MINISTRY OF EDUCATION AND TRAINING
CAN THO UNIVERSITY

SOCIALIST REPUBLIC OF VIETNAM
Independence - Freedom - Happiness

COURSE OUTLINE DETAILS

1. Course: Fish Genetic Enhancement and Resources Management (Cải tiến di truyền và quản lý nguồn lợi thủy sản)

- **Code number:** AQ307
- **Credits:** 3
- **Hours:** 39 hours, 6 lab-demonstration hours, and 90 self-study hours

2. Management Unit:

- **Department:** Freshwater Aquaculture
- **Faculty:** College of Aquaculture and Fisheries

3. Requisites:

- **Prerequisites:** TN057 (Basic biology)
- **Corequisites:** No

4. Course objectives:

Objectives	Descriptions	Program Outcomes
4.1	Provide basic concepts on fish genetics, techniques and methods used in genetic enhancement programs that can improve performances for economically important traits of fishes and other aquatic organisms; introduce basic molecular genetics and molecular tools that can be applied in aquaculture and wild fish genetic resources	2.1.3a
4.2	Train students' abilities of selecting and designing a genetic enhancement program and evaluating the output of the program.	2.2.1.a
4.3	Develop rational thinking, activeness, and confidence	2.2.2
4.4	Strengthen habits of self-study and team working skills	2.3

5. Course learning outcomes:

COs	Descriptions	Objectives	POs
	Knowledge		
CO1	Define basic concepts on fish genetics and selective breeding (such as gene and chromosome, Mendelian laws, traits and heritability, environmental effects ...)	4.1	2.1.3a

COs	Descriptions	Objectives	POs
	Knowledge		
CO2	Explain genetic basis and applications of sex termination, qualitative and quantitative traits, population genetics, and genetic changes under domestication and species introduction	4.1	2.1.3a
CO3	Describe breeding approaches to improve traits of interest, including selection, hybridization, chromosome manipulation, and sex reversal	4.1	2.1.3a
CO4	Generalize principals, pros and cos of commonly used molecular tools to solve issues in aquaculture and fisheries.	4.1	2.1.3.a
	Skills		
CO5	Apply appropriate selective breeding programs and/or genetic tools to improving seed quality of aquaculture species and managing wild fish populations.	4.2	2.2.1a
CO6	Develop rational thinking, group- and individual working skills	4.3	2.3
	Attitudes/Autonomy/Responsibilities		
CO7	Develop habits of self-study, long-life learning and positive attitude toward genetics	4.4	2.3.b, 2.3.c

6. Brief description of the course

The course introduces theory of genetics and breeding in fishes and other aquatic animals, methods in fish selective breeding population genetics, conservation genetics, and genetic management of natural population of fish; traditional animal breeding, genetic engineering and other genomic manipulations for genetic enhancement of aquatic organisms; inheritance of characters responsible for efficient fish production.

7. Course structure:

71. Theory:

Units	Contents	Hours	COs
Chapter 1	**Introduction to fish selective breeding**	**1**	CO1, CO7
Chapter 2	**Qualitative traits**	**2**	CO1, CO2

2.1	Dominance and recessiveness		
2.2	Linkage		
2.3	Pleiotropy and Epistasis		
2.4	Penetrance and expressivity		
2.5	Albinism, Scaleness, Skeletal deformities		
2.6	Sex linkage and Progeny testing		

Chapter 3.	**Quantitative traits**	**3**	CO1, CO2
3.1	Definition		
3.2	Measurements of quantitative traits		
3.3	Partitioning components variance		
3.4	Heritability		
Chapter 4.	**Breeding methods**	**6**	CO3, CO5, CO6, CO7
4.1	Selection		
4.1.1	Mass selection		
4.1.2	Family selection		
4.1.3	Other methods of selection		
4.2	Inbreeding		
4.3	Cross breeding (intraspecific): heterosis and overdominance		
4.4	Hybridization (interspecific)		
4.4.1	Reproductive isolating mechanisms		
4.4.2	F1 hybrids		
4.4.3	Reciprocal recurrent selection		
4.4.4	Backcrossing and introgression		
Chapter 5.	**Sex reversal and chromosome manipulation**	**6**	CO3, CO5, CO6, CO7
5.1	Sex determination and sex reversal in fish		
5.2	Sex determination and sex reversal in crustacean		
5.3	Polyploidy		
5.4	Gynogenesis		

5.5	Androgenesis		
Chapter 6	**Population genetics**	**6**	CO1, CO2, CO6, CO7
6.1.	Hardy-Weinberg equilibrium		
6.2.	Allele frequencies, genotypic and phenotypic frequencies of qualitative traits		
6.3	Testing Hardy-Weinberg equilibrium and applications		
Chapter 7	**Broodstock management**	6	CO2, CO6, CO7
7.1	Genetic drift		
7.2	Effective population size		
7.3	Inbreeding and its effects		
7.4	Maintaining genetic diversity of captive populations		
Chapter 8	**Molecular genetics and applications**	**15**	CO1, CO4, CO6, CO7
8.1	Introduction to molecular techniques		
8.2	DNA markers		
8.3	Applications of DNA markers in aquaculture		
8.4	Gene Mapping, Gene transfer in fish		
8.5	Applications of DNA markers in fisheries and conservation		

8. Teaching method:

Teaching methods include lecturing, discussion and lab demonstration. Lectures are presented in powerpoint slides incorporated with board drawing when needed. Reasoning questions will be asked during lecturing, which help students develop active thinking. Lab demonstration will be applied on molecular techniques for students.

9. Duties of student:

Students have to do the following duties:

- Attending 100% lab demonstration
- attending classes and participating in class activities.
- preparing before classes all required reading and homework

10. Assessment of student learning outcomes:

10.1. Assessment

No.	Point components	Rules and Requirement	Weights	COs
1	Participation	Attending 90% class hours Contributing to class discussion	5%	CO6, CO7
2	Homwork and mini-tests		20%	CO1 – CO7
3	Mid-term exam	Multiple choice and short-answer questions	20%	CO1 – CO7
4	Final exam	Multiple choice and short-answer questions	55%	CO1 – CO7

10.2. Grading

- Grading components and final test scores will be marked on a scale of 10 (0 to 10), rounded to one decimal place.
- Course score is the sum of all the components of the evaluation multiplied by the corresponding weight. The course score is marked on a scale of 10 and rounded to one decimal place, then it is converted to A-B-C-D score and score on a scale of 4 under the academic regulations of the University.

11. Materials:

Materials information	Code number
[1] Phạm Thanh Liêm, Dương Thúy Yên và Bùi Minh Tâm, 2015. Giáo trình Di truyền và chọn giống thủy sản. Nhà xuất bản Nông nghiệp, 144 trang	TS.005365
[2] Lutz, C.G., 2001. Practical Genetic for Aquaculture. Fishing News Books, Blackwell Science. 235 p	639.8L975 TS.001379
[3] Tave, D., 1993. Genetics for fish hatchery managers. 2nd Edition, Van Nostrand Reinhold, New York.	
[4] Dunham, R.A., 2011. Aquaculture and fisheries biotechnology – Genetic approaches. CABI Publishing. 372p.	639.3 D917 TS004676

12. Self-study Guide:

Week	Content	Theory (hours)	Practice (hours)	Students' duties
1	**Chapter 1. Introduction to fish selective breeding**	1	0	*Before class*: + Read chapter 1, reference 1+
1	**Chapter 2. Qualitative genetics** 2.1. Dominance and recessiveness 2.2. Linkage 2.3. Pleiotropy and Epistasis 2.4. Penetrance and expressivity 2.5. Albinism, Scaleness, Skeletal deformities 2.6 Sex linkage and Progeny testing	2	0	*Before class*: + Read chapter 1, reference 4 + Read chapter 2, reference 3
2	**Chapter 3. Quantitative genetics** 3.1. Definition 3.2. Measurements of quantitative traits 3.3. Partitioning components variance 3.4. Heritability	3	0	*Before class*: + Read chapter 4, reference 2 about genetics of quantitative phenotypes + Review basic descriptive statistics: mean, variance, standard deviation, coefficient variation, normal distribution.
3-4	**Chapter 4. Breeding methods** 4.1. Selection 4.2. Inbreeding 4.3. Cross breeding 4.4. Hybridization	6		*Before class*: + Read chapter 4, reference 2 + Read chapter 3, reference 3 + Read chapter 4, reference 4 *Homework*: search for examples of hybrids which are important in

				aquaculture. Discuss issues relating to hybridization
5-6	**Chapter 5. Sex reversal and chromosome manipulation** 5.1. Sex determination and sex reversal in fish 5.2. Sex determination and sex reversal in crustacean 5.3. Polyploidy 5.4. Gynogenesis 5.5. Androgenesis	6		*Before class*: + Read chapter 4-5, reference 3 + Review meiosis, mitosis from online sources + Additional reading: Duong et al., 2017. Can Tho University Journal 51, 64-71. *Homework*: search for genetic basis and protocol of sex reversal of tilapia
7-8	**Chapter 6. Population genetics** 6.1. Hardy-Weinberg equilibrium 6.2. Allele frequencies, genotypic and phenotypic frequencies of qualitative traits 6.3. Testing Hardy-Weinberg equilibrium and applications	6		*Before class*: + Review Chapter 2 + Read chapter 3, reference 3 *Homework*: Calculate Allele frequencies, genotypic frequencies, and test Hardy- Weinberg equilibrium (provided in class)
9	**Chapter 7. Broodstock management** 7.1. Genetic drift 7.2. Effective population size 7.3. Inbreeding and its effects 7.4. Maintaining genetic diversity of captive populations	6		*Before class*: + Read chapter 6, reference 3 *Homework*: Calculate Effective population size and the number of breeders needed to maintain genetic diversity of broodstock populations (provided in class)
10-14	**Chapter 8. Molecular markers and population**	9	6	*Before class*:

	genetics 8.1. Introduction to molecular techniques 8.2. DNA markers 8.3. Applications of DNA markers in aquaculture 8.4. Gene Mapping Gene transfer in fish 8.5. Applications of DNA markers in fisheries and conservation			+ Read chapter 4, reference 3 + Read chapter 6, reference 4 *Homework*: What does GMO mean? Discuss advantages and concerns about GMO in fisheries *Before practice hours (Lab demonstration on 8.1)* + Search demonstrations from the internet about DNA extraction, PCR and gel electrophoresis.
15	**Final exam**			

Can Tho, ..30.../..8..../2022

ON BEHALF OF RECTOR

DEAN OF COLLEGE

TRƯỜNG ĐẠI HỌC CẦN THƠ

Vũ Ngọc Út

HEAD OF DEPARTMENT

Phạm Thanh Liêm