MINISTRY OF EDUCATION
AND TRAINING
CAN THO UNIVERSITY

COURSE SYLLABUS

1. INFORMATION OF COURSE AND LECTURER

1.1. Course name and code: **Recirculation Aquaculture Systems (RAS) AQ....**

1.2. Course specification: 2 Cred. (Theory: 1.3; Assigment: 0; Practice: 0.7), 30 hours (T: 20; A: 0; P: 20)

1.3. Prerequistes courses: None

1.4. Responsible Department: College of Aquaculture and Fisheries, CTU

1.5. Information of lecturer:

Name: Pham Thanh Liem
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Co-teaching lecturer:
Name: Nguyen Nhut
Email: nhut300676@yahoo.com

2. COURSE DESCRIPTION

The course deals with principles, concepts and operation of conventional - based Recirculating Aquaculture System (RAS) and its application in aquaculture. Students are provided knowledge on the relation between cultured animal and their environment, the latter comprising both the direct production space and the wider ecosystem in which the farm operates; the main aspects of aquaculture system are addressed considering effluents, water quality management, husbandry and overall system design.

The course is divided into 2 parts: Theory (including lecture and exercise courses in class) and Practical (building and maintaining a RAS system in hatchery)

3. COURSE EXPECTED LEARNING OUTCOMES

Theoretically:

After taken this course, students are able to:

- know types of microorganisms present in aquatic system and their function on the process of organic matter decomposition;
- understand the basic principles, concepts and functioning of Recirculation Aquaculture System (RAS);
- design, measure and evaluate the performance of RAS; and
- manage water quality in RAS, maintaining a healthy living environment for culture species.

Practically:

Practice in RAS system aim:

- to gain insight in processes affecting water quality in intensive aquaculture systems;
- to provide practical in managing a RAS, especially with: constructing a RAS; water quality management based on daily water quality monitoring (pH,

oxygen, ammonium, nitrite, nitrate and conductivity); stocking of fish, feeding and evaluating effects of feed input and biofiltration of water quality.

4. COURSE CONTENTS

Chapters	Hours (T/A/P)
Chapter 1: Introduction to Recirculating Aquaculture System (RAS) *This chapter will provide knowledge on basic RAS principles and RAS types* 1.1. Components of a RAS and functions 1.2. Types of existing RAS and application. Practice 1: Recirculating system design; start up RAS management in hatchery. *In order to understand well this chapter, students should read references of [3] and [9].*	2/0/4
Chapter 2: Biological processes in aquaculture production systems *This chapter introduces different metabolic groups of microorganisms present in the aquatic system; bacterial and phototrophic processes occurring and their function on controlling water quality.* 2.1. Factor influencing bacterial production and composition 2.2. Important groups of microorganisms 2.3. Nitrification 2.4. Denitrification 2.5. Anaerobic process – Anammox 2.6. Phototrophic process – Algae and higher plants *In order to understand well this chapter, students should read references of [1], [2], [9] and [10].*	6/0/0
Chapter 3: Water treatment processes in RAS *This chapter will provide conventional techniques of wastes removal and maintaining healthy water environment for aquacultured animal* 3.1. Solid removal 3.2. Biofilters 3.3. Limming 3.4. Denitrification reactor in RAS 3.5. Gas exchange: Aeration and degassing 3.6. Disinfection: UV and ozone Practice 2: Exercise on production plan – Growth, biomass and waste production calculation for 100 MT African catfish farm. Practice 3: Exercise on Production plan – Flow calculation, solid removal and biofilter design.	8/0/8

In order to understand well this chapter, students should read references of [1], [7], [9] and [10].	
Chapter 4: System enhancement *This chapter will provide methods for determining system carrying capacity (the maximum feed load, standing stock, culture volume), treatment efficiency, controlling flow and monitoring water quality; provide characteristics of fish tanks applied in aquaculture* 4.1. System carrying capacity, nutrient budgets 4.2. Holding system design Practice 4: Exercises on pH/alkalinity managment and denitrification Practice 5: Exercises on design of farm outline and operation *In order to understand well this chapter, students should read references of [4], [5], [6], [7], [8] and [10].*	4/0/8
Practical in Hatchery: Operation and daily management RAS - Start up of RAS (preparing biofilter and fish tanks, control of biofilter functioning). Start at the 1st week of the course. - Operation of RAS (Stocking fish, feeding, and measuring water quality and controlling system). Duration: 6 weeks - End of practice: harvest fish and analyze results	1 hour/day

5. TEACHING METHODS AND ASSESSMENT

5.1. Teaching methods:

Student obtain the learning goals by

- receiving lectures in class
- doing exercises in computer room and practical works in a hatchery

Students should do all 5 Practical including exercises in computer room and practice on certain RAS in fish hatchery. During the course, there will be a midterm exam after completing Chapter 2 and the final exam at the end of the course. For practical, students will practice by groups of 2-5 students then present the obtained results by groups.

5.2. Assessment methods: midterm exam: 2/10; presenting practical results: 2/10; and final exam: 6/10 grade course

6. READING REFERENCES

[1] Eding, E.H., A. Kamstra, J.A.J. Verreth, E.A. Huisman and A. Klapwijk, 2006. Design and operation of nitrifying trickling filters in recirculating aquaculture: A review. Aquacultural Engineering, 34: 234-260

[2] Kuypers, M.M.M., A.O. Sliekers, G. Lavik, M. Schmid, B.B. Jørgensen, J.G. Kuenen, J.S.S. Damste, M. Strous and M.S.M. Jetten, 2003. Anaerobic ammonium oxidation by anammox bacteria in the Black Sea. Nature, Vol. 422: 608-611

[3] Losordo, T.M., M.P. Masser, and J.E. Rakocy, 1999. Recirculating Aquaculture Tank Production Systems: A Review of Component Options. SRAC Publication No. 453, 12 pp.

[4] Nijho, M., 1994. Theoretical effects of feed composition, feed conversion and feed spillage on waste discharge in fish culture. J. Appl. Ichthyol., 10: 274-283

[5] Nijho, M., 1995. Bacterial stratification and hydraulic loading effects in a plug-flow model for nitrifying trickling filters applied in recirculating fish culture systems. Aquaculture, 134: 49-64

[6] Ross, R.M., B.J. Watten, W.F. Krise, M.N. DiLauro, 1995. Influence of Tank Design and Hydraulic Loading on the Behavior, Growth, and Metabolism of Rainbow Trout (*Oncorhynchus mykiss*). Aquacultural Engineering, 14: 29–47

[7] SustainAqua, 2009. Tilapia farming using Recirculating Aquaculture Systems (RAS) - Case study in the Netherlands. In "Integrated approach for a sustainable and healthy freshwater aquaculture – A handbook for sustainable aquaculture", p. 71-95

[8] Timmons M.B., S.T. Summerfelt, B.J. Vinci, 1998. Review of circular tank technology and management. Aquacultural Engineering, 18: 51–69

[9] Timmons, M.B. and J.M. Ebeling, 2007. Recirculating Aquaculture. NRAC Publication No. 01-007. Cayuga Aqua Ventures, New York, USA. 975 pp.

[10] van Rijn, J., Y. Tal, and H.J. Schreier, 2006. Denitrification in recirculating systems: Theory and applications. Aquacultural Engineering, 34: 364-376

Date:
Lecturer