

Discipline	ZOOLOGY								
Course Code	UK3DSEZOO201								
Course Title	Fisheries Science I-	Гахопоту а	nd Fishery l	Biology					
Type of Course	DSE								
Semester	III								
Academic Level	200 - 299								
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours/Week				
	4	3 hours	-	2 hours	5				
Pre-requisites	Pass in Class XII								
Course Summary	The course provides	basic underst	anding abour	t the taxonom	y and biology of				
	finfishes and shel	lfishes to	undertake	any aquacul	ture operation.				
	Conventional and mo	Conventional and modern methods employed for identification of species are							
	discussed in the first	module. In t	he subsequer	nt modules, b	iological aspects				
	pertaining to food ar	nd feeding, re	eproductive l	biology, early	life history and				
	age and growth are d	iscussed.		-	-				

Detailed Syllabus:

Module	Unit Content 4							
		Taxonomy of finfishes and shellfishes	12					
	1.1 Taxonomic procedures: Collection, identification and preservation of							
Ι	commercially important fishes, crustaceans, and molluscs with special							
	reference to the fauna of Kerala.							
	1.3	Morphological features and characters used in identification of fishes,	6					
		prawns, crabs, lobsters, gastropods and bivalves (brief account, follow						
		FAO identification sheets), Truss morphometry in fish.						
	1.4	Modern taxonomical tools: Karyotyping, DNA barcoding	1					
		Related activity : Preparation of model of karyotype of any one fish						
		Food and feeding behaviour	7					
	2.1	Food and feeding habits of fishes, commercially important crustaceans and						
II		molluscs. Feeding adaptation, feeding in relation to season, growth, sex	4					
		and breeding in fishes.						
	2.2	Methods of studying Food and Feeding habit: Stomach fullness Index,	3					
		Empty Stomach Ratio, Relative Gut Length, Gastrosomatic Index.						
		Reproductive Biology	12					
	3.1	Anatomy of gonads, modes of reproduction – gonochorism,	3					
		hermaphroditism, protandry, protogyny. semelparity, iteroparity.						
	3.2	Reproductive strategies – oviparity, viviparity and ovoviviparity. Stages	4					
		of maturity in finfishes and shellfishes. Factors influencing reproduction.						

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III	3.3	Maturation and Spawning in Fishes: Methods used to estimate size at	3
		maturity, sex ratio, spawning season, spawning frequency, fecundity,	
		Gonadosomatic index.	
	3.4	Fecundity and its relationship to reproductive adaptation, Environmental	2
		influence of fecundity.	
		Early life history	9
IV	4.1	Types of eggs, embryonic and larval development in finfishes. Hatching	4
		rate, survival rate and mortality rate, free embryo, critical period concept.	
		Early developmental stages of shrimps, crabs, lobsters and bivalves	
	4.2	(brief account only)	5
		Related activity : Powerpoint presentation on parental care in fishes	
		Age and Growth	5
	5.1	Age determination – Methods employed in age determination, tagging	3
V		recapture technique, chemical markers, Petersen method, examination of	
		hard parts	
	5.2	Factors affecting fish growth, Length-weight relationship, isometric and	2
		allometric growth, Condition Factor and Relative condition factor.	

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. Chapmann 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.
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- 12. Hillis, D. M., C. Moritz, and B. K. Mable. 1996. Molecular Systematics, 2d ed. Sinauer Associates, Sunderland, Mass.
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- 14. Hoithuis, L.B. 1991. FAQ species catalogue. Marine lobsters of the world. An annotated and illustrated catalogue of species of interest to fisheries known to date. FAO Fisheries Synopsis. FAO. Rome, Vol.
- 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. Corpn., New Delhi, 297 pp.
- 19. Lagler, K.F., J.E. Bardach & R.E. Miller 1963. Ichthyology. John Wiley & Sons, Inc., NY.
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- 21. Narendran, T.C. 2006. An Introduction to Taxonomy. Zoological Survey of India, Koltata.
- 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, Feeding habits, Alimentary canal and Digestion in fishes: A Bibliography. 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, Kokata, 986 pp.

Practicum							
Sl.	Content	30					
No		Hrs					
1	Identification of fishes (2) and prawns (2) using standard keys	8					
2	Study of external morphology of fishes and prawns	2					
3.	Study of anatomical variations in digestive system of fish (mouth, teeth, gill rakers,	4					
	alimentary canal) – herbivore, omnivore and carnivore						
4.	Estimation of Gastrosomatic Index	3					
5.	Male and female reproductive system in teleost	3					
6.	Estimation of fecundity and gonadosomatic index in fish	3					
7.	Study of larval stages of shellfishes – nauplius, protozoea, mysis, zoea, megalopa,	4					
	phyllosoma, puerulus, trochophore, veliger (Any five-representing prawn, crab,						
	lobster, and bivalve) (Use preserved specimen/slides/diagram)						
8.	Length weight relationship and condition factor of finfish	3					

Practicum Component (Credit :1 30 Hrs)

References:

- 1. Day, F. 1878. Fishes of India, Vols. 1 & 2. William Dawson & Sons Ltd., London.
- 2. Ian.S.R. Munro. 2000. The Marine and Freshwater Fishes of Ceylon. Narendra Publishing House.
- 3. Josileen Jose and Lakshmi. S. Pillai. 2013. Training Programme on "Taxonomy and Identification of Commercially Important Crustaceans of India". CMFRI.
- 4. Evans, D.H. 1998. The Physiology of Fishes. 2nd ed. CRC Press, NY
- 5. Jayaram, K.C. 2002. Fundamentals of Fish Taxonomy. Narendra Publ. Co., Delhi.
- 6. Khanna, S.S. & H.R. Singh 2006. A Textbook of Fish Biology and Fisheries. Narendra Publ. Hse., India
- 7. 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.

- 8. Nelson, J.S. 2006. (4th Ed.). Fishes of the World. John Wiley & Sons, Inc., New Jersey.
- 9. Jhingran, V.G (1997). Fish and Fisheries of India, Third Edition. Hindustan Publishing Corporation India.
- 10. Winston, J.E. 1999. Describing species. Practical Taxonomic Procedure for Biologists. Columbia University Press, New York

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

Course Outcomes

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

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	СО	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	Understand concepts of taxonomy, taxonomic procedures, morphological characters, 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	Р

2	Understand the diversity of feeding, feeding adaptations and analyse food and feeding habits using gut contents and indices	PO- 1,3,4,5 PSO-2, 3	U, Ap, An, Ev,C	F,P	L	Р
3	Familiarise reproductive organs, 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 ,C	Р	L	Р
4	Understand the development and early life history of cultivable important species	PO-7,8 PSO-4	U, Ap, An,C	F,P	L	Р
5	Evaluate age determination methods , factors affecting fish growth and growth patterns	PO- 1,2,4,6 PSO-1,3	U, Ap, E,C		L	Р

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

Mapping	of COs	with	PSOs	and POs :	
mapping.	01 0 05	** 1 011	1000	unu i Ob .	

	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 Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark			\checkmark
CO 4		\checkmark		\checkmark
CO 5		\checkmark		\checkmark
CO 6			\checkmark	\checkmark