



University of Kerala

| | | | | | |
|----------------|---|------------------|-------------------|--------------------|------------------|
| Discipline | ZOOLOGY | | | | |
| Course Code | UK2DSCZOO103 | | | | |
| Course Title | Aquatic Ecosystems and Sustainable Management | | | | |
| Type of Course | DSC | | | | |
| Semester | II | | | | |
| Academic Level | 100 - 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | - | 4 |
| Pre-requisites | Pass in class XII | | | | |
| Course Summary | This course shall provide a comprehensive understanding of the structure, function, and dynamics of aquatic ecosystems and enable the student to understand the classification of aquatic fauna and their adaptations. The goal of this course is to comprehend and investigate the challenges that aquatic ecosystems face as well as their conservation tactics. Techniques for the sustainable use and management of aquatic resources are also covered in the course. | | | | |

Detailed Syllabus

| Module | Unit | Content | 60 hrs |
|----------|---------------------------|---|-----------|
| I | Aquatic Ecosystems | | 12 |
| | 1.1 | Introduction, definition and types of aquatic ecosystems (freshwater, marine and brackish water ecosystems) | 2 |
| | 1.2 | Freshwater ecosystems- Lentic and Lotic environments (Pond, Lakes and Reservoirs). | 2 |
| | 1.3 | Marine ecosystems – Intertidal zone, Neritic zone and oceanic zone (Brief description) | 2 |
| | 1.4 | Brackish water ecosystems – Estuaries, backwaters - example Vembanad | 2 |
| | 1.5 | Marine benthic zones- Coral reefs and their significance | 2 |

| | | | |
|------------|---|--|-----------|
| | 1.6 | Mangrove ecosystem – Sunderbans and Kunhimangalam, Kannur | 2 |
| II | Fauna of Aquatic Ecosystems | | 12 |
| | 2.1 | Classification - Plankton, Nekton , Neuston and Benthos (Brief account only) Adaptations of Planktons, deep sea fishes and marine mammals | 6 |
| | 2.2 | Major Bioindicators- Definition and importance in aquatic ecosystems (plankton, mayflies, mussels) | 6 |
| III | Challenges and Conservation Strategies | | 12 |
| | 3.1 | Challenges to Aquatic Ecosystems: Sand Mining, Ocean Acidification, Overfishing, Habitat destruction and Oil Pollution (oil seepage and shipping). | 6 |
| | 3.2 | Conservation Strategies in Aquatic Ecosystem Restoration- Mangrove restoration program, Sea ranching Program, Bioremediation using superbugs, Ramsar sites in Kerala, Marine protected areas (MPAs) – Gulf of Mannar, Sundarbans. (Related Activities- Visit to Mangrove/Ramsar sites) | 6 |
| IV | Utilization of Aquatic Resources | | 12 |
| | 4.1 | Bioprospecting of aquatic ecosystems in the field of food, industry, and medicine – Green algal extract, Cytarabin, Single Cell Protein (Spirulina), Chitin. | 6 |
| | 4.2 | Value Addition of Aquatic resources - Nutraceuticals developed by CMFRI (Cadalmine Green Mussel extract and Cadalmine Antidiabetic extract), Value added seafood products from MPEDA (any two), Water hyacinth as value added product (Mention Center for Research on Aquatic Resources, Alappuzha). | 6 |

| | | | |
|----------|--|--|-----------|
| V | Sustainable Management - Issues and Innovations | | 12 |
| | 5.1 | Integrated Water Resource Management(IWRM)- Ecosystem – based management(EBM). | 3 |
| | 5.2 | Blue economy ,Blue Carbon and Water budget | 3 |
| | 5.3 | Climate change and Aquatic ecosystems- Impact on Biodiversity, Sea level rising, Coral bleaching. | 3 |
| | 5.4 | Innovative Technologies in Management – Remote sensing, GIS and bio- monitoring techniques. | 3 |

References

1. Allan, J.D and Castillo.M.M.2009, Stream Ecology (Second Ed.) Springer, Netherlands
2. Wetzel, R. G. (2001). Limnology: Lake and River Ecosystems (3rd ed.). Academic Press.
3. Odum, E.P. 1971. Ecology. Holt Riehart& Winston Inc., USA, 152 pp.
4. Sharma, B. K. (2016). Environmental Science: Water Pollution and Management. Rastogi Publications.
5. Kalff, J. (2002). Limnology: Inland Water Ecosystems. Prentice Hall.
6. Prasad, B., & Sharma, C. (2019). Sustainable Management of Aquatic Resources. CRC Press.
7. Datta, S. C., & Chattopadhyay, G. N. (2017). Ecology of Plankton. Springer.
8. Keshaviah, P. (Ed.). (2014). Water Resources, Policies, and Politics in India: Initiatives and Challenges. Routledge.

Web Resources

1. International Union for Conservation of Nature (IUCN) - Freshwater Conservation: <https://www.iucn.org/theme/freshwater>.
2. Central Pollution Control Board (CPCB), India: <http://www.cpcb.nic.in/>
3. National Institute of Oceanography (NIO), India: <https://www.nio.org/>
4. Ministry of Environment, Forest and Climate Change, Government of India: <http://moef.gov.in/>
5. Indian Council of Agricultural Research (ICAR) - Central Inland Fisheries Research Institute: <https://cifri.icar.gov.in/>
6. National Institute of Oceanography, India: <https://www.nio.org/>
7. National Mission for Clean Ganga, Government of India: <https://nmcg.nic.in/>
8. World Wide Fund for Nature (WWF) - India: <https://www.wwfindia.org/>
9. United Nations Environment Programme (UNEP) - India: <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/resource-efficiency-and-chemicals/regions/asia-and-87>
10. https://mpeda.gov.in/?page_id=933
11. <https://www.cmfri.org.in/cmfri-neutraceuticals>

Course Outcomes

| No. | Upon completion of the course the graduate will be able to | Cognitive Level | PSO addressed |
|------|---|-----------------|---------------|
| CO-1 | Develop a comprehensive knowledge and understand different types of aquatic ecosystems. | R, U, An | PSO-1,2,3 |
| CO-2 | Categorize various aquatic fauna and analyse the way they are adapting to the different aquatic habitats. | U, An, E | PSO-1,2,3 |
| CO-3 | Evaluate various aquatic ecosystem issues and assess the major conservation strategies used to revitalize aquatic ecosystems. | U, An, E | PSO-1,2,3,7 |
| CO-4 | Analyze the bioprospecting potential of aquatic ecosystems, and evaluate various value-added products | An, E, C | PSO-1,3,5,7 |
| CO-5 | Understand various issues and apply innovations in Sustainable Blue Economy Management. | U, Ap, An | PSO-1,2,3,7 |

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: Aquatic Ecosystems and Sustainable Management

Credits: 4:0:0 (Lecture: Tutorial: Practical)

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|--------|---|-------------------------|-----------------|--------------------|--------------------------|---------------|
| CO-1 | Develop a comprehensive knowledge and understand different types of aquatic ecosystems. | PO-1,2,3 PSO-1,2,3 | R, U, An | F, C | L | - |
| CO-2 | Categorize various aquatic fauna and analyse the way they are adapting to the different aquatic habitats. | PO-1,2,3 PSO-1,2,3,4 | U, An, E | F, C | L | - |

| | | | | | | |
|------|---|---------------------------|-----------|---------|---|--|
| CO-3 | Evaluate various aquatic ecosystem issues and assess the major conservation strategies used to revitalize aquatic ecosystems. | PO-1,2,3 PSO-1,2,3,7 | U, An, E | F, C | L | |
| CO-4 | Analyze the bioprospecting potential of aquatic ecosystems, and evaluate various value-added products | PO-2,3,6 PSO-1,3,5,7 | An, E, C | F, C, P | L | |
| CO-5 | Understand various issues and apply innovations in Sustainable Blue Economy Management. | PO-2,3,6,7 PSO-1,2,3,7 | U, Ap, An | F, C | L | |

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| CO 1 | 3 | 2 | 1 | - | - | - | | 3 | 2 | 1 | - | - | - | - | - |
| CO 2 | 2 | 3 | 2 | 1 | - | - | | 2 | 3 | 2 | - | - | - | - | - |
| CO 3 | 2 | 1 | 2 | - | - | - | 2 | 1 | 2 | 3 | - | - | - | - | - |
| CO 4 | 1 | - | 3 | - | 2 | - | 2 | - | 2 | 2 | - | 3 | 2 | - | - |
| CO 5 | 1 | 2 | 2 | - | - | - | 2 | | 2 | 2 | | - | 2 | 1 | - |

Correlation Levels:

| Level | Correlation |
|-------|--------------------|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

Assessment Rubrics:**Assignment/Seminar topics**

1. Types of aquatic ecosystems.
2. Importance of bioindicators in aquatic systems with examples.
3. Aquatic adaptations of deep sea fishes.
4. Ramsar sites in Kerala.
5. Impact of Climate change on aquatic ecosystems.

Continuous Comprehensive Assessment

1. Assignments
2. Seminars
3. Test
5. Quiz/Debate

End Semester Evaluation

1. Multiple Choice Question
2. Very Short Answer Question
3. Short Answer Questions
4. Essay Type Questions

Mapping of COs to Assessment Rubrics:

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|------|---------------|------------|--------------------|---------------------------|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |