C. Mendelian and Non-Mendelian Modes of Inheritance
- VIII. Evolution
  - A. Concepts and Significance
  - B. Processes, Evidences and Issues
- IX. Ecology
  - A. Ecosystem Concept
  - B. Major Ecosystems
  - C. Human Ecology and Environmental Issues

### **Laboratory**

- I. Reproductive Patters in Plants
- II. Gametogenesis and Fertilization in Angiosperms
- III. Plant Growth and Development
  - A. Seed Germination
  - B. Distribution of Growth
  - C. Factors Affecting Seeding Development
  - D. Tropisms
  - E. Growth movements
  - F. Abscission
- IV. Reproductive Patterns in Animals
- V. Gametogenesis in Frogs
- VI. Development of a Frog
  - A. Early Development
  - B. 7-mm Frog Embryo
- VII. Plant and Animal Diversity
- VIII. Genetics
  - A. Types of Variation
  - B. Probability
  - C. Pedigree Study
  - D. Problem Solving
- IX. Ecology
  - A. Animal Associations/Succession (Hay Infusion)
  - B. Plant Associations
  - C. Special Studies in Ecology

### **LABORATORY EQUIPMENT AND FACILITIES**

The laboratory facilities shall provide the proper atmosphere for long hours of laboratory work such as adequate space, ventilation, lighting and safety measures.

- A. Basic glassware and supplies for experiments

- B. Basic Equipment: Compound microscopes (with histological slides), one per student  
 Balance, one unit per lab  
 Oven, one unit per lab  
 Stove, one unit per lab  
 Refrigerator, one unit per lab  
 Dissecting/Binocular Microscopes, one unit per group of 5-6 students
- C. Optional Equipment: Television and VCR, one unit  
 Overhead projector (slide and transparency), one unit

### TEXTS AND REFERENCES.

Suggested References (dated not earlier than 1985)

1. Audrisk, G. and T. Audrisk. *Biology. Life on Earth*. 3<sup>rd</sup> ed or latest edition. McMillan Publishing Co.
2. Campbell, N.A. *Biology*. 4<sup>th</sup> Ed or latest edition. The Benjamin Cummings Publishing Co., Inc.
3. Hickman, C.P. Sr., C.P. Hickman, Jr. and F.M. Hickman. *Integrated Principles of Zoology*. C.V. Mosby Co. Latest edition
4. Kimball, J.W. *Biology*. Wm. C. Brown Communications, Inc. 6<sup>th</sup> ed or latest edition.
5. Mauseth, J.D. *Botany: An Introduction to Plant Biology*. Saunders College Publishing Co. 2<sup>nd</sup> ed or latest edition.
6. Miller, S.A. and J.P. Harley. *Zoology*. McGraw-Hill Book Co. Latest edition
7. Morgan, J.G. and R.F. Evert and S.E. Eichorn. *Biology of Plants*. Worth Publishers, New York. Latest edition
8. Raven, P.H., R.F. Evert and S.E. Eichhorn. *Biology of Plants*. Worth Publishers, N.Y. Latest edition
9. Starr, C. and R. Taggart. *Biology. The Unity and Diversity of Life*. Wadsworth Publishing Co. 4<sup>th</sup> or latest ed.

### COURSE NAME. GENERAL ECOLOGY, LECTURE

**COURSE DESCRIPTION.** General Ecology lecture is 3-unit introductory course on the biology and properties of ecological systems. It consists of three lecture hours per week on the general concepts and principles pertaining to the complex pattern of interactions between the physical environment and the communities on Earth. Emphasis is given on the current issues, especially in the Philippine context.

**NUMBER OF UNITS.** 3

**PREREQUISITE.** General Biology 1 and 2 or General Zoology and General Botany: 10 units (lecture and lab)  
 Analytical Chemistry  
 Statistics

**COURSE OBJECTIVES**

At the end of the term, the student should be able to:

1. Articulate the general concepts and principles of ecology; and
2. Integrate ecological concepts and principles to current environmental issues and practice.

Values Aims:

1. To increase the student's awareness of his role in nature;
2. To help the student realize our special power to alter the biosphere and special responsibility for its health; and
3. To help the student develop respect and nurturing of Mother Nature.

**COURSE OUTLINE**

- |  |           |
|--|-----------|
| I. Introductions                                   | Week 1-2  |
| A. Definitions                                     |           |
| B. Why and How to Study Ecology                    |           |
| C. Scientific Method                               |           |
| D. The Effects of Scale                            |           |
| E. Evolutionary Ecology                            |           |
| How Variation Originates                           |           |
| How Variation is Maintained                        |           |
| How Much Variation Exists in Nature                |           |
| Reduction in Variation                             |           |
| II. Natural Selection and Speciation               | Week 3    |
| A. Phylogenetics                                   |           |
| B. The Fossil Record                               |           |
| C. Extinction: Causes and Patterns                 |           |
| III. Behavioral Ecology                            | Week 4-5  |
| A. Group Selection                                 |           |
| B. Altruism  |           |
| C. Living in Groups                                |           |
| D. Resource Assessment                             |           |
| E. Animal Communication                            |           |
| F. Foraging Behavior and Optimality in Individuals |           |
| G. Maintenance of Sex Ratios                       |           |
| H. Sexual Selection                                |           |
| Polygyny   |           |
| Polyandry  |           |
| IV. Population Ecology                             | Week 6-8  |
| A. Physiological Ecology                           |           |
| B. Abiotic Factors                                 |           |
| C. Population Growth                               |           |
| D. Mutualism and Commensalism                      |           |
| E. Competition                                     |           |
| F. Predation                                       |           |
| G. Herbivory and Parasitism                        |           |
| H. Causes of Population Change                     |           |
| V. Community Ecology                               | Week 9-11 |
| A. Species Diversity and Community Stability       |           |
| B. Island Biogeography                             |           |

- C. Community Change
- D. Ecosystems (Main types of Communities)
- VI. Applied Ecology Week 12-15
  - A. The Effects of Humans
  - B. Human Population Growth
  - C. Loss of Wildlife through Human Activity
  - D. How to Solve Ecological Problems
  - E. Patterns of Resource Use
    - Water Catchment Areas
    - Forestry
    - Agricultural Land
    - The Sea
  - F. Waste and Pollution
    - Wastes Emitted in the Atmosphere
    - Economic Poisons
    - Contamination by Organic Substances
    - Eutrophication
- VII. Introduction of Exotic Species, Epilogue Week 16

**COURSE NAME. GENERAL ECOLOGY, LABORATORY**

**NUMBER OF UNITS. 2**

**PREREQUISITE.** Same as lecture. Should be taken concurrently with the lecture portion.

**COURSE DESCRIPTION.** General Ecology laboratory is 2-unit introductory course on the biology of the ecosystems. It consists of 6 laboratory hours per week dealing with the basic principles and methodologies pertaining to population and community structure and the assessment of environmental quality.

**COURSE OBJECTIVES**

At the term, the student should have familiarized themselves with the basic ecological laboratory procedures and be able to apply such in a real ecosystem setting.

Value Aims:

1. To increase the student's awareness of the place of humans in nature;
2. To help the student realize our special power to alter the biosphere and special responsibility for its health; and
3. To help the student develop respect and nurturing of Mother Nature.

**COURSE OUTLINE**

- I. Assessment of the Aquatic Environment Week 1-5
  - A. Physical Characteristics of Water
    - Temperature
    - Depth
    - Suspended solids

- Color
- Transparency
- B. Chemical Characteristics of Water
  - pH
  - Dissolved Oxygen
  - Hardness
  - Alkalinity
  - Acidity
  - Salinity
  - Conductivity
  - Nitrate content
  - Orthophosphate content
  - Silicate content
- C. Biological Characteristics
  1. Primary Productivity Studies
    - Plankton Productivity Estimation
    - Chlorophyll Analysis
    - Light and Dark Bottles Technique
  2. Population and Community Structure Studies/Plankton Cell Count using the Sedgwick Rafter method or the haemocytometer method
- II. Assessment of the Terrestrial Environment Week 6-10
  - A. Climatological Measurements
    - Light Intensity
    - Wind Velocity
    - Atmospheric Pressure
    - Air Temperature
  - B. Physical Properties of the Soil
    - Soil Temperature
    - Soil Texture
    - Composition
  - C. Chemical Properties of the Soil
    - pH
    - N, P, Ca and humus content
  - D. Biological Properties
    1. Primary Productivity Studies
      - Macrophyte Productivity Estimate and Harvest
    2. Population and Community Structure
      - Plant Population Studies (line intercept, transect and point quarter methods)
- III. Field Study Week 11-13
- IV. Biodiversity Studies Week 14-15
- V. Tolerance to Environmental Factors Week 16

**LABORATORY EQUIPMENT AND FACILITIES****A. Basic glassware for experiments****B. Equipment:**

## 1. Required

- |                               |                               |  |
|-------------------------------|-------------------------------|--|
| 1. sling psychrometer         | 9. plankton net               | 17. transect line (50 m)                             |
| 2. secchi disc                | 10. sieves                    | 18. spectrophotometer                                |
| 3. thermometer (soil and air) | 11. salinometer/refractometer | 19. light meter – LICOR                              |
| 4. furnace                    | 12. dessicators               | 20. quadrats (0.25m <sup>2</sup> & 1m <sup>2</sup> ) |
| 5. wind meter                 | 13. centrifuge                | 21. vacuum pump                                      |
| 6. oven/incubator             | 14. refrigerator              | 22. barometer  |
| 7. weighing scale             | 15. compass                   | 23. BOD bottles/burettes, pipettes, flask            |
| 8. pH meter/pH paper          | 16. dissecting microscope     |  |

## 2. Desired

- |   |                      |
|---|----------------------|
| 1. DO meter (digital) & accessories (O <sub>2</sub> probe & mechanical stirrer) | 3. mechanical shaker |
| 2. sediment sampler   | 4. water sampler     |

**C. Desired Chemicals and Supplies:**

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| 1. ascorbic acid                      | 17. sodium hydroxide               |
| 2. acetone                            | 18. phenolphthaline indicator      |
| 3. ammonium molybdate tetrahydrate    | 19. potassium dihydrogen phosphate |
| 4. antimony potassium tartrate        | 20. sulfanilamide                  |
| 5. 1-amino-2 naphthol-4 sulfuric acid | 21. borax                          |
| 6. EDTA                               | 22. potassium nitrate              |
| 7. EBT-powder                         | 23. ammonium chloride              |
| 8. methyl orange                      | 24. N-1 naphthyl ethylene-diamine  |
| 9. hydrochloric acid                  | 25. sodium sulfite                 |
| 10. sodium thiosulfate                | 26. spongy cadmium                 |
| 11. sulfuric acid                     | 27. cadmium sulfate                |
| 12. manganous sulfate                 | 28. tartaric acid                  |
| 13. ammonium hydroxide                | 29. starch                         |
| 14. potassium iodide                  | 30. formalin                       |
| 15. sodium iodide                     | 31. silica                         |
| 16. potassium hydroxide               | 32. GF/C Filter Paper              |

**TEXTS/REFERENCES**

## Suggested references

1. Begon, M., Harper, J.L. and C.R. Townsend. *Ecology: Individuals, Populations and Communities*. Blackwell. 3<sup>rd</sup> ed. or latest edition.
2. Brewer, R. *The Science of Ecology*. Saunders College. 2<sup>nd</sup> ed. or latest edition.
3. Bush, M.B. *Ecology of A Changing Planet*. Prentice Hall. Latest edition.
4. Caldsa, M.P., Cervencia, C.R., Cuevas, V.C. and Z.N.Sierra. *Laboratory Guide in Ecology*. UPLB Pub. Center. 2<sup>nd</sup> ed. or latest edition.
5. Colinvaux, P. *Ecology 2*. John Wiley and Sons Inc. Latest edition.
6. Jackson, A.R.W. and J.M. Jackson. *Environmental Science*. Longman. Latest edition.
7. Kupchella, C.E. *Environmental Science: Living Within the System of Nature*. Prentice Hall. 3<sup>rd</sup> ed. or latest edition.
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9. Miller, G.T., Jr. *Living in the Environment. Principles, Connections and Solutions*. Wadsworth Pub. Co. Latest edition
10. Miller, G.T. Jr. *Environmental Science*. Prentice Hall. 6<sup>th</sup> ed. or latest edition.
11. Nebel, J.B. and R.TR. Wright. *Environmental Science. The Way the World Works*. Prentice Hall. 6<sup>th</sup> ed. or latest edition.
12. Odum, E.P. *Fundamentals of Ecology*. Saunders. 3<sup>rd</sup> ed. or latest edition
13. Stilling, P.D. *Ecology. Theories and Applications*. Prentice Hall. 2<sup>nd</sup> ed. or latest
14. Smith, R.L. *Ecology and Field Biology*. Harper Row. 2<sup>nd</sup> ed. or latest edition
15. Umaly, R. and M.L.V. Cuvin. *Limnology Laboratory and Field Guide. Physico-chemical Factors. Biological Factors*. National Bookstore. Latest edition

**B. CHEMISTRY COURSES****GENERAL CHEMISTRY  
INTRODUCTION**

The two General Chemistry courses introduce students to tertiary level chemistry. It is recommended that general chemistry courses, particularly the lecture part, be handled by a senior staff whose broader experience in the area would enable him/her to present the chemistry as an interesting and relevant area of study. If junior staff handles laboratory classes, there should be close coordination between lectures and laboratory instructors.



The objectives of the General Chemistry courses are as follows:

- (a) *To make students conscious of the reality of chemistry in everyday life. The course should aim to promote and sustain interest and consequently motivate students in the study of chemistry. Use of examples and applications in the Philippine context is encouraged so that students may envision their future roles as chemists in the country.*
- (b) *To provide the theoretical background and skills necessary to prepare the students for the upper level courses. The higher-level courses are built on the basic concepts, theories and skills learned in this course.*
- (c) *To impress upon the students that chemistry is an experimental science. Experimental evidence is the basis for formulating generalizations and theories as well as illustrating concepts and principles.*
- (d) *To lead students to appreciate the relationship of chemistry to other fields of science and technology, as well to society, the economy, and the environment. Chemistry is not an isolated field of study and its applications and growth are linked to developments in other areas of study.*
- (e) *To enable students to appreciate the work of chemists, past and present, in the context of the social milieu. The work of chemists affects and is affected by the society in which they live. Students should appreciate their future role in the development of society.*

**COURSE NAME. GENERAL CHEMISTRY I and II, LECTURE**

**NUMBER OF UNITS.** General Chemistry I: 3  
General Chemistry II: 3

**PREREQUISITES.** None

**COURSE OUTLINE.**

The lecturer may opt to cover the topics in a different order. What is presented below is a list of topics rather than a suggested sequence. Because students will be starting with different backgrounds, no time allocation is indicated so that the lecturer can adjust the pace of the course depending on the needs of the students.

**I. Structure and properties of Matter**

The atomic theory

Atomic structure

The periodic table/periodicity of properties

Electronic structure

Bonding theories

Physical and chemical properties of substances based on composition and structure

Metallic, ionic, covalent bonding

Intermolecular forces states of matter

- States of matter
  - Properties of different states of matter
  - Kinetic-molecular theory
  - Changes of state; energetic of phase changes
- II. Mole Concept and the Laws of Chemical Combination
  - Mass relationships during chemical reactions
- III. Reactions of Matter
  - Acid-base reactions
  - Redox reactions
  - Energy changes in chemical reactions
  - Spontaneity of processes
  - Chemical kinetics/collision theory
  - Equilibria
    - Reactions of Gases
    - Acids and bases; Buffers
    - Solubility and  $K_{sp}$

**SUGGESTED TEXTBOOKS:**

- (a) Brady, J.E. and Holum, J.R. *Fundamentals of Chemistry*. 3rd ed. John Wiley & Sons. latest edition.
- (b) Z. Brescia, F., Arents, J. Meislich, H. and Turk, A. *Fundamentals of Chemistry*. Academic Press. latest ed.
- (c) Brown, TL and LeMay HE Jr. *Chemistry: The Central Science*. Prentice-Hall. latest ed.
- (d) Chang, R. *Chemistry*. 4th ed. McGraw-Hill Inc., latest ed.
- (e) Hill, JW. *Chemistry for Changing Times*. Burgess Pub. latest ed.
- (f) Jaffe, B.. *Crucibles: The Story of Chemistry*. Dover Publishing Inc., 1976.
- (g) Keenan, Wood and Kleinfelter. *General College Chemistry*. Harper and Row Publ.
- (h) Masterson, W.L. and Slowinski, E.J. *Chemical Principles*. W.B. Saunders Co.
- (i) Padolina, MCD, Marquez, L and Sabulase V. *Chemistry in the 20th Century*. Diwa Publishing 1995.
- (j) Zumdahl, S.S. *Chemistry*. 3rd ed. D.C. Heath and Co., latest ed.

**COURSE NAME: GENERAL CHEMISTRY I AND II, LABORATORY****LEARNING OBJECTIVES**

The Laboratory is intended to enable the students

- i. To practice the processes involved in carrying out scientific investigations
- ii. To develop the skills in carrying out basic laboratory techniques
- iii. To experience and observe the concepts taken in the lecture

**NUMBER OF UNITS.**

General Chemistry I: 2 units  
General Chemistry II: 2 units

**PREREQUISITES.** None; should be taken concurrently with the lecture portion.

### **COURSE OUTLINE**

Laboratory Activities:

1. Exercise on the scientific method: observing and data gathering, data analysis and interpretation, making conclusions.
2. Classification of matter
3. Composition of compounds
4. Exercise on the mole concept
5. Stoichiometry
6. Thermochemistry
7. Rates of reactions
8. Oxidation-reduction reactions
9. Periodicity of properties
10. Geometry of molecules
11. Intermolecular forces of attraction
12. Changes of state: Cooling and heating curves
13. Chemical equilibrium and Le Chatelier's Principle
14. Properties of solutions; colligative properties
15. Determination of solubility product constant
16. Acid-base equilibrium, buffers.
17. Exercises on qualitative analysis

### **SUGGESTED REFERENCES FOR LABORATORY ACTIVITIES**

- (a) *Chemistry in the Community (ChemCom)*, An American Chemical Society publication
- (b) *Smith and Dwyer, Key Chemistry*
- (c) *Journal of Chemical Education*

### **EQUIPMENT AND FACILITIES**

- (a) Basic glasswares and supplies
- (b) Basic equipment: Fume hood, at least one unit, working area 60" wide balance, triple beam, one unit balance, up to 0.001g sensitivity hot plates/burners, 5 units manometer, one unit for all sections centrifuge, 5 units
- (c) Models: atomic and molecular, gas models, etc.
- (d) Optional equipment: VCR-television set -for video lessons  
computer - for tutorials
- (e) Educational videos, CAI materials

### **ANALYTICAL CHEMISTRY**

#### **INTRODUCTION**

The last decade has seen the increasing role of analytical chemistry in industry, environment, biological and related sciences. Recent advances in electronics and material science have brought significant improvements to this area through new analytical techniques

and sensors. As a consequence, modifications are inevitable in the teaching of analytical chemistry.

Modern analytical methods should be included in the course content of analytical chemistry. However, there should be a good balance between important classical and modern analytical methods. There is also a need for good balance between theory and practice in problem solving using these analytical techniques.

To be able to understand better how modern analytical techniques work, basic electronics for chemical instrumentation should be incorporated in the course. With the application of computers in analytical chemistry, computer methods for analytical chemistry should also be included in the course.

### **COURSE NAME. ANALYTICAL CHEMISTRY, LECTURE**

**COURSE DESCRIPTION.** The course on Analytical Chemistry describes the analytical process and will concentrate on the classical methods of analysis.

### **LEARNING OBJECTIVES**

This course is structured around simple but important analytical techniques. The students should become familiar with the commonly used analytical methods and acquire an appreciation of the essential role of chemical analysis in chemistry and related fields. The main thrust of this basic course is to provide adequate training for students to understand the fundamental principles on which these analytical techniques are based.

The following recommendation covers 44 hours of lecture time. The teacher may spend more time on a particular topic or introduce other topics.

**NUMBER OF UNITS.** 3

**PREREQUISITES.** General Chemistry (10 units, lecture and laboratory)

### **COURSE OUTLINE**

- I. Introduction (1.5 hours)
  - A. Nature, scope and importance of Analytical Chemistry
  - B. Classification of analyses
    1. Gravimetric, volumetric, instrumental
    2. Ultimate, proximate, single - component
    3. Macro, semi - micro and micro
    4. Major constituent, minor constituent and trace constituent

- II. The Analytical Process (1.5 hours)
  - A. Sampling
  - B. Moisture determination
  - C. Dissolving the sample
  - D. Analytical separations
  - E. Actual determination
  - F. Evaluation
  
- III. Chemical Reactions used in Quantitative analysis (4 hours)
  - A. Review of chemical equilibria
  - B. Types of chemical reactions
  - C. Criteria used for choosing chemical reaction for quantitative analysis
  
- IV. Stoichiometry (6 hours)
  - A. Concentration of solution (molarity, formality, normality, titer, ppm, p-values)
  - B. Gravimetric methods (gravimetric factor)
  - C. Volumetric methods
    - 1. Millimole approach
    - 2. Milliequivalent approach
    - 3. Titer method
  - D. Problems in gravimetric and volumetric methods
  
- V. Gravimetric Analysis (3 hrs)
  - A. Requirements for a gravimetric chemical reaction
  - B. Solubility of precipitates and factors affecting solubility (common - ion;pH; complexing agent)
  - C. Precipitation
    - 1. Mechanism
    - 2. Von Weimarn's Ratio
    - 3. Conditions of analytical precipitation
    - 4. Purity of precipitates
    - 5. Drying or ignition of precipitates
    - 6. Examples of gravimetric determinations
  
- VI. Volumetric Analysis (3 hrs)
  - A. Requirements for a volumetric chemical reaction
  - B. Primary standard and standard solution
  - C. Endpoint determination (chemical indicators; potentiometric)
  - D. Precipitation titrations
    - 1. Titration curves
    - 2. Indicators used
    - 3. Applications and calculations
  - E. Acid - base Titrations (7.5 hrs)
    - 1. Titration curves (strong acid vs. strong base; weak acid vs. strong base; etc.)
    - 2. Acid - base indicators
    - 3. Buffers (properties and preparation)

4. Applications and calculations
    - a. Double - indicator titration (alkali mixtures)
    - b. Kjeldahl method
  - F. Complexometric Titrations (3 hrs)
    1. Titration curves
    2. Indicators used
    3. Liebig cyanide method
    4. Chelometric methods (EDTA titration)
    5. Applications and calculations
  - G. Redox Titrations (6hrs)
    1. Review of basic electrochemistry (standard electrode potentials-IUPAC convention; formal potentials; Nernst Equation)
    2. Titration curves
    3. Redox indicators
    4. Applications
- VII. Introduction to Instrumental Methods (9 hrs)
- A. Spectrophotometric methods
  - B. Electrochemical methods
  - C. Chromatographic methods

#### **TEXTS AND REFERENCES.**

##### **Suggested Textbooks:**

- (a) Day and Underwood, *Quantitative Analysis* latest ed.
- (b) Skoog and West, *Analytical Chemistry* latest ed.
- (c) Christian, *Analytical Chemistry* latest ed.
- (d) Hargis, *Analytical Chemistry* Latest ed.

#### **COURSE NAME. ANALYTICAL CHEMISTRY LABORATORY**

##### **LEARNING OBJECTIVES**

The experiments that will be performed in this course illustrate a wide variety of analytical principles and reinforce the basic concepts of chemical analysis. This laboratory course is designed to enable the students to master the basic skills required to perform quantitative chemical analysis in the laboratory.

##### **NUMBER OF UNITS. 2**

**PREREQUISITES.** Same as lecture course; to be taken simultaneously with the lecture course

##### **COURSE OUTLINE**

###### **List of Experiments**

1. Calibration of Volumetric Apparatus
2. Determination of Weight Variations in Coins (Statistical Treatment of Data)
3. Determination of HCl and KHP by Titration with NaOH (Practice Titration)

4. Gravimetric Determination of Nickel as Nickel Dimethylglyoxime (Gravimetric Analysis)
5. Determination of Acetylsalicylic acid Content of Aspirin Tablets (Acid - Base Titration)
6. Determination of Calcium Carbonate Content of Chalk by EDTA Titration (Complexometric Titration)
7. Assay of Vitamin C Tablets Using Iodimetric Titration (Redox Titration)
8. Iodometric Determination of Copper (Redox Titration)
9. Determination of Available Oxygen in Manganese Ore (Redox Titration)
10. Determination of Calcium by Ion-Exchange Chromatography (Chromatography)
11. Colorimetric Determination of Iron as 1,10 - Phenanthroline Complex (Absorption Spectrophotometric Method)
12. Potentiometric Determination of KHP and its Acid Dissociation Constant (Electroanalytical Method)

Note: The experiments listed are suggested experiments. Similar experiments or materials may be substituted as long as all types of analysis are performed in the laboratory.

#### **TEXTS AND REFERENCES.**

**Suggested Textbooks.** Same as in lecture

#### **COURSE NAME. THE ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM, LECTURE**

**COURSE DESCRIPTION.** The Environmental Impact Assessment system is one of the most important whereby environmental considerations are integrated into the planning of projects which affect the environment. This integrative course seeks to study the application of the natural sciences, social sciences and humanities in development projects. The course will include lectures, case studies, and exposure trips.

#### **LEARNING OBJECTIVES**

This course will equip the students with the basic knowledge and skills in EIA. The course includes the theoretical framework, methodology, and applications for EIA in the Philippines. At the end of the course, students are expected to understand the rationale behind the EIA, predict and assess impacts of development projects on the biophysical and sociocultural environments, and relate their field of specialization to other fields of studies applicable to EIA.

**NUMBER OF UNITS:** 3

**PREREQUISITES.** Students should be in their senior year level. Students should have completed the majority of their course requirements.

## COURSE OUTLINE

1. Introduction
  - a. Sustainable Development
  - b. Environmental Impact Assessment
2. Concepts and Principles of EIA
  - a. Approaches and methodologies
  - b. The practice of EIA in the Philippines, in multi-lateral agencies and in other countries
3. The Philippine EIS system
  - a. Historical background
  - b. Legal framework
  - c. Procedural framework
4. Case studies and field trips
5. Trends and Issues

## TEXTS AND REFERENCES.

**Suggested Textbooks:** (use latest edition, if available)

1. *Environmental Guidelines for Selected Infrastructure Projects*. Asian Development Bank, 1990.
2. *Environmental Impact Assessment: Cutting Edge for the 21st Century*. Allan Gilpin, 1995.
3. *Integration of Environmental Considerations in the Program Cycle*. Asian Development Bank, 1990.
4. *Philippine EIS System Guide: Policies and Procedure*. Environmental Management Bureau, Department of Environment and Natural Resources, 1994.
5. *Public Participation in EIA: An Environmental Monitoring Manual*. Cardenas *et al.*, Environmental Management Bureau, 1992.
6. *Strengthening Environmental Impact Assessment Capacity in Asia: A Case Study on the Philippine EIA System*. Balagot, Beta and Briones, Nicomedes, Environmental Resource Management Project, UP Los Baños, 1994.

## COURSE NAME. EARTH SCIENCE, LECTURE and LABORATORY

**COURSE DESCRIPTION.** This course introduces the student to the features and the interactions in and between of the lithosphere, hydrosphere, atmosphere, and the biosphere. Being an integral part of the Environmental Science curriculum, this course includes topics on the relationship of human activity to Earth features, particularly on those processes that are altered by and those that cause threat to man. The course will include lectures and laboratory sessions.



**LEARNING OBJECTIVES**

This course will equip the students with the basic knowledge and skills in Earth science. The course includes an overview of the Earth as a planet, its history and its nearby neighbors, the different groups of rocks and minerals and their chemical significance, major processes that affect the surface of the planet, the various resources that man employs, geologic hazards, and the impact of man on the environment.

**NUMBER OF UNITS.** Lecture – 3, Laboratory - 2

**PREREQUISITES.** Students should be in their junior year level. Students should have taken most of their basic science course requirements.

**COURSE OUTLINE**

1. A habitable planet
  - a. Planet Earth and its neighbors
  - b. Rocks and minerals
2. Internal processes that shape the Earth
  - a. Plate tectonics
  - b. Magmatism
  - c. Isostasy and orogeny
3. Earth's processes
  - 1 Weathering and soils
  - 2 Downslope movement
  - 3 Streams/ rivers and erosion/ sedimentation
  - 4 Wind and glacier movements
  - 5 Earthquakes
  - 6 Volcanoes
4. Earth resources
  - a. Groundwater
  - b. Surface water
  - c. Mineral resources
  - d. Energy resources
5. The Earth and human activity
  - a. Geologic hazards
  - b. Resource exploitation
  - c. Land use and misuse
  - d. Effects of Human activity on the ocean and coastal areas
  - e. Effects of human activity on the atmosphere
  - f. Essential concepts for sustaining life on Earth

The Laboratory course (preferably a 6-hour, per week course) will lead the students to do individual and small-group exercises focusing on each week's lecture topic. Priority is given to activities that will make students conduct both

qualitative observations and quantitative assessments/ measurements of Earth features discussed during the lectures.

#### **TEXTS AND REFERENCES.**

1. Environmental Geology, Fifth Edition., Carla W. Montgomery, WCB-McGraw Hill, 1997.
2. Environmental Geology, Third Edition, Edward A. Keller, Charles E. Merril Publishing 1982.
3. Principles of geology, James Gilluly, Aaron Waters, A.O. Woodford, Freeman and Company, Latest edition
4. Earth, Frank Press and R. Siever, W.H. Freeman and Company, 1985 or later edition
5. The Earth: An introduction to Physical Geology, Merril Publishing, London, 1993.

### **Article VII. Other Requirements.**

#### **Section 13 Program Administration**

One advantage of a multidisciplinary program such environmental science is that it can be built from existing resources within the institution. Faculty from different academics can be tapped to teach in the program and equipment and facilities can be shared with other programs.

TPSM does not require the setting up of a different unit to accommodate the implementation of a BS Environmental Science Program. However, it is recommended that a separate full-time program coordinator be appointed to oversee the program.

#### **Section 14 Qualifications of BS ES program coordinator**

The program coordinator of the BS ES program should be a full-time faculty member with a minimum of a master of science (MS) degree from any of the allied fields of environmental science identified in Section 6 above.

#### **Section 15 Faculty**

##### **A. Qualifications of faculty**

Any faculty teaching major science and ES courses in the BS ES program must have the minimum of a MS degree in any of the allied fields in Section 6. Faculty teaching courses in Environmental Studies should have a master's degree in the relevant area. Faculty teaching courses in Environmental Management and Environmental Impact Assessment should be practitioners.

**B. Full time faculty members**

The institution shall maintain **at least** 50% of the faculty members teaching in the BS ES program as full time.

**C. Teaching Load**

Teaching load requirements for BS ES shall be as follows:

- (1) Full time faculty members should not be assigned more than four (4) different courses/subjects within a semester.
- (2) In no instance should the aggregate teaching load of a faculty member exceed 30 units (inclusive of overload and teaching loads in other schools).
- (3) Teaching hours per day should not exceed the equivalent of 6 lecture hours.

**D. Faculty Development.**

The institution must have a system of staff development. It should encourage the faculty to:

- (1) Pursue graduate studies
- (2) Undertake research activities and to publish their research output
- (3) Give lectures and present papers in national/international conferences, symposia and seminars.
- (4) Attend seminars, symposia and conferences for continuing education

The institution must provide opportunities and incentives such as:

- (1) Tuition subsidy for graduate studies
- (2) Study leave with pay
- (3) Deloading to finish a thesis or carry out research activities
- (4) Travel grants for academic development activities such as special skills training and attendance in national/ international conferences, symposia and seminars.
- (5) Awards & recognition

**Section 16 Library****A. Policy**

Libraries service the instructional and research needs of the staff and students making it one of the most important service units within an HEI. It is for this reason that libraries should be given special attention by HEI administrators by maintaining it with a wide and up-to-date collection, qualified staff, and communications and connectivity portals.

**B. Library Staff**

The Head Librarian should: 1) have an appropriate professional training; 2) be a registered librarian; and 3) have a Master's degree.

The library should be: 1) staff with one full time professional librarian for every 1,000 students and 2) a ratio of 1 librarian to 2 staff / clerks should be observed.

**C. Library Holdings**

Library holdings should conform to existing requirements for libraries. For the BS Envi Sci program, the libraries must provide 5 book titles per professional course found in the curriculum at a ration of 1 volume per 15 students enrolled in the program. These titles must have been published within the last 5 years.

The HEI is likewise encouraged to maintain periodicals and other non-print materials relevant to environmental science to aid the faculty and students in their academic work. CD-ROMs could complement a library's book collection but should otherwise not be considered as replacement for the same.

**D. Internet Access.** Internet access is encouraged but should not be made a substitute for book holdings.**E. Space Requirements**

At least 126 m<sup>2</sup>. or approximately 2 classrooms shall be required for the library. It should include space for collections, shelving areas, stockroom, office space for staff and reading area

The library must be able to accommodate 5% of the total enrollment at any one time.

**F. Finance.**

All library fees should be used exclusively for library operations and development for collections, furnitures and fixtures, equipment and facilities, maintenance and staff development.

**G. Networking**

Libraries shall participate in inter-institutional activities and cooperative programs whereby resource sharing is encouraged.

**H. Accessibility**

The library should be readily accessible to all.

**I. Office Hours**

The library should be open to serve the needs of the users.

**Section 17 Facilities and Equipment****A. Laboratory requirements**

Laboratories should conform to existing requirements as specified by law (RA 6541, "The National Building Code of the Philippines" and Presidential Decree 856, "Code of Sanitation of the Philippines"). List of required and recommended equipment are listed in each of the course requirements above.

**B. Classroom requirements****Class Size.**

- (1) For lecture classes, ideal size is 35 students per class, maximum is 45
- (2) For laboratory and research classes, class size shall be specific to the discipline to be stated in the policies and standards.
- (3) Special lectures with class size more than 45 may be allowed as long as the attendant facilities are provided.

**C. Educational Technology Centers**

The institution should provide facilities to allow preparation, presentation and viewing of audio-visual materials to support instruction.

**Section 18 Admission and Retention**

The basic requirement for eligibility for admission of a student to any tertiary level degree program shall be graduation from the secondary level recognized by the Department of Education. Higher education institutions must specify admission, retention and residency requirements. They should ensure that all students are aware of these policies.

**Article VIII. Repealing Clause**

**Section 19** All pertinent rules and regulations or parts thereof that are inconsistent with the provisions of this policy are hereby repealed or modified accordingly.

**Article IX. Effectivity Clause**

**Section 20** These policies and standards for Bachelor of Science in Environmental Science shall be effective first semester of school year 2006-2007.

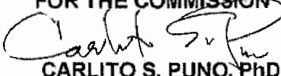
**Article XX. Transitory Provision**

**Section 21** HEIs with existing program offerings in the Bachelor of Science in Environmental Science degree shall be given a 3-year grace

period to comply with these policies and standards. HEIs who decide not to comply with these standards and realign their existing programs to the sciences and mathematics must rename their programs with more appropriate terms descriptive of the nature of their programs.

For strict compliance.

Pasig City, Philippines October 6, 2005

**FOR THE COMMISSION**  
  
**CARLITO S. PUNO, PhD**  
Acting Chairman

Appendix A – Other Recommended Texts and References

## APPENDIX A

### OTHER RECOMMENDED TEXTS AND REFERENCES

#### Manuals and Handbooks

1. Polotan-dela Cruz, L and EM Ferrer (editors). 2003. Resource Book on CBCRM. Volume 1 Fisheries Management in Community-Based Coastal Resource Management. Oxfam Great Britain & the CBCRM Resource Center, University of the Philippines, Diliman, Quezon City, Philippines. 167 pages. May 2003.
2. Polotan-dela Cruz, L. and EM Ferrer (editors). 2003. Resource Book on CBCRM. Volume 2 Sustainable Livelihoods in Community-Based Coastal Resource Management. Oxfam Great Britain & the CBCRM Resource Center, University of the Philippines, Diliman, Quezon City, Philippines. 111 pages. May 2003.
3. Polotan-dela Cruz, L., EM Ferrer and M Reynaldo (editors). 2003. Resource Book on CBCRM. Volume 3 Participatory Monitoring and Evaluation in Community-Based Coastal Resource Management. Oxfam Great Britain & the CBCRM Resource Center, University of the Philippines, Diliman, Quezon City, Philippines. 94 pages. May 2003.
4. Heinen, A. 2003. Rehabilitating Nearshore Fisheries. Theory and Practice on Community-Based. Coastal Resources Management from Danao Bay, Philippines. Lenore Polotan de la Cruz (ed). CBCRM Resource Center, UP Social Action Research and Development Foundation, Inc., UP College of Social Work and Community Development, University of the Philippines, Diliman, Quezon City, Philippines, Oxfam Great Britain-Philippine Office, Netherlands Development Organization (SNV Philippines), and Pipuli Foundation. 206 pages. .
5. Monasterio, FT. 2002. Enterprise development, monitoring and evaluation manual. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 74, 28 pages plus Annexes.
6. Trudeau, H and C Federico. 2002. Municipal Fisheries Licensing, Licensing System User's Manual, Volume 1. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. 48 pages.
7. Trudeau, H and C Federico. 2002. National/Regional Commercial Fisheries Licensing, Licensing System User's Manual, Volume 2. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. 48 pages.
8. Trudeau, H and C Federico. 2002. Violations Information System, System User's Manual, Volume 3. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the

- Department of Agriculture, Diliman, Quezon City, Philippines. 27 pages.
9. 2002. Handbook on IEC material preparation. Prepared by: Mandala Agriculture Development Corporation (MADECOR) in association with the Asian Institute of Journalism and Communication (AIJC) for the Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 76. 117 pages. June 2002.
  10. 2002. Handbook on process documentation. Prepared by: Mandala Agriculture Development Corporation (MADECOR) in association with the Asian Institute of Journalism and Communication (AIJC) for the Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 75. 171 pages. August 2002.
  11. Gonzales, BJ and JE Sta. Ana. 2002. Solid waste management training manual for local government. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 66, 46 pages.
  12. Batongbakal, JL. 2001. Handbook for making municipal fisheries ordinances.. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 52. 81 pages plus Annexes. September 2001.
  13. Braid, FR and CC Maslog. 2001. Handbook on IEC planning and research. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 41. 115 pages.
  14. Braid, FR and CC Maslog. 2001. Handbook on basic communication. Fisheries Resource Management Project (FRMP), Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Diliman, Quezon City, Philippines. FRMP/IP No. 50. 103 pages.
  15. Melana, DM , J Atchue III, CE Yao, R Edwards, EE Melana and H I Gonzales. 2000. Mangrove Management Handbook. Department of Environment and Natural Resources, Manila, Philippines through the Coastal Resource Management Project, Cebu City, Philippines. 96 pages.
  16. 1998. Participatory methods in community-based coastal resource management. Volume 1 Introductory Papers: Coastal communities living with complexity and crisis in search for control; Community-based coastal resource management; Community organizing and development process; Participation and participatory methods; and General guidelines for using participatory tools. International Institute of Rural Reconstruction, Silang, Cavite, Philippines. 85 pages.



17. 1998. Participatory methods in community-based coastal resource management. Volume 2 Tools and Methods: Matrices; Group methods; Surveys and interviews; Visualizing and diagramming relationships; Temporal methods; and Spatial methods. International Institute of Rural Reconstruction, Silang, Cavite, Philippines. 291 pages.
18. 1998. Participatory methods in community-based coastal resource management. Volume 3 Tools and Methods: Assessment and monitoring tools; Resource enhancement strategies; Education and extension; Advocacy; Documentation; and Cross-cutting themes. International Institute of Rural Reconstruction, Silang, Cavite, Philippines. 263 pages and Annex.
19. 1997. Sustainable Livelihood Options for the Philippines, An information kit. Volume 1 Upland ecosystem. Department of Environment and Natural Resources, Visayas Avenue, Diliman, Quezon City. 484 pages.
20. 1997. Sustainable Livelihood Options for the Philippines, An information kit. Volume 2 Urban-lowland ecosystem. Department of Environment and Natural Resources, Visayas Avenue, Diliman, Quezon City. 162 pages.
21. 1997. Sustainable Livelihood Options for the Philippines, An information kit. Volume 3 Coastal ecosystem. Department of Environment and Natural Resources, Visayas Avenue, Diliman, Quezon City. 225 pages.
22. 1984. Handbook on land and other physical resources. National Land Use Committee, National Economic and Development Authority, Amber Avenue, Pasig, Metro Manila. 124 pages.

### **Guidelines**

1. 2001. Philippine Coastal Management Guidebook No. 1: Coastal Management Orientation and Overview. Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of Interior and Local Government. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 58 pages.
2. 2001. Philippine Coastal Management Guidebook No. 2: Legal and Jurisdictional Framework for Coastal Management. Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of Interior and Local Government. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, \_\_\_ pages.
3. 2001. Philippine Coastal Management Guidebook No. 3: Coastal Resource Management Planning. Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of Interior and Local Government. Coastal Resource Management Project of the

- Department of Environment and Natural Resources, Cebu City, Philippines, 94 pages.
4. 2001. Philippine Coastal Management Guidebook No. 4: Involving Communities in Coastal Management. Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of Interior and Local Government. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 84 pages.
  5. 2001. Philippine Coastal Management Guidebook No. 5: Managing Coastal Habitats and Marine Protected Areas. Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of Interior and Local Government. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 106 pages.
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