



**University of Kerala**

Discipline	<b>ZOOLOGY</b>				
Course Code	<b>UK3DSEZOO201</b>				
Course Title	<b>Fisheries Science I-Taxonomy and Fishery Biology</b>				
Type of Course	<b>DSE</b>				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Pass in Class XII				
Course Summary	The course provides basic understanding about the taxonomy and biology of finfishes and shellfishes to undertake any aquaculture operation. Conventional and modern methods employed for identification of species are discussed in the first module. In the subsequent modules, biological aspects pertaining to food and feeding, reproductive biology, early life history and age and growth are discussed.				

**Detailed Syllabus**

Module	Unit	Content	45 hrs
		<b>Taxonomy of finfishes and shellfishes</b>	<b>12</b>
<b>I</b>	1.1	Taxonomic procedures: Collection, identification and preservation of Commercially important fishes, crustaceans, and Mollusc with special reference to the fauna of Kerala.	5
	1.3	Morphological features and characters used in identification of fishes, prawns, shrimps, crabs, lobsters, and molluscs (Truss morphometry).	6
	1.4	Modern taxonomical tools: Karyotyping, DNA barcoding Related activity : Preparation of model of karyotype of any one fish	1
		<b>Food and feeding behaviour</b>	<b>6</b>

<b>II</b>	2.1	Food and feeding habits of commercially important fishes, Crustaceans, and Molluscs. Feeding adaptation, Feeding in relation to Season, Growth, Sex and Breeding in commercially important Fishes, Crustaceans and Molluscs.	3
	2.2	Methods of studying Food and Feeding habit: Stomach fullness Index, Empty Stomach Ratio, Relative Gut Length, Gastro Somatic Index.	3
<b>Reproductive Biology</b>			<b>11</b>
<b>III</b>	3.1	Anatomy of gonads, modes of reproduction – gonochorism, hermaphroditism, protandry, protogyny. semelparity, iteroparity.	3
	3.2	Reproductive strategies – oviparity, viviparity and ovoviviparity. Stages of maturity in finfishes and shellfishes. Factors influencing reproduction.	3
	3.3	Maturation and Spawning in Fishes: Methods used to estimate size at maturity, sex ratio, spawning season, spawning frequency, Fecundity, Gonadosomatic index.	3
	3.4	Fecundity and its relationship to reproductive adaptation, Environmental influence of Fecundity.	2
<b>Early life history</b>			<b>9</b>
<b>IV</b>	4.1	Types of eggs, embryonic and larval development in finfishes. Hatching rate, survival rate and mortality rate, free embryo, critical period concept.	4
	4.2	Early developmental stages of shrimps, crabs, lobsters and bivalves ( brief account only ) Related Activity -Power point presentation on parental care in fishes	5
<b>Age and Growth</b>			<b>7</b>
<b>V</b>	5.1	Age determination – Methods employed in age determination, tagging recapture technique, chemical markers, Petersen method, examination of hard parts	4
	5.2	Factors affecting fish growth, Length-weight relationship, isometric and allometric growth, Condition Factor and Relative condition factor.	3

#### References:

1. Bal, D.V. and K.V. Rao, 1990. Marine fisheries of India. Tata McGraw-Hill Publishing Company Limited, New Delhi. First revised edition. 472 pp.
2. Bone, Q and R.H. Moore. 2008 (Third Ed.). Biology of fishes. Taylor & Francis Group, New York.
3. Biswas, K.P. 1996. A Textbook of Fish, Fisheries and Technology. 2nd ed. Narendra Publ. Hse., India
4. Bone, Q., N. B. Marshall and J.H.S. Blaxter. 1999. Biology of Fishes. Chapman and Hall

5. Carpenter KE & VH Niem (1998) FAO Species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol 1. Seaweeds, corals, bivalves and gastropods. FAO, Rome.
6. Clark, A.B. & A.L. Panchen 1974. Synopsis of Animal Classification. John Wiley & Sons Inc., NY.
7. Cowey, C.B. et al. 1985. Nutrition and Feeding in Fish. Academic Press, New York
8. Datta Munshi, J.S & M.P. Srivastava 1988. Natural History of Fishes: Systematics of Freshwater Fishes of India. Narendra Publishing Co., New Delhi, 403 pp.
9. Day, F. 1865. The Fishes of Malabar. Quariteb, London, 293 pp.
10. Halver, J.E. 1972. Fish Nutrition. Academic Press, London.
11. Hewitt, G. M., A. W. B. Johnston, and P. R. W. Young, eds. 1991. Molecular Techniques in Taxonomy. Springer-Verlag, Berlin.
12. Hillis, D. M., C. Moritz, and B. K. Mable. 1996. Molecular Systematics, 2d ed. Sinauer Associates, Sunderland, Mass.
13. Hoar, W.S. and D.J. Randall. 1971. Fish Physiology. Vols. I to V. Academic Press, New York.
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15. Jayaram, K.C. 1999. The Freshwater Fishes of the Indian Region. Narendra Publ. Hse., Delhi, 551 pp.
16. Khanna, S.S., 1993. An introduction to fishes, Central Book Depot, Allahabad, 530 pp.
17. Kottelat, M. & T. Whitten 1996. Freshwater Biodiversity in Asia with Special Reference to Fish. World Bank Technical Paper No.343, The World Bank, Washington.
18. Kurian, C.V. & V.O. Sebastian 1986. Prawns and Prawn Fisheries of India. Hindustan Publ. Corp., New Delhi, 297 pp.
19. Lagler, K.F., J.E. Bardach & R.E. Miller 1963. Ichthyology. John Wiley & Sons, Inc., NY.
20. Moyle, P.B. and J.J. Cech, 1996. Fishes, an introduction to ichthyology. (3rd Ed.). Prentice Hall, Upper Saddle River, New Jersey, 590 pp.
21. Narendran, T.C. 2006. An Introduction to Taxonomy. Zoological Survey of India, Kolkata.
22. New & Barnard. 2010. Freshwater Prawns Biology & Farming. Wiley- Blackwell, London.
23. Raghunath, M.R. 2013. Nutrition and Feeding of Fishes. Swastik Publishing House, Delhi.
24. Simpson, G.G. 1969. Principles of Animal Taxonomy. Oxford & IBH Publ. Co., Bombay.
25. Smyth & Lynwood. 2003. Introduction to Fish Physiology. Narendra Publishing House, Delhi
26. Srivastava, C.B.L. 2008. Fish Biology. Narendra Publ. Hse., India, 329
27. Subba Rao, N.V. 2003. Indian Seashells: Part-I: Polyplacophora and Gastropoda. Zoological Survey of India, Kolkata.
28. Surendra Nath. 2002. Food, Feed habits and Alimentary canal of fishes. Vinod Publishers and Distributors, India
29. Talwar, P.K. & V.G. Jhingran 1991. Inland Fishes of India and Adjacent Countries. Vol. 2. Oxford & IBH Publ. Co., New Delhi.
30. Talwar, P.K. & R.K. Kacker 1984. Commercial Sea Fishes of India. Zoological Survey of India, Kolkata, 986 pp.

#### Web Resources:

<https://www.fao.org/fishery/en>  
<https://www.fishbase.se/>  
<https://indiabiodiversity.org/>  
<http://eprints.cmfri.org.in/>  
<https://www.fisheries.noaa.gov/>  
<http://www.seafdec.org/#>  
[e-Krishi Shiksha \(iasri.res.in\)](http://e-Krishi Shiksha (iasri.res.in))

### Practicum (30 hrs)

Sl. No	Contents
1	Identification of fishes (2) and prawns (2) using standard keys
2	Study of external morphology of fishes and prawns
3.	Study of anatomical variations in digestive system of fish – herbivore, omnivore and carnivore
4.	Gut content analysis – Occurrence/ Numerical/ Gravimetric method (any one)
5.	Estimation of Gastro somatic Index
6.	Male and female reproductive system in teleost
7.	Estimation of fecundity and gonadosomatic index in fish
8.	Study of larval stages of shellfishes – nauplius, protozoa, mysis, zoea, megalopa, phyllosoma, puerulus, trochophore, veliger (Any five-representing prawn, crab, lobster, and bivalve)
9.	Length weight relationship and condition factor of finfish

#### References:

1. Day, F. 1878. Fishes of India, Vols. 1 & 2. William Dawson & Sons Ltd., London.
2. Evans, D.H. 1998. The Physiology of Fishes. 2nd ed. CRC Press, NY
3. Jayaram, K.C. 2002. Fundamentals of Fish Taxonomy. Narendra Publ. Co., Delhi.
4. Khanna, S.S. & H.R. Singh 2006. A Textbook of Fish Biology and Fisheries. Narendra Publ. Hse., India
5. Kurian, C.V. & V.O. Sebastian 2002. Prawns and Prawn Fisheries of India. Revised and Edited Fifth Edition by K. Gopakumar & V.N. Pillai. Hindustan, New Delhi.
6. Nelson, J.S. 2006. (4th Ed.). Fishes of the World. John Wiley & Sons, Inc., New Jersey.
7. Jhingran, V.G ( 1997). Fish and Fisheries of India, Third Edition. Hindustan Publishing Corporation India.
8. Winston, J.E. 1999. Describing species. Practical Taxonomic Procedure for Biologists. Columbia University Press, New York

### Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Understand concepts of taxonomy, conventional and modern methods used for the identification of finfishes and shellfishes	R, U, Ap	PSO-1,7
CO2	Understand the diversity of feeding and analyse food and feeding habits using gut contents and indices	U, Ap, An, Ev	PSO-2, 3
CO3	Familiarise modes and strategies of reproduction and methods to assess reproductive parameters in fishes	U, Ap, An, Ev	PSO-1,3
CO4	Understand the development and early life history of cultivable important species	U, Ap, An	PSO-4
CO5	Evaluate growth patterns and determine age of cultivable species	U, Ap, E	PSO-1,3

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

**Name of the Course: Fisheries Science I-Taxonomy and Fishery Biology**

**Credits: 3:0:1 (Lecture: Tutorial: Practical)**

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	Understand concepts of taxonomy, conventional and modern methods used for the identification of finfishes and shellfishes	PO-1,2,5 PSO-1,7	R, U, Ap	F,C	L	P
2	Understand the diversity of feeding and analyse food and feeding habits using gut contents and indices	PO-1,3,4,5 PSO-2, 3	U, Ap, An, Ev	F,P	L	P

3	Familiarise modes and strategies of reproduction and methods to assess reproductive parameters in fishes	PO-1,2,4,5 PSO-1,3	U, Ap, An, Ev	P	L	P
4	Understand the development and early life history of cultivable important species	PO-7,8 PSO-4	U, Ap, An	F,P	L	P
5	Evaluate growth patterns and determine age of cultivable species	PO-1,2,4,6 PSO-1,3	U, Ap, E		L	P

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

### Mapping of COs with PSOs and POs

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	3	-	-						

### Correlation Levels:

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

### Assessment Rubrics:

#### Assignment / Seminar topics

1. Collect and identify cultivable species of fishes from your locality
2. Molecular methods in taxonomy
3. Food and feeding of common cultivable species
4. Physiology of digestion in fishes
5. Sex reversal in fishes
6. Impact of climate change in fish biology

#### Field activities

- Visit to harbours/ landing centres to collect and submission of commercially important finfishes and shellfishes

#### Continuous comprehensive Assessment

1. Assignment/ Quiz/ Discussion / Seminar
  2. Submission of specimen collection report
  3. Submission of Field report

#### End semester Evaluation

1. Very short answer questions
2. Short answer questions
3. Essay type questions
4. Practical examinations

### Mapping of COs to Assessment Rubrics

	Internal	Assignment	Project Evaluation	End Semester Examinations
	Exam			
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	✓