FACULTY OF FISHERIES AND FOOD SCIENCE
UNIVERSITI MALAYSIA TERENGGANU

Course Name	**Fishery Molecular Ecology**
Course Code	SP6133
Course Level	Master
Credit Hours	3(3+0)
Pre-requisite Courses	None
Assessment Method	**Assessment** — **Percentage** Continuous assessment (60%) - Test 1 and 2 - Assignments - Quiz Final exam — 40% Total — 100%
Method of Delivery	• *Lectures/ Laboratory* • *Assignments* • *Group Discussion*
Teaching Staff	
Semester Offered	Semester 1 & 3
Course Synopsis	This course aims to expose students to basic concepts and skills in sustainable management of fishery resources through molecular approaches. In this course, basic principles of ecological genetics and population genetics as well as the application of molecular markers in the ecological and evolutionary aspects of fish will be emphasized. Molecular techniques which are commonly used in fish population studies such as species identification, phylogeny, phylogeography, and conservation unit determination will also be discussed. Current issues related to threatened aquatic biodiversity and associated conservation strategies will also be discussed. Students will also be trained to conduct research in fisheries molecular ecology encompassing the process of sampling, voucher specimens preparation, data analysis and scientific report writing.
Course Objectives	1. Identify endangered species and the importance of conserving biodiversity of fishery resources 2. Understanding the basic concepts of genetics in the field of ecology, population, evolution and conservation, and fisheries resource conservation issues 3. Studying various molecular markers used in ecology and fishery resources conservation management research

Course Outline

Week	Content	Hours
1	Introduction to Conservation Biology of Fisheries Resources • Why biodiversity and fisheries resources need to be preserved? • Threatened and extinct fish species in the list of the International Union for Conservation of Nature (IUCN) • Factors that cause extinction • Fisheries resources conservation methods	3
2-3	Genetics in Ecology • Nucleic acid and the origins of life • Genome structure: the overall picture • Genotype and phenotype variations • DNA sequence and its application	4
4-5	Molecular Markers in Ecology • Allozyme electrophoresis • Restriction Fragment Length Polymorphism (RFLP) • Amplified Fragment Length Polymorphism (AFLP) • Minisatellites and microsatellites • Single Nucleotide Polymorphism	4
5-6	Mechanism of Evolutionary Changes • Mutation and evolutionary rate • Gene flow and migration rate • Natural selection • Principles and types of evolution models	4
7-8	The Principles of Population Genetic • The concepts of genetic diversity • Measurement of genetic diversity • Hardy-Weinberg Equilibrium (HWE) • Fixation Index	4
8-9	Molecular Identification Methods • Molecular identification methods for: o Species o Population ○ Sex • Determination of a population based on genetic information (Population assignment)	4
10-11	Phylogeny and Phylogeography • Molecular markers in phylogeny and phylogeography • Genetic variation in the aspect of space (spatial) and time (temporal) • Application of phylogeny and phylogeography in fisheries management	4

11-12	Conservation Unit • The basic concept of genetic conservation • Determination of species management units • Application of conservation units in the planning of fishery resource management	4
12-13	Conservation Genetics and Management of Endangered Species • Genetics issues in threatened population • The diagnosis of genetic problems • Assessment of conservation strategies • Conservation breeding • Restoration Programs	5
13-14	Genomics in Fisheries Research • Next Generation Sequencing (NGS) • Large scale genome analysis • Algorithm for prediction of molecular function and structure • Comparative Genomics • Metagenomics • Transcriptomics	6

References

1. Beebee, T.J.C. And Rowe, G. (2008). An Introduction to Molecular Ecology (2nd edition). Oxford University Press Inc., New York. 400 p.
2. Page, R.D.M. and Holmes, E.C. (2009). Molecular Evolution: A Phylogenetic Approach. John Wiley and Sons. 352 p.
3. Frankham, R., Ballou, J.D. and Briscoe, D.A. (2010). Introduction to Conservation Genetics. Cambridge University Press. 642 p.
4. Hamilton, M. B. (2011). Population Genetics. John Wiley and Sons. 424 p.
5. Allendorf, F.W., Luikart, G. And Itken, S.N. (2012). Conservation and the Genetics of Populations (2nd edition). John Wiley and Sons. 608 p.

<table>
<tr><td>Course Name</td><td>Fisheries Limnology and Oceanography</td></tr>
<tr><td>Course Code</td><td>SP 6143</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td></td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
Assignments
Field trip report
Presentation of report and assignment
Test</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>Method of Delivery</td><td>Lectures
Practical
Presentation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 1 & 3</td></tr>
<tr><td>Course Synopsis</td><td>The aim of this course is to express an understanding on fisheries in freshwater and marine ecosystems. Topics covered include the roles of fish response to environmental variation, adaptation of fish by natural selection, and subsequent ecological diversification in generating fish species diversity and allowing population and community persistence. Students also will be exposed to the methods and techniques to evaluate environmental changes as well as changes in fish and other aquatic animal’s population. At the end of the course, students will be able to explain similarities and differences in the ways that fish maintain fitness and interact with other biota in both ecosystems.</td></tr>
<tr><td>Course Objectives</td><td>i. Understand the knowledge of limnological and oceanographic principles which will enable deeper understanding of fish adaptation processes.
ii. Explain the importance of fish resources in freshwater and marine ecosystem.
iii. Relate the impact of human and environmental factors on fish production</td></tr>
</table>

Course Outline: Theory

Week	Content	Hours
1	Introduction - Physical and chemical dynamics of limnology and oceanography - Fisheries issues	2
2	Population dynamics - Diversity - Estimation of fish population size - Fish condition factors	2
3−4	Source of changes in freshwater and marine ecosystem - Toxins and pollutants - Urbanization and effect towards aquatic resources	4
5−6	Fish community response - Competition - Consumer-resources interaction	4
7−9	Trophic cascade - Food web - Exotic species - Toxic algae	6
10 - 11	Empirical fisheries relationships - fisheries-nutrient relationship - Fisheries-plant relationship	4
12	Developing management plans - Tools and strategies - Application, bias and confidence.	2
13 - 14	Environmental issues - Climate change - Eutrophication	4

Course Outline: Practical

Content
1. Lake field trip
2. Ocean field trip
3. Biodiversity and habitat-specificity
4. Trophic cascade experiments
5. Nutrient limitation experiments

References

1. Dobson, M., and C. Frid. 2009. Ecology of Aquatic Systems. Oxford University Press, Oxford. 321 pp.
2. Likens, Gene E. 2010. Lake Ecosystem Ecology. Elsevier Inc., San Diego, California. 463 pp.
3. Nybakken and Bertness. 2005. Marine Biology: An Ecological Approach. 6th Edition, Pearson Education. 453 pp.
4. Paul, J. H. and Timothy R. P. 2001. Fisheries Oceanography (Fish and Aquatic Resources). Wiley-Blackwell. 360 pp.
5. Taivo L, 1993. Marine Climate, Weather and Fisheries: The Effects of Weather and Climatic Changes On Fisheries and Ocean Resources. Wiley-Blackwell. 204 pp.

<table>
<tr><td>Course Name</td><td>Sport and Game Fishing</td></tr>
<tr><td>Course Code</td><td>SP6153</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
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<tr><td>Continuous assessment
Assignments
Field trip report
Presentation of report and assignment
Test</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
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</td></tr>
<tr><td>Method of Delivery</td><td>Lectures
Practical
Presentation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 2</td></tr>
<tr><td>Course Synopsis</td><td>The aim of this course is to introduce the students to the sports fishing industries globally. Topics covered include the famous freshwater and saltwaters fish species, the fishing methods used, famous sport fishing area in the world, ethics and principles, rules and regulations and industrial importants and its related industries. The students will also gain experiences in applying sports fishing activities by field works and workshop.</td></tr>
<tr><td>Course Objectives</td><td>Understand the sports fishing concepts and practices as an industry.
Explain the rules, regulations and fishing ethics related to the sports fishing practices.
Organize and practice sports fishing.</td></tr>
</table>

Course Outline: Theory

Week	Content	Hours
1	Introduction - Definition - Industrial point of view	2
2	Species preferable - Famous Freshwater species - Famous Saltwater species	2
3−4	Fishing Methodologies - Rod and Line fishing - Fly fishing	4
5−6	Major sports fishing area of the worlds - US - Europe - Asia - Oceania	4
7−9	Fishing ethics and principles - Catch and release methods - Open and close season - Minimum size regulations - Pay ponds	6
10 - 11	Rules and Regulations - USA and Canada - Australia - Asia	4
12	Industrial approaches by countries	2
13 - 14	Related Industrie	4

Course Outline: Practical

Content
1. 3D/2N sports fishing trip
2. Workshop on fly fishing

References

1. Hall, J.B., Richard, J. and Suroviec, J. (2007). Sportsman's Best: Offshore Fishing. Florida Sportsman Pap/DVD Re edition. 285 pages
2. Peachin, M.L. (2011). Sport Fishing In the Caribbean. CreateSpace Independent Publishing Platform. 376 pages
3. Unkart, J. (2013). Offshore Pursuit: A Complete Guide to Blue-Water Sport Fishing. Schiffer Publishing; 2nd edition. 232 pages
4. Fichter. G.S., Francis, P., Dolan, T., Martin, K., McKnaught, H. (2001). Fishing: A Guide to Fresh and Salt-Water Fishing. St. Martin's Press; 1st edition: 160 pages
5. Rosenbauer, T. (2007). The Orvis Fly-Fishing Guide. Lyons Press: 288 pages

<table>
<tr><td>Course Name</td><td>Coral Reef Fisheries</td></tr>
<tr><td>Course Code</td><td>SP6163</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
1. Site visit reports
2. Assignment
3. Test
4. Quiz</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
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</td></tr>
<tr><td>Method of Delivery</td><td>Combination of following methods:
Lectures
Assignments
Group Discussion
Site visitation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 2</td></tr>
<tr><td>Course Synopsis</td><td>This course will introduce students to the fishing practices in coral reef. The course also covers the importance of coral reef, the diversity of fishery resources and the destructive fishing gears. Students will be exposed to the concept of marine protected area and Coral Triangle Initiative – coral reef, fisheries and food security applied in our region. At the end of the course, students are able to understand the threats and impacts on coral reef fisheries and the effective approach to manage coral reef fisheries</td></tr>
<tr><td>Course Objectives</td><td>i. Understanding the variety of fishery resources and the fishing practices in coral reef.
ii. Understanding the threats and impacts to coral reef.
iii. Knowing the adaptive management strategies to protect the coral reef fisheries sector.</td></tr>
</table>

Course Outline

Week	Content	Hours
1	Fishery resources • History, development and production status of fishery resources globally and locally. • The importance and contribution of coral reef fisheries sector.	2
2-3	Coral reef • Biodiversity. • Coverage. • Importance.	4
4-5	Type of fishery resources • High commercial fishery resources. • Low commercial fishery resources. • Unconcern fishery resources.	4
6-7	Fishing practices • Gill net, fish trap, bottom trawling, cyanide fishing, dynamite fishing, muroami fishing, and etc.	4
8-9	Threats and impacts to coral reef • Destructive fishing, ghost fishing, vessel anchor, human-caused, natural threats and etc.	4
10-12	Coral reef management • Adaptive management strategies. • Marine protected areas (MPAs). • Coral Triangle Initiative (CTI). • Regulations and laws. • Information and education.	6
13-14	Coral restoration • Coral farming. • Artificial reef.	4

Practical

No.	Lab Title
1	Site visitation (2 nights)

References

1. Carcasson, R. H. 1977. *A field guide to the coral reef fishes of the Indian and West Pacific Oceans*. London: Collins.
2. Bryant, D., L. Burke, J. McManus, and M. Spalding. 1998. Reefs at Risk: A Map-based Indicator of Threats to the World's Coral Reefs. World Resources Institute. 56pp
3. Sinclair, M. and G. Valdimarsson, (Eds) 2002. *Responsible Fisheries in the Marine Ecosystem.* CABI Publishing. xvii + 426pp
4. Kelleher, G. 1999. Guidelines for Marine Protected Areas. Gland, Switzerland and Cambridge, UK: IUCN — The World Conservation Union. xxiv + 107 pp.
5. Hatziolos, M. E., Hooten, A. J. And Fodor, M (Eds.). 1998. Coral reefs challenges and opportunities for sustainable management. Washington, D.C. The World Bank. X + 224pp

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<table>
<tr><td>Course Name</td><td>Habitat Replenishment Areas</td></tr>
<tr><td>Course Code</td><td>SP6183</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
1. Site visit reports
2. Assignment
3. Test
4. Quiz</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>Method of Delivery</td><td>Combination of following methods:
Lectures
Assignments
Group Discussion
Site visitation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 2</td></tr>
<tr><td>Course Synopsis</td><td>This course is designed to introduce the students with various innovative concept of replenishment of degraded fisheries habitat in the coastal waters. The course begins with lectures on various commonly practiced destructive fishing gears in the coastal waters including in the hot spot habitat such as coral reefs, seagrass and mangrove ecosystems. Then the discussion continues with mitigating measures to replenish and protecting the degraded habitats. This will include various methods of fishing habitat restoration including installation of artificial reefs, ships wrecks, and policies. Monitoring of recovery rates in the affective replenished areas will also be discussed. In addition to lectures, the student will also be given several assignments such as essays on special related topics, term papers and examination during the whole course of the study.</td></tr>
<tr><td>Course Objectives</td><td>1. Understanding the causes and factors of habitat degradation.
2. Understanding the ecosystem recovery requirement.
3. Knowing the various approaches in mitigation of replenishes areas and monitoring.</td></tr>
</table>

Course Outline

Week	Content	Hours
1	Introduction • Definition • Current status of threaten marine habitat in the World and Malaysia Waters	2
2	Contributing factors to habitat Degradation • Human factors (fishing and marine exploration, river mouth alteration and reclamation activities) • Natural hazards (Tsunami, cyclones etc.)	2
3−5	Detrimental development • Fishing methods (detrimental gears) • Coastal developmant (Reclamation etc.)	6
6−7	Types of habitat degradation • Fishing ground degradation • Coastal habitat degradation (mangrove, seagrass, mudflats)	4
8−10	Mitigation, and habitat replenishment approaches • Physical approaches - Installation of artificial reefs and FAD's - Ship wreck - Beach replenishment, mangrove protection , revetment etc • Biological approaches - Coastal restoration e.g. mangrove replanting etc • Policy and legal approaches	6
11	Continues assessment and monitoring of replenished areas	2
12−14	Critical discussion and term paper presentation	6

Practical

No.	Lab Title
1	Site visitation (2 nights)

References

1. Burkett V. and Davison M. 2013. Coastal Impacts, Adaptation, and Vulnerabilities. A Technical Input to the 2013 National Climate Assessment. Island Press. 126 p.
2. Howell, E.A. ,Harrington, J.A. and Glass S.B. 2011. Introduction to restoration ecology. Island Press 436 p.
3. Spalding, M.D., Meliane, I., Milam, A., Fitzgerald, C. and Hale, L.Z. (2013) Protecting marine spaces: global targets and changing approaches In: A. Chircop, S. Coffen-Smout, McConnell (Eds.), Ocean yearbook, 27 Dalhousie University, Leiden (2013), p. 213
4. Sinclair, M. and G. Valdimarsson, (Eds) 2002. *Responsible Fisheries in the Marine Ecosystem.* CABI Publishing. pp. 65-85.
5. Salm, R.V., Clark, J. and Siirila, E. (2000). Marine and Coastal Protected Areas: A guide for planners and managers. IUCN. Washington DC. xxi + 371pp.

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<table>
<tr><td>Course Name</td><td>Fisheries Post-Harvest Technology</td></tr>
<tr><td>Course Code</td><td>SP6193</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
Assignments
Field trip report
Presentation of report and assignment
Test</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
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<tr><td>Method of Delivery</td><td>Lectures
Practical
Presentation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 2</td></tr>
<tr><td>Course Synopsis</td><td>The course provides knowlegde on process and/or activities immediately after catch, handling and transportation, processing and distribution of fish and fish products. It covers the aspects of physicochemical and biochemical changes, method of quality assesment and currect technological development for product shelf-life extension. The student will also exposed in critical thinking, lifelong learning and scientific approach skills.</td></tr>
<tr><td>Course Objectives</td><td>i. Understand the concepts of fish handling and processing
ii. Analyse the quality assessment and post-harvest technology to manage live fish and fishery product</td></tr>
</table>

Course Outline: Theory

Week	Content	Hours
1-2	Introduction -Definition -Interest in post-harvest fisheries -Harvesting techniques	4
3-4	The structure and composition of fish -Fish muscle structure -Fish muscle component	4
5-6	Factor that influence the composition of fish -Physiology and biochemistry of fish -Definition, Classification, biological significance of proteins, lipids, carbohydrates, nucleic acids -Structure, functional of protein, lipid, carbohydrate, nucleic acid	4
7-8	Biochemical degradation -Biochemical changes in glycogen, protein, non-protein nitrogen, lipids, pigments, during handling, storage and processing	4
9-10	Handling and preserving the catch - Fish landing - Fish dressing - Onboard preservation	4
11-12	Effect of temperature and processing -Biochemistry and psycochemical on fish during handling, storage and processing -Biochemistry changes in fishery products which are dried, fermented, smoked	4
13-14	Enzyme fish -Adaptation of cold enzyme -Adaptation of osmotic enzyme -Enzyme degradation -Endogenous enzymes reaction during processing -Enzyme technology	4

Course Outline: Practical

Content
1. Assingment/Tutorial
2. Field trip

References

1. Granata L.A., Flick, G.J. & Martin, R.E. (2012). The Seafood Industry: Species, Products, Processing, and Safety. Wiley-Blackwell.
2. Nollet L.M.L. & Toldra, F. (2009). Handbook of Seafood and Seafood Products Analysis. CRC Press.
3. Hui, Y.H. (2006). Food Biochemistry & Food Processing. Blackwell Publishing.
4. Haard, N.F. & Simpson, B.K. (2000). Seafood Enzymes: Utilization and influence on Postharvest Seafood Quality. Food Science and Technology.
5. deMan, J.M. (1999). Principles of Food Chemistry. Springer.

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<table>
<tr><td>Course Name</td><td>Biosecurity and Seafood Safety</td></tr>
<tr><td>Course Code</td><td>SP 6203</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
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<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
Lab reports
Assignments</td><td>50%</td></tr>
<tr><td>Final exam</td><td>50%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
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</td></tr>
<tr><td>Method of Delivery</td><td>• Lectures
• Group Discussion
• Presentation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 1 & 3</td></tr>
<tr><td>Course Synopsis</td><td>The aim of this course is to emphasize the importance of biosecurity and seafood safety. It is also aims to provide students to the best management concept that can be used in aquaculture with the development of an environmental friendly and sustainable sector. Topics covered include a food-chain perspective from chemical contaminants in farmed fish and potential impact on human health and also methods of improving fish health, quality and safety, as well as managing such issues. Students will also learn about good aquaculture practices (GAqP) in different aspects of best practice which includes local and global nature of aquaculture, roles of stakeholders, compliance issues in the authorization of new projects, and environmental, management and operational specifications that make up best practices around aquaculture.</td></tr>
<tr><td>Course Objectives</td><td>i. To recognize the potential impact of fish consumption on human health
ii. To Identify the possible hazards and methods of determination of the hazards in farmed fish
iii. To relate the factors affecting and methods to improve flesh quality and safety in farmed fish
iv. To plan, organize and manage the best practice approach in aquaculture</td></tr>
</table>

Course Outline

Week	Content	Hours
1	Introduction • Safety in the pre-and post-fishery	2
2 - 4	Relavance of biosecurity act and regulation in seafood industry Good aquaculture practices (GaqP)	6
5	Seafood allergens • Patterns of fish allergy • Materials and methods to identify	2
6	Toxic elements in seafood • Mercury, arsenic, lead and cadmium • Materials and methods to identify • Latest issues to human health, methods of reduction in toxic elements cultured organisms, etc.	2
7	Chemoterapeutants used in aquaculture • Trends in pesticide used • Risks to human health in aquaculture products • Future trends	2
8 - 9	Seafood quality • Factors affecting flesh quality in aquaculture	4
10 - 11	Quality management of seafood • Methods of improving aquaculture products quality • Husbandary techniques	4
12 - 13	HACCP in the fishing industry	4
14	Ethics and responsible in aquaculture practices	2

Week	Practical titles
1 - 3	Seafood safety - Microbiology quality analysis - Antibiotic residues analysis - Heavy metal determination
4	Seafood sensory
5 - 8	Seafood quality - TBA analysis - TVBN analysis - Histamine analysis
9 - 10	Design of HACCP system
References	1. Granata, L.A., Flick, G.J., Martin R.E. (2012). The seafood industry: Species, products, processing and safety. 2nd edition. Wiley-Blackwell, UK. 2. Martin, R.E., Carter, E.P. and Flick, G.J. (2000). *Marine and Freshwater Products Handbook*. CRC Press. 3. FAO (2005). Ethical issue in fisheries. Food and Agriculture Organization of the United Nation, Rome Italy. 4. Boziaris, I.S. 2013. Seafood processing: technology, quality and safety. Willey-Blackwell.

<table>
<tr><td>Course Name</td><td>Fisheries Biosystems</td></tr>
<tr><td>Course Code</td><td>SP6213</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (3+0)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
Assignments
Presentation of assignment
Test</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>Method of Delivery</td><td>Lectures
Presentation</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 1 & 3</td></tr>
<tr><td>Course Synopsis</td><td>The course aims to introduce students to fisheries biosystems and its concept, importance and application in sustainable fisheries management. It comprise of several main topics including introduction to fisheries biosytems, component of fisheries biosystems, mechanism and function of biosystems in fisheries. The course will also look into the interaction between fish population with their biotic and abiotic environment based on the biological and molecular aspects. The integration of basic biological information with genomics, transcriptomics and metabolomics of the organisms will also be introduced. In addition, the application of the systems towards sustainable fisheries management will be discussed. At the end of this course, student should be able to analyze and outline the application of various biological systems for management of fisheries resources.</td></tr>
<tr><td>Course Objectives</td><td>i. Expose student to the concept and importance of fisheries biosystems in sustainable fisheries management.
ii. Understand the component and function of fisheries biosystems for management of fisheries resources.
iii. Understand the use of molecular information in fisheries resources management.</td></tr>
</table>

Course Outline: Theory

Week	Content	Hours
1-2	Introduction to fisheries biosystems. - Concept of fisheries biosystems - Importance of fisheries biosystems in management of fisheries resources	6
3-4	Component of fisheries biosystems. - Biological component - Environment component	6
5-7	Mechanism and Function of fisheries biosystems in fisheries management. - Biological Pathway - Molecular information - Biological response of organism towards environmental changes	9
8-9	The interaction between fish population with their environment - Biotic - Abiotic	6
10-12	Molecular approach in fisheries biosystems - Genomics - Transcriptomics - Metabolomics	9
13-14	Application of the fisheries biosystems towards sustainable fisheries management.	6
	Total	42

References

1. Bernot, A. (2004). Genome Transcriptome and Proteome Analysis. Wiley-Blackwell: 248 pages.
2. Charles, A.T. (2001). Sustainable Fishery Systems. Wiley-Blackwell: 388 pages.
3. Christense, V. Maclean, J (2011). Ecosystem Approaches to Fisheries: A Global Perspective. Cambridge University Press: 322 pages
4. Crollius, H.R., Weissenbach, J. (2005). Fish Genomics and Biology. Genome Res. 15: 1675-1682.
5. Liu, Z. (2006). Fish genomics and analytical genetic technologies, with examples of their potential applications in management of fish genetic resources. In: FAO Fisheries Proceedings of Workshop on Status and trends in aquatic genetic resources: a basis for international policy. 145-179.
6. Saroglia, M., Liu, Z. (2012). Functional Genomics in Aquaculture. Wiley-Blackwell: 416 pages.

<table>
<tr><td>Course Name</td><td>Fisheries Product Innovation</td></tr>
<tr><td>Course Code</td><td>SP6223</td></tr>
<tr><td>Course Level</td><td>Master</td></tr>
<tr><td>Credit Hours</td><td>3 (2+1)</td></tr>
<tr><td>Pre-requisite Courses</td><td>None</td></tr>
<tr><td>Assessment Method</td><td>
<table>
<tr><th>Assessment</th><th>Percentage</th></tr>
<tr><td>Continuous assessment
Assignments
Field trip report
Presentation
Test</td><td>60%</td></tr>
<tr><td>Final exam</td><td>40%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
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<tr><td>Method of Delivery</td><td>Lectures
Practical
Presentation
Industrial visit</td></tr>
<tr><td>Teaching Staff</td><td></td></tr>
<tr><td>Semester Offered</td><td>Semester 1 & 3</td></tr>
<tr><td>Course Synopsis</td><td>This course provides the principles of fisheries product development. It involves eight steps namely, idea generation and screening, testing the concept, business analytics, marketability test, product development, commercialization, launching and pricing of the products. Students will also be exposed to critical thinking and entrepreneurial skills prior to the development of the prototype.</td></tr>
<tr><td>Course Objectives</td><td>Understand the steps required to produce a new or modified food.
Familiar with group work and be able to communicate with other institutions in managing the project.
Understand the relationship between various aspects of the results including science, technology, management, research, business management, and others.</td></tr>
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Course Outline: Theory

Week	Content	Hours
1	Introduction - Product development	2
2 - 3	Generation of idea / Selection of idea	4
4 − 5	Market survey - Perception and consumer preference	4
6 - 8	Marketing strategy	6
9 - 11	Introduction to patent	6
12 - 14	Product innovation assessment	6

Course Outline: Practical

Week	Content
1	Brainstorming of product
2	Protocol design for product formulation/development
3	Development of product prototype
4	Presentation of developed product

References

1. Brody, A. L., and Lord, J. B. (eds). 2008. *Developing new food products for a changing marketplace.* Boca Raton, Fla: CRC press.
2. Advances in Fish processing Technology. 2005. Sen D. P., Pub. Allied Publishers Pvt. Ltd. New Delhi.
3. Fuller, G. W. 2005. *New food products development; from concept to marketplace*. Boca raton, Fla: CRC Press.
4. Smith, J. S., and Hui, Y. H. 2004. Food Processing: Principles and Applications. Blackwell Publishing.
5. Knuckey, I. A. 2004. South East Fishery Industry Development Subprogram: Assessing the Commercial Viability of Utilising Fish Processing Wastes. Final report to Fisheries Research and Development Corporation. 23pp.