MINISTRY OF EDUCATION AND TRAINING
CAN THO UNIVERSITY

SOCIALIST REPUBLIC OF VIET NAM
Independence-Freedom-Happiness

MODULE SPECIFICATIONS

1. Title the the module: WATER SCIENCE

- **Code of the module:** AQ207
- **The number of credits:** 03 credits
- **Contact time:** 30 periods for theory; 30 periods for practice

2. School which will be responsible for management of the module

- **Depatment:** Applied Hydrobiology
- **College:** Aquaculture and Fisheries

3. Prerequisite and co-requisite module: TN055(Analytical Chemistry)

4. The intended subject specific learning outcomes: Upon completing this course, students will be able to:

4.1. Knowledge:

4.1.1. Understand important factors in water quality management in aquaculture ponds;

4.1.2. Master the spatial and temporal patterns of water quality in aquatic environment;

4.1.3. Understand the interactions of water quality and aquatic animal life

4.1.4. Understand reasonable methods for water quality management in aquaculture ponds

4.1.5. Master standard methods for water in aquaculture ponds examination.

4.2. Skills:

4.2.1. Conduct professionally water quality assessment in aquatic environment through monitoring

4.2.2. Explain changes of water quality in aquatic environment

4.2.3. Propose the methods for water quality management in aquatic environment

4.2.4. Express plan of water quality monitoring in the hatcheries and growth-out ponds/cages

4.2.5. analyze and assess dada

4.2.6. work independently or/and in group, well working on presentation

4.3. Attitudes:

4.3.1. Indulge in career

4.3.2. Demonstrate competence in area of professional or academic specialization

4.3.3. Aptitude for study and professional experiences

5. A synopsis of the module:

The module "Water science" provides undergraduate students knowlege on changes and interactions among aquatic animals and their environment including physical, chemical and biological environment factors as well. On successful completion of the module students will have knowledge of the methods for water quality analysis and dada assessment. In addition, the module also supports students reasonable methods and experiences for water quality management in aquaculture ponds.

6. Structure of the moulde:

6.1. Theory

	Contents	**Period**	**Generic outcomes**
Lesson 1.	**Module introduction**	**2**	4.1.1, 4.3.1, 4.3.2, 4.3.3
1.1.	Introduction		
1.2.	Water quality concepts		
1.3.	Characteristics of aquatic environment		
Lesson 2.	**Aquatic nutrients and biological processes**	**2**	4.1.1, 4.1.2, 4.2.5, 4.3.1, 4.3.2, 4.3.3
2.1.	Sources and macronutrients		
2.2.	Biological processes (photosynthesis, respiration, decomposition etc)		
Lesson 3	**Physical properties of water**	2	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1,4.2.2, 4.2.3, 4.2.5, 4.3.1, 4.3.2, 4.3.3
3.1.	Light, Secchi depth visibility		
3.2.	Temperature		
3.3.	Color		
Lesson 4	**Chemical properties of water**	10	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1,4.4.2, 4.2.3, 4.2.5 4.3.1, 4.3.2, 4.3.3
4.1.	pH		
4.2.	Carbon dioxide		
4.3.	Alkalinity and Hardness		
4.4.	Dissolved oxygen		
4.5.	Ammonia, Nitrite and Hydrogen sulfide		
4.6.	Macronutrients (Nitrate – Phosphate)		
4.7.	Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD)		
Lesson 5	**Water quality management**	4	4.2.1,4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.3.1, 4.3.2, 4.3.3
5.1.	Liming		
5.2.	Pond fertilization		
5.3.	Aeration		
Lesson 6	**Solid wastes in aquaculture**	2	4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.3.1, 4.3.2, 4.3.3
6.1.	Feeds and nutrient composition		
6.2.	Intake, digestion, absorption and conversion of food in the shrimp/fish		
6.3.	Wastes from shrimp/fish culture		

	Contents	Period	Generic outcomes
Lesson 7	**Suspended solids removals**	2	4.2.3, 4.2.4, 4.2.5, 4.3.1, 4.3.2, 4.3.3
7.1.	Sources and properties of suspended solids		
7.2.	Methods for suspended solids determination		
7.3.	Techniques for suspended solid removal		
Lesson 8	**Nitrification process**	2	4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.3.1, 4.3.2, 4.3.3
8.1.	Nitrification reaction		
8.2.	Interreaction of nitrification process and alkalinity		
8.3.	Applications of nitrification process in aquaculture		
Lesson 9	**Recirculating water system – Application in aquaculture**	2	4.2.4, 4.3.1, 4.3.2, 4.3.3
9.1.	The basis components of recirculating water system		
9.2.	Different models aquaculture recirculation water		
9.3.	Wetlab visiting for recirculating water system		
Lesson 10	**Chemical usage in aquaculture**	2	4.2.3, 4.2.4, 4.3.1, 4.3.2, 4.3.3
10.1.	Chemicals		
10.2.	Probiotics		

6.2 Practice

№	Contents	Period	Generic outcomes
Lesson 1.	**Electrical Methods of analysis**		4.1.2; 4.1.5; 4.2.5; 4.2.6; 4.3.1; 4.3.2
1.1.	Salinity	4	
1.2.	Electrical Conductivity (EC)		
1.3.	Turbidity		
Lesson 2.	**Gravimetric Methods of Analysis**		4.1.2; 4.1.5; 4.2.5; 4.2.6; 4.3.1; 4.3.2
2.1.	Total Solids (TS)	4	
2.2.	Total Suspended Solids (TSS)		
2.3.	Total volatiled Suspended Solids (TVSS)		
Lesson 3.	**Titrimetric Methods of Analysis**		4.1.2; 4.1.5; 4.2.5; 4.2.6; 4.3.1; 4.3.2
	Acidity	4	
	Dissolved Oxygen (DO)		
	Alkalinity	4	
	Hardness		
	Chemical Oxygen Demand (COD)		
Lesson 4.	**Spectroscopic Methods of Analysis**		4.1.2; 4.1.5; 4.2.5; 4.2.6; 4.3.1; 4.3.2
	Ammonia and Ammonium NH_3/NH_4^+	2	
	Nitrite ($N\text{-}NO_2^-$)	2	
	Nitrite (NO_3^-)	2	
	Reactive Phosphorus (PO_4^{3-})	2	
	Ferrous (Fe^{2+})	2	

7. Teaching methods:

Active teaching and learning offer opportunities for interaction between lecturers and students, among the students themselves, as well as between students and the materials, the topic itself or the academic discipline.

- Students are expected to read the lesson before class, participate in discussion during class. At the end of each class, the lecturer expresses the explanation of core issues of the lesson.
- The small group PowerPoint presentation assessment will run towards the end of each period (10 minutes). The presenter will be randomly selected. Informal peer-to-peer feedback will be sought, but will not contribute to the assessment mark. Students are asked to communicate how and why regarding to their topic choosing, to a non-specialist audience.

8. Responsibilities of students:

- Academic participating at least 80% of total number of theory periods.
- Participating in all seminar presentations
- Participating in midterm exam.
- Physical participation in final exam.
- Independent study activities

9. Assessment methods for the module

9.1. Assessment methods: Student learning will be assessed by means of

№	Activity	Requirement	Portion (%)	Generic outcomes
1	Debate ability	Participating in discussion during class	5%	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3
2	Seminar	Involving seminar preparation/discussion and recorgnized by group members. The small group PowerPoint presentation assessment will run towards the end of each lesson.	15%	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.1.3, 4.1.4, 4.2.5, 4.3.1, 4.3.2, 4.3.3
3	Midterm exam	Participating the midterm exam (30 minutes, assay)	20%	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3
4	Practical class	- Participating all periods of the practice on water quality analysis in the lab	5%	4.2.5; 4.2.6; 4.3.1; 4.3.2
5	Practical report	- Report/Exam	15%	4.2.5; 4.2.6;

				4.3.1; 4.3.2
6	Final test	- Multiple choice + Assay	40%	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3

9.2. Module cumulative GPA assessment

- Marks of portions as class attention, seminar, practice, midterm exam, final exam etc are assessed by 10.0 GPA (Grade Point Average). The GPA will be calculated to one decimal place.
- Module cumulative GPA is calculated by sum of units and to one decimal place then transferred into mark in word and 4.0 GPA (one decimal place) flollowing the Can Tho University's Academic Rules.
- Scheduled final examinations are held at the end of the semester during the university's official final examination period.
- The student who is absent only one of period of practice in the lab is not allowed to participate in the final exam.

10. Indicative reading list

Core text	**Dewey Decimal Classification (DDC) code**
[1] Boyd, C.E. 1998. Water quality for pond aquaculture. Research and Development Series No. 43 August 1998 International Center for Aquaculture and Aquatic Environment Alabama Agricultural Experiment Station, Auburn University. 37pp.	
[2] Boyd, C.E. 1990. Water quality in pond for aquaculture. Birmingham Publishing Co., Birmingham, USA. 482 pp.	
[3] Ministry of Natural Resources and Environment, 2009. Vietnam Environmental Standards. Labor and Social Publishing House. 598 pp.	
[4] Applied Analytical Chemistry in Aquacultrure book (Huynh Truong Giang and Truong Quoc Phu, College of Aquaculture and Fisheries, Can Tho University)	
[5] APHA, AWWA, WEF. 1999. Standard methods for the examination of water and wastewater, 19th edition. American Public Health Association 1015 Fifteenth Street, NW Washington, DC 20005.	

11. Guidances for self-study

Week	**Content**	**Theory**	**Practice (period)**	**Duties and responsibilities of**

		(period)		students
1	**Module introduction** – Introduction – Water quality concepts – Properties of waters	2	0	– Answer the questions: What are indicators for good quality water? What are differences in characteristics of flow water and static water? – Read the documents to find out the meanings of: tolerate level, optimum level, optimum range (see TS106 module)
	Nutrients and biological processes in aquatic environment – Sources and macronutrients – Biological processes (photosynthesis, respiration, decomposition)	2	0	– Required reading before class attending: Document [1] from pages 3-9; Document [2] form pages 65-69 and 101-106. – Group discussion preparation: Sources of nutrients for aquatic environment. + Biological processes in aquatic environment + Bacteria involving in biological processes in aquatic environment. – Seminar (Group 1): Effects of photosynthesis, respiration, matter decomposition processes in water quality in aquatic environment
3	**Physical properties of waters** – Light, Secchi disk visibility, turbididy – Temperature – Water color	2	0	– Required reading before class attending: Document [1] from pages 13-15; Document [2] from pages 12-15 – Group discussion preparation: + Effects of light on water quality in aquaculture ponds + Law of thermal load and its application in aquaculture + Relarionship between Secchi disk visibility, water color and macronutrients in water.

				– Seminar (Group 2): Water quality assessment based on Secchi disk visibility. Water color and macronutrients .
4	**Chemical properties of waters** – pH	2	0	– Required reading before class attending: Document [1] from page 8-16; Document [2] from pages 34-35 and 152-155; Document [3] QCVN 08 and QCVN24, QCVN 38 – Group discussion preparation: + Fluctuaton of pH in aquaculture ponds and its effects on aquatic animals. + pH management in aquaculture ponds. – Seminar (Group 3): Interactions of CO_2, pH and alkalinity
5	**Chemical properties of waters (cont.)** – Carbon dioxide	2	0	– Required reading before class attending: Document[1] page 8 and from pages 11-12; Document[2] from pages 36-45 and 47-48; – Group discussion preparation: + Sources of CO_2 in ponds. + Effects of CO_2 to aquatic animals. + CO_2 management.
6	**Chemical properties of waters (cont.)** – Alkalinity – Hardness	2	0	– Required reading before class attending: Document[1] page 8 and pages 10-11; Document[2] from pages 36-46; – Group discussion preparation: + Alkali ions + How to convert units of alkalinity (dKH to $CaCO_3$/L).
7	**Chemical properties of waters (cont.)** – Dissolved oxygen	2	0	– Required reading before class attending: Document[1] page 8 and fo17-26; Document[2] from pages

				48-64 and 144-151; Document[3] QCVN 08 and QCVN24, QCVN 38. – Group discussion preparation: + Sources and fluctuation of dissolved oxygen in aquaculture ponds + Solubility of oxygen in waters, the dissolved oxygen requirements of aquatic animals, and introduces the redox potential. Effects of Low DO Concentration DO management in aquaculture ponds – Seminar (Group 4): Adaptivities of aquatic animals in gas exchange efficiency
8	**Chemical properties of waters (cont.)** – Toxic parameters (Ammonia, Nitrite, H_2S)	2	0	– Required reading before class attending: Document[1] page 8 and from pages 43-46; Document[2] from pages 70-89 and 156-161; Document[3] QCVN 08 and QCVN24, QCVN 38. – Group discussion preparation: + Source of toxic gases in aquaculture ponds + Effects of toxic gases on aquatic animals. + Methods for toxic gases mangement in quaculture ponds. – Seminar (Group 5): Interaction principles of toxic gases to aquatic animals.
9	**Chemical properties of waters (cont.)** – Macronutrients (Nitrate – Phosphate) – COD and BOD	2	0	– Required reading before class attending: Document[1] page 8 and pages 26-30; Document[2] from pages 70 to 86; Document[3] QCVN 24

				– Group discussion preparation: + Effects of macronutrients on water quality + Effects of COD and BOD levels in aquatic environment. – Seminar (Group 6): Interactions of macronutrients and pH, DO, CO_2, and fluctuation.
10	**Water quality management in aquaculture ponds** – Liming – Pond fertilization – Aeration	2	0	– Required reading before class attending: Document[1] from 38 to 41 and 47-50; Document[2] from pages 195-261 and 303-334; – Group discussion preparation: + Liming and its principles in aquaculture + Fertilization of aquaculture ponds ponds + Aeration principles – Seminar (Group 7): Correct liming improves pond water, bottom quality
11	**Wastes in aquaculture** – Feeds in aquaculture – Waste from shrimp/fish culture	2	0	– Required reading before class attending: Document[1] from pages 35-37; Document[2] from pages 177 to 180; also see TS107 module. – Group discussion preparation: + Feeds for aquaculture + Nutrient composition in aquafeeds + Mass balance and solid wastes in aquaculture systems.
12	**Solids removals** – Sources and properties of suspended solids – Methods for suspended solids determination – Techniques for	2	0	– Required reading before class attending: Document[1] from pages of 13 and 52; Document[2] from pages 364 to373; – Group discussion preparation: + Sources and properties of

	suspended solid removals			suspended solids in aquatic environment. + Principles of suspended solid removals – Seminar (Group 8): Sources and methods for suspended solid management in aquaculture ponds
13	**Nitritrification in aquatic environment** – Nitrification process – Interaction of intrification process and alkalinity of water – Applications of nitrification process in aquaculture	2	0	– Required reading before class attending: Document[1] from pages 27-29; Document[2] from pages 70-86; – Group discussion preparation: + Nitrification important process in aquaculture + Effects of nitrification process in aquaculture ponds – Seminar (Group 9): Applications of nitrification process in aquaculture.
14	**Recirculating water system – Inovations and Application** – The basis components of recirculating water system – The models of recriculating water system – Wetlab visiting	2	0	– Required reading before class attending: Document[1] page 8, 50; Document[2] from pages 330-334; – Group discussion preparation: + The components of recirculating water system + Roles of denitrification, aquatic plants, periphyton tanks aquaculture recirculating water system application
15	**Chemical usage in aquaculture** – Disinfectants – Probiotics	2	0	– Required reading before class attending: Document[1] from pages 51-56; Document[2] from pages 337-392; – Group discussion preparation: + Disinfectants + Probiotics + Banned and restricted chemicals use in aquaculture

				– Seminar (Group 10): Chemical usage in aquaculture.

Can Tho, May 06th 2014

For the Rector
Dean

Head of department