Course Syllabus, Spring 2013

BE 4380 AQUACULTURAL ENGINEERING

Dr. Hall, Spring 2013, T, Th 12:00-1:30, 116 Tureaud

Credit Hours: 3 (3 hours lecture, with design/project component)

Course Description: *Prerequisites: Senior Standing or Permission of Instructor*. Engineering principles applied to aquacultural systems; water chemistry; fluid mechanics; aquacultural pumping plants; fish pond design; recirculating aquacultural systems; water filtration; disinfection; aeration and degassing; instrumentation in aquacultural systems; biological, ecological and environmental aspects of aquacultural engineering design.

Objectives: Teach students the unique aspects of engineering in aquacultural systems. Learn basics of design of aquacultural systems under a variety of theoretical and applied conditions. Recognize and include biological, economic and environmental aspects in design of aquacultural systems.

Instructor: Dr. Steven G. Hall, 143 E.B. Doran, 578-1049, cell 281-9454
e-mail: sghall@agcenter.lsu.edu
TAs: Jake Farlow jfarlow1@lsu.edu; Stefanie Gilliam sgilli1@lsu.edu; Matt Byrum mbyrum1@lsu.edu; Daniel Smith dsmi112@lsu.edu;
Office hours: 1:30-2:00, T, Th or by appointment.

Required Text: Timmons and Ebeling, 2010. Recirculating Aquaculture Second Edition, Cayuga Aqua Ventures 2010. 948pp.
References: See separate listing.

Criteria for determining grade:

Homework:		15%
Final project:		35%
Report, proj	25%	
Presentation	10%	
Midterm		25%
Final Exam		25%

Final course grade will be determined from the following scale:
A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; F: 0-59%

Late policy: One letter grade reduction each late day after an assignment is due.
Missed exams: At the discretion of the instructor.
No Cheating: Absolutely no cheating will be tolerated on exams. Collaborative work is expected on projects.

Course Outline, **BE 4380 AQUACULTURAL ENGINEERING**

Biological Engineering Design of Aquacultural Systems

- The Design Process in a Biological Framework
- Aquatic Ecology and Environments (Water Quality)
- Species Considerations
- Site Selection

Water Supply

- Ground Water
- Surface Water
- Water Quality and Preparation
  - Dissolved Oxygen (DO)
  - Solids (TSS,etc.)
  - Nitrogen Considerations (NH_3, NO_2, NO_X, Feed)
  - Relevance of pH, Temperature and Other factors

Aquaculture in Open Systems

- Mariculture
- Environmental Issues
- Behavioral, Biological and Ecological Considerations

Fluid Mechanics

- Open Channel Flow
  - Continuity
  - Manning's Equation
  - Flow Measurement
    - Flumes and Weirs
    - In-Situ Instrumentation
- Pipe flow: Minor and Major Losses
- Design Considerations

Materials and Equipment

- Materials Selection
  - Corrosion Considerations
  - Fouling of Filters, Instrumentation, etc.
  - Disease and Trophic Considerations
- Tanks and Piping
- Pumps and Motors
- Filters and Filtration
  - Physical (Screen/Overflow/Sand or Rock)
  - Biological (e.g. Filter beds, RBC’s, PAS applications, etc.)
- Aeration and Oxygen Needs
  - Air Lifts, Airstones, Pressurized O2, Mechanical Aeration

Biological Aeration: Plant/Animal Interactions

<u>Aquaculture in Enclosed and Semi-Enclosed Systems</u>

- Flow-Through or Fixed Systems
    - Production Ponds
    - Polyculture with aquatic plants (e.g. Crawfish/Rice)
    - Cages
    - Recreational Ponds
- Recirculating Systems
    - Tanks
    - Raceways (e.g. PAS)
    - Research Systems
    - Recreational Aquaria

<u>Harvesting and Transport</u>

- Harvesting Methods
    - Physical Approaches
    - Behavioral Approaches
    - Automated Harvesting Systems
- Transport Systems
    - Biological Needs of Aquatic Species (DO, TSS, N)
    - Stress and Disease
    - Transport Economics

<u>Processing Methods</u>

- Cleaning, Depuration
- Live Tanks in Restaurants and Stores
- Processing to Filets
- Freezing, Drying, Salting
- Off Flavor Work (MIB etc)

<u>Instrumentation and Control in Aquacultural Systems</u>

- Biological Considerations in Instrumentation and Control
- Centrally Controlled Computer Systems
- (see Hall Aqua-lab; EVEG Labs)
- Timers, Switches
- Solid State Units
- Data Retrieval and Alarm Systems
- Safety

<u>Biological, Trophic and Environmental Considerations</u>

- PAS system and other Ecological/Trophically Based Aquaculture Systems
- Disease, Species Requirements
- Other Considerations

BE 4380 Aquacultural Engineering Course Schedule Spring 2013

Date	Topic	Work Due
1/15/2013	Introduction, Syllabus, Grading, Schedule	(First Assignment)
1/17	**Biological Engineering in Aqua-systems** (See Aqua Lab)	**(Ch1,2 Timmons)**
1/22	**Culture and Biology of Aquatic Organisms** (Aquaculture in Louisiana, IP, Publications)	**(HW 1 due)**
1/24	**Water Quality Parameters**	**(Ch 2, Timmons)**
1/29	**Recirc I: Mass Balances**	**(Ch 3, Timmons) HW 2 due**
1/31	**Aquaculture In Open Systems (Ben Hur)** (Ch 16 Timmons, Ref. Lekang)	{Choose Project Topics}
2/5	**Environmental Issues Discussion Day**	**HW 3 due**
2/7	**Fluid Mechanics: Pipe Flow**	**(Ch 12, Timmons)**
2/12	**Mardi Gras Holiday: Go fishin' ☺**	
2/14	**Culture Units** {Early Class Evals}	**(Ch 4, Timmons) (HW 4 due)**
2/19	**Solids Capture; Waste Management**	**(Ch. 5, 6)**
2/21	**World Aquaculture Society Meetings, TN: work on projects**	
2/26	**WAS Review**: presentations by students/review by Dr. Hall (Coastal Eng) (Marine Systems ref Lekang) (Byrum)	
2/28	**Biofiltration** (Saidu, Hall) {Prelim. Project Report = **HW 5**}	**(Ch 7,8,9)**
3/5	**Fluid Mechanics: Open Channel Flow**	(Ref Lawson)
3/7	**MIDTERM**	
3/12	**Waste Management**; Flow Through Systems	**(Ch 6 Timmons)**
3/14	**Recreational Systems**: Water Gardens, Aquaria (Farlow)	
3/19	**Recirc II:** Advances in Recirc. Aquaculture	

BE 4380 Aquacultural Engineering Course Schedule (Continued)

Date	Topic	Work Due
3/21	**Harvesting and Transport**	**(HW 6 due)**
3/26	**Equipment: Gas Transfer; Cleaning**	**(Ch 10, 11 Timmons)**
3/28	**Biological and Trophic Considerations Discussion Day (HW 7 due)**	
4/2	**Spring Break**	(Go Fishin' ☺)
4/4	**Spring Break**	
4/9	**Instrumentation and Control** (Smith)	**(Ch 13, Timmons, ref Hall)**
4/11	**Aquaponics and the Future** (Gilliam)	**(Ch 19, Timmons)**
4/16	Student Presentations	(**Final Projects Due**)
4/18	Student Presentations	
4/23	Possible Field Trip	
4/25	Student Presentations	
4/30	(**Optional Exam 2**)	
5/2	**Aquafest!** Course wrapup/evals	
5/ 6	**Official Date of Final Examination Monday May 6, 3-5 PM** **116 Tureaud**	

BE 4380 Course Project

An aquacultural engineering design project will be incorporated into the course. This will have theoretical and practical design components, with students calculating and designing a relevant aquacultural system or component, and then building and testing that device if possible.

Final Report: 25%

A final report should summarize the engineering design calculations, relevant literature review (who has done similar work before), actual system or component designed and built, and operational testing.

Final Presentation: 10%

A final presentation will be made during the last weeks of the course by each group (groups should consist of 1-3 students), which should present this information in a clear fashion in approximately 20 minute presentation. You may use powerpoint, multimedia, props as available.

Grading of Project Components

The final report should summarize the project fully but succintly, and will be worth 25% of the course grade. Grading will depend heavily on work done, applicability, design relevance and report excellence. The final presentation will be worth 10% of the final course grade, and should include all the above, plus be appropriate for the audience. Web-based or html format presentation are encouraged. All work should be submitted, in electronic format (by file attachment or on disk) if possible.

Project Ideas

Projects provide an opportunity to learn about the design process; about real-world constraints such as economics; and also to serve and educate others. Projects should have a real impact in a research, education or service area. Ideally, some design, analysis, construction and testing should be included. Possible project areas are outlined below. Please see Dr. Hall regarding project specifics.

Including new ideas for 2013:

- Recirculating Aquaculture: Demonstration System; Biofiltration (Hall, Farlow)
- Autonomous Vehicles for Aquaculture: Daniel Smith
  - Battery and Energy Balance
  - Electronics and Control
  - Fleet Communications

    - Field Testing: Aquacultural Research Station, LSU Lakes
- How to Video Production
    - Boat Construction, Operation (Smith)
    - Artificial Reef Construction (Byrum)
    - Aquaponics (Gilliam)
- Use of rice hulls and/or wood chips as biofiltration media (Saidu)
- Alligators: Energy Efficiency (Hall, Frederick, Husser)
- Alligators: Housing Improvements (Reigh at ARS, Hall, Frederick, Husser)
- Autonomous vehicles: help develop such products to reduce bird depredation, measure water quality or do other functions: fleet building; logic; etc. (Smith)
- Waste Management: Develop a composting system for aquacultural wastes (Hall)
- Fish emulsion development for application (Hall, Carney, Motsenbacher)
- Aquaponics: Build a simple hydroponic system which incorporates animal and plant species with an aquatic environment
- Plants: Aquatic plants for bioenergy (Malveaux)
- Crawfish: Design/build improved culture units for crawfish (Farlow, Smith)
- Crawfish: Toxicology experiments (Farlow)
- Algae Oyster Complex (Hall et al.)
- Algae for bioenergy (Theegala, Kato or Malveaux)
- Appropriate Technology: Catfish System for Nigeria (Akinwole, Hall)

Projects should focus on a particular component or system. However, these systems should be integrated into existing systems and/or with other systems under present or future development. For example, waste management and hydroponics could be considered together, even if a single group's project focuses only on one or the other. In addition, educational components (e.g. a poster or explanation, website or other educational device) should be included. University tours, high schoolers or members of the public may visit these devices, whether here at the department or on a farm. Explanations should include some technical information, but should be simple enough that an interested layperson or high school students can understand the basic principles of a system's operation. In the project as a whole and in the final report, you should be both technically excellent, including all relevant calculations and schematics; as well as creative, thinking of system aesthetics and convenience in your design. In other words, your design should be sound, robust, and beautiful, and should aim for excellence.

Additional References, BE 4380 Aquacultural Engineering

(Should be at Library)

Lekang, Odd-Ivar, 2008. Aquaculture Engineering, Blackwell Publishing, 340 pp.

Reference Text: Lawson, Thomas, 1995. Fundamentals of Aquacultural Engineering. Chapman and Hall.

Hutchinson, Lawrence, 2005. Ecological Aquaculture. Permanent Publications, 149 pp.

Huguenin, J.E. and Colt, J., (1989), Design and operating guide for aquaculture seawater systems, Elsevier Scientific Publishing Co., Amsterdam, 264 pp.

Timmons, M.B., Losordo, T.M., editors, (1994), Aquaculture water reuse systems: engineering design and management, Elsevier Scientific Publishing Co., Amsterdam, 333 pp.

Wheaton, F.W., (1977), Aquacultural Engineering, Wiley, New York, 708 pp.

(Websites)

Handouts from Dr. Hall