UZO 1

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Course Name: **B.Sc., ZOOLOGY**

Curriculum and Scheme of Examinations under CBCS

(Applicable to students Admitted from the Academic Year **2019 – 2020**)
Scheme of Examinations (With 4 Sem Language Papers)

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
SEMESTER - I									
I	I	18TML101	Language I@	6	25	75	100	3	3
	II	18ENG101	English –I	6	25	75	100	3	3
	III	19UZO101	Core Paper 1–Invertebrata	7	25	75	100	3	5
	III	18UZO1I1 18UBO1A1	**Allied A Paper 1- Sericulture** I / Botany I	5	20	55	75	3	4
			Core Practical. 1- Invertebrata and Chordata	2	-	-	-	-	-
			Allied Practical. 1. Sericulture	2	-	-	-	-	-
	IV	18EVS101	Environmental Studies**	2	-	50	50	3	2
			Total	**30**			**425**		**17**
SEMESTER - II									
II	I	18TML202	Language II@	6	25	75	100	3	3
	II	18ENG202	English –II	6	25	75	100	3	3
	III	18UZO202	Core Paper 2 –Chordata	7	25	75	100	3	5
	III	18UZO2I2 18UBO2A2	**Allied A Paper 2- Sericulture** II / Botany II	5	20	55	75	3	4
		19UZO2CL	Core Practical. 1- Invertebrata and Chordata	2	40	60	100	3	2
		18UZO2IL 18UBO2AL	**Allied A Practical 1. Sericulture** /Botany	2	20	30	50	3	2
	IV	18VED201	Value Education- Moral and Ethics **	2	-	50	50	3	2
			Total	**30**			**575**		**21**

SEMESTER - III									
III	I	18TML303	Language III@	6	25	75	100	3	3
	II	18ENG303	English –III	6	25	75	100	3	3
	III	19UZO303	Core Paper 3– Cell and Molecular Biology	5	25	75	100	3	5
	III	18UBC 3A3	Allied B paper 1- Biochemistry	5	20	55	75	3	4
			Core Practical 2- Cell Biology and Physiology	2	-	-	-	-	-
			Allied B Practical 2. Biochemistry	2	-	-	-	-	-
	IV	18UGA3S1	Skill Based subject 1- General Awareness	2	25	75	100	3	3
	IV	18TBT301/ 18TAT301/ 18UHR3N1	Basic Tamil* / Advanced Tamil** (OR) Non-major elective- I**- Human rights	2	-	75	75	3	2
			Total	**30**			**550**		**20**
SEMESTER - IV									
IV	I	18TML404	Language IV@	6	25	75	100	3	3
	II	18ENG404	English –IV	6	25	75	100	3	3
	III	18UZO404	Core Paper 4– Physiology	5	25	75	100	3	5
	III	18UBC4A4	Allied B paper 2- Biochemistry	5	20	55	75	3	4
		18UZO4CM	Core Practical 2- Cell Biology and Physiology	2	40	60	100	3	2
		18UBC4AL	Allied B Practical-1. Biochemistry	2	20	30	50	3	2
	IV	18UZO4S2	Skill Based subject 2- Health education	2	25	75	100	3	3
	IV	18TBT402/ 18TAT402/ 18UWR4N2	Basic Tamil* / Advanced Tamil** (OR) Non-major elective- II**- Women's rights	2	-	75	75	3	2
			Total	**30**			**700**		**24**
SEMESTER - V									
v	III	18UZO505	Core Paper 5- Genetics	5	25	75	100	3	4
	III	18UZO506	Core Paper 6- Evolution	5	25	75	100	3	4
	III	18UZO507	**Core Paper 7–Ecology**	5	25	75	100	3	4

	III	19UZO508	Core Paper 8–Biostatistics and Bioinformatics	5	25	75	100	3	4

UZO 3

			Core Practical 3: Evolution, Microbiology and Immunology and Biotechnology	2	-	-	-	-	-
			Core Practical 4: Ecology, Developmental Biology and Animal Diversity	2	-	-	-	-	-
	III	18UZO5E1	**Major Elective -1**	4	25	75	100	3	5
	IV	18UBC/UBT/ UBO – 5X1	EDC-Extra Departmental Course	2	25	75	100	3	3
		18UZO5IT	Internship						Grade
			Total	**30**			**600**		**24**
SEMESTER - VI									
VI	III	18 UZO609	Core Paper 9 –Microbiology and Immunology	4	25	75	100	3	4
	III	18 UZO610	Core Paper 10 – Biotechnology	5	25	75	100	3	4
	III	18 UZO611	Core Paper 11 – Developmental Biology	5	25	75	100	3	4
	III	18 UZO612	Core Paper 12 – Biodiversity and Animal behaviour	4	25	75	100	3	4
		18UZO 6CN	Core Practical 3: Evolution, Microbiology and Immunology and Biotechnology	2	40	60	100	3	2
		18UZO 6CO	**Core Practical 4: Ecology**, Developmental Biology and Animal Diversity	2	40	60	100	3	2
	III	18UZO6E2	Major Elective 2	3	25	75	100	3	5
	III	18UZO6Z1	Project	3	20	80	100	3	5
	IV	18UZO6S4	**Skill Based subject-3 Commercial fish culture**	2	25	75	100	3	3
	V	$$	Extension Activities*	-	50	-	50	-	1
			Total	**30**			**950**		**34**
				180			**3800**		**140**

			Grand Total						

UZO 11 18UZO1I1

Programme code -06	B.Sc Zoology			
Course code 18UZO1I1	Allied A Paper -I Sericulture -I			
Batch 2018-2019	Semester 1	Hour/Week 5	Total hours 75	Credit 4

Course Objectives

1. To create a self employment opportunity among student
2. To equip the skills of rearing of silkworms
3. To create better breeding and grainage techniques

Course Outcomes

K1	COI	Get knowledge about the mulberry and non mulberry silkworms.
K2	CO2	Understand the various silkworm rearing techniques
K3	CO3	Apply knowledge on control measures of silkworm diseases
K4	CO4	Analyze silkworm breeding and grainage techniques

SYLLABUS

UNIT I **15Hrs**

Introduction

Bombyx mori : Systematics, General organisation, lifecycle, Silk gland and silk formation. Origin and economic importance of sericulture industry. Mulberry and non-mulberry (Tasar, Eri & Muga) silk producing species, their distribution and food plants (Primary, Secondary & Tertiary).

UNIT II **15Hrs**

Silkworm rearing

Selection, location and orientation of rearing houses*. Environmental conditions essential for rearing - temperature, humidity, ventilation and light - methods for providing optimum conditions. Different methods of rearing, quality of leaf required for different stages. Cleaning, spacing and frequency of feeding.Mounting of worms. Harvesting of cocoons.

UNIT III **15Hrs**

Silkworm pathology

Disinfection of rearing rooms and equipments - control and prevention of a. Flacherie b. Muscardine c. Grasserie and d. Pebrine. Insects injurious to silkworm larva, pupa and cocoons.

UNIT IV **15Hrs**

Silkworm Genetics

Genetic basis of variation in silkworm - multiple alleles in *Bombyx mori*, Sex-linked inheritance and mutation in *Bombyx mori.*

Breeding : Aims of silkworm breeding-Inbreeding and cross breeding - combining various qualities of races, maternal inheritance and its consideration in breeding.

UNIT V **15Hrs**

Grainage techniques: various grainage techniques - selection of seed cocoons -emergence of moths - preparation and treatment of layings - refrigeration of over -wintered eggs.

*** Self Study (Questions may be asked from these topics also)**

Teaching methods : Over Head Projector, Power Point Presentation, Seminar, Smart Class Room, Quiz

Text Book

1. Madan Mohan Rao. M. (2008) A text book of sericulture B.S publications,Hyderabad.

2. Ganga &Sulochanachetty .G. (2006) An introduction to sericulture.. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Reference Books

1. Ullal .S.R and M.N Narasimhanna(1977) Hand book of Practical Sericulture Published by Shri .A.R S. Gopalachar Secretary ,Central silk board ,.Meghdoot,Bombay.

2.Rangaswami.G and S. Manjeet. Jolly.(1988) Sericulture Manual –I , Mulberry Cultivation Published by Mohan Primlani for Oxford & IBH publishing CO. Pvt.Ltd. New Delhi

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	M	M
CO2	S	M	H	M	H

CO3	H	M	M	H	M
CO4	S	H	H	M	M

S-Strong H- High M-Medium L-Low

UZO 19 18UZO212

Programme code -06	B.Sc Zoology			
Course code 18UZO212	Allied A Paper 2. Sericulture-II			
Batch 2018-2019	Semester II	Hour/Week 5	Total hours 75	Credit 4

Course Objective

1. To study the mulberry cultivation and rearing of silkworm
2. To develop skills about the quality and processing of silk
3. To know the importance of reeling and byproducts of reeling for industrial development

Course Outcomes

K1	COI	Get knowledge about the moriculture
K2	CO2	Understand the cultivation of mulberry, pests, diseases and control measures
K3	CO3	Apply knowledge on processing of cocoons and different methods of silk reeling
K4	CO4	Analyze the importance of sericulture in entrepreneurship development.

SYLLABUS

UNIT I **15Hrs**

Moriculture: Distribution of varieties of mulberry - Climatic and other conditions for its growth - selection of land for cultivation. Different methods of cultivation- sexual and vegetative methods - merits and demerits.

UNIT II **15Hrs**

Weeds and weeding - pruning methods - dormancy in mulberry* – manuring. Insects injurious to the mulberry gardens - bacterial and fungal diseases of mulberry.

UNIT III **15Hrs**

Silk reeling: Origin and importance of reeling industry. Selection of Raw material (cocoons). Importance of quality of cocoons - physical and commercial characteristics of cocoons - defective cocoons. Cocoons testing and classification- price fixation of raw materials.

UNIT IV **15Hrs**

Processing of raw materials: Stiffling and condition of cocoons - storage – sorting - riddling of cocoons. Boiling of cocoons - Different methods - Brushing of cocoons - Reeling

techniques: Reeling equipments. Comparative study of various equipments - Charka ,cottage basins, multi end basins - automatic reeling machines.

UZO 20 18UZO212

UNIT V **15Hrs**

Importance of water in reeling. Raw silk examination - Lacing and skeining - Byproducts of reeling. Filature management: Layout of a filature - sections of a modern filature

*** Self Study (Questions may be asked from these topics also)**

Teaching Methods:

Over Head Projector, Power Point presentation, Seminar, Smart class Room, Assignment, Discussion, Quiz.

Text Books

1. Madan Mohan Rao M. (2008) A text book of sericulture. B.S publications Hyderabad.
2. Ganga and Sulochanachetty G. (2006). An introduction to sericulture. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Reference Books

1. Ganga G. (2003) Comprehensive Sericulture– Vol. 2 Silkworm Rearing & Silk Reeling Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Rangaswami, G.and . Manjeet S. Jolly(1998), Mulberry Cultivation, Sericulture Manual-I FAO, UN IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Kamal Jaiswal, Sunil P. Trivedi, B.N. Pandey and R.K. Khatri , (2009) Moriculture..APH Publishing Corporation, Ansari Road, Daryakanj. New Delhi

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	M	M
CO2	S	M	H	M	H
CO3	H	M	M	H	M
CO4	S	H	H	M	M

S-Strong H- High M-Medium L-Low

Programme code- 06	B.Sc Zoology			
Course code 18UZO2IL	Allied A Practical 1. Sericulture			
Batch 2018-2019	Semester I&II	Hour/Week 2	Total hours 60	Credit 2

Course Objectives

1. To inculcate the practical knowledge on moriculture and sericulture, mulberry propagation, pests and diseases and their control measures
2. To know the importance of silkworm rearing, pests and diseases of silkworms and their control measures
3. To analyze the quality of silk through experiments

Course Outcomes

K1	COI	Apply knowledge on moriculture and sericulture
K2	CO2	Observe the biology, rearing, pests and diseases of silkworm and their control measures
K3	CO3	Evaluate the quality of silk

SYLLABUS

I. Moriculture:

1. Mulberry garden preparation & Maintenance
2. Preparation of Mulberry cuttings.
3. Pests & diseases of Mulberry Plant.

II. Silkworm rearing:

4. Silk worm: Life cycle.
5. Rearing house
6. Rearing equipments.
7. Pests and diseases of silkworms.

III. Eggs & Cocoons:

8. Treatment of eggs.
9. Cooking & Reeling.
10. Estimation of renditta
11. Estimation of denier.
12. Estimation of shell ratio.

IV. Field Visit/ Study Tour

UZO 24 18UZO2IL

MODEL QUESTION PAPER FOR ALLIED PRACTICAL I

PRACTICAL EXAM

Model Practical Exam	=	10Marks
Observation Note	=	5Marks
Attendance	=	5Marks
Total	**=**	**20 Marks**

END OF SEMESTER EXAMINATION

Time = 3 hrs **MaxMarks = 30**

I – Determine _____ of Cocoon characters.	10 Marks
II – Determine _____ of Cocoon characters	6 Marks
III – Spotters – Identify and comment on A,B & C (3x3)	9 Marks
IV - Submission of Record	5 Marks
Total	**30 Marks**

UZO 76 18UZO6CO

Programme Code :06	B.Sc, Zoology			
Course code 18UZO6CO	Core Practical 4. Ecology, Developmental Biology and Animal Diversity			
Batch	Semester	Hour/Week	Total hours	Credit
2018-2019	VI	2	60	2

Course Outcomes

K2	COI	Get practical knowledge about the species identification, diversity and their ecological significance
K3	CO2	Understand about the species diversity and water pollution due to anthropogenic activity
K4	CO3	Apply practical knowledge on plankton analysis, sericulture, vermiculture, and pest management.
K5	CO4	Analyze about practical and filed knowledge in relation to

		environment management

SYLLABUS

I. Analysis of water – Pond and Sewage.

1. Estimation of dissolved oxygen
2. Salinity
3. pH
4. Carbonates and bicarbonates
5. Carbondioxide

II. Qualitative analysis of plankton (any five) & mounting.

III. Study of intertidal rocky, sandy and muddy shore fauna (any three examples) with their specific adaptations.

UZO 77 18UZO6CO

Developmental Biology

Frog embryology slides: Stages of cleavage – 2 cell stage, 4 cell stage, 8 cell stage, Blastula and Gastrula.

1. Chick embryology - Stages of development 24hr, 48hr, 72hr & 96hr.
2. Placenta of Pig, Sheep and Man.

Field Study

1. Visit to coastal area to study the intertidal fauna

Sericulture

1. Study of life history of *Bombyxmori* using live specimens.
2. Practical knowledge of methods of Silkworm rearing. Visit to Silkworm rearing center.
3. Assessment of cocoon characters- Shell ratio, Denier and Renditta.

Vermiculture

1. Rearing of earthworm.

Pests and Their Control

Spotters: Identify and comment on

1. Coconut pest
2. Brinjal pest
3. Mosquitoes (Adults of Culex and Aedes)
4. House fly
5. Bed bug
6. Head louse

Teaching methods :

Over Head Projector/ Power Point presentation/ Seminar/ Assignment/Quiz

UZO 78 18UZO6CO

MODEL QUESTION PAPER FOR CORE PRACTICAL III

Model Practical Exam	=	25 Marks
Observation Note	=	10 Marks
Attendance	=	5 Marks
Total	**=**	**40 Marks**

END OF SEMESTER EXAMINATION

Time- 3 Hours **Max Marks-60**

Q I : Major Experiment - 20 Marks

Q II : Minor Experiment - 15 Marks

Q III :Spotters 3x5 - 15 Marks

Q IV : Record - 10 Marks

Total - 60 Marks

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	M	S	M	H	S
CO2	H	S	S	M	H
CO3	H	H	H	H	H
CO4	S	M	H	S	H

S-Strong **H**- High **M**-Medium **L**-Low

UZO 81 18UZO6S4

Programme Code : 06	B.Sc, Zoology			
Course code 18UZO6S4	Skill Based Subject 3 Commercial Fish Culture			
Batch	Semester	Hour/Week	Total hours	Credit
2018-2019		**2**	30	3

Course Objectives

1. To develop knowledge in characteristics, structure and resources of fisheries.
2. To increase the fishery sector performance by production, culture practices and farm management.
3. To improve the trade and its contribution to the nation economy.

Course Outcomes

K1	COI	Get knowledge about the commercial production of fishes in India
K2	CO2	Understand the practices of fish culture and its management to produce quality fish for human consumption

K3	CO3	Apply practical knowledge into fish production and marketing to become successful entrepreneur
K4	CO4	Analyze students acquired technical knowledge which is helpful to begin an entrepreneurship in the field of Fisheries

UNIT I Introduction **6Hrs**

Fishery resources of India. Major reservoir, lakes and their fisheries. Fisheries- status - exploitation and prospects. Marine, Brackishwater, Freshwater and Cold water fisheries of India.

UNIT II Biology of fishes **6Hrs**

Study of food and feeding habits of commercially important fishes. Reproductive biology – maturity stages, gonadosomatic index, pondoral index, fecundity, sex ratio and spawning. Eggs and larval stages and developmental biology of finfishes and shell fishes.

UNIT III Culture practices **6Hrs**

Commercially important fishes breading and seed productions techniques*. Traditional (pokkali, bheries, gazanis, khazans), semi-intensive, intensive and super-intensive culture systems.

UNIT IV Soil and Water Chemistry **6Hrs**

Water culture, Water quality parameters for Fishculture – Temperature, Turbidity, determination of pH, Electrical conductivity and salinity. Dissolved Oxygen, Carbon dioxide, Total alkalinity, Total hardness, Ammonium and Nitrite. Soil preparation and quality management for Fishculture.

UNIT IV Fish Nutrition and Feed Technology **6Hrs**

Nutritional requirements of cultivable fish and shellfish. Feed formulation and manufacturing. Feed evaluation - feed conversion ratio (FCR), feed efficiency ratio (FER). Feeding devices and methods. Factors affecting digestibility. Nutritional deficiency diseases.

UNIT V Entrepreneurship Development **6Hrs**

Government schemes and subsidies for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to fisheries sector. Contract farming and joint ventures, public-private partnerships. Fish processing and export.

***Self study (Questions may be asked from theses topic also)**

Teaching Methods Power point presentation/ Seminar / Discussion / Quiz

Text books

1. Srivasta C.B.L (2002). A text book of fishery science and Indian fisheries, kitab Mahal, Allahabad.

2. Santhanam, R. (1990). Fisheries Science, Daya publishing House, New Delhi.

3. Ayyappan, S. J. K. Jena, A. Gopalakrishnan, A. K. Pandey (2011). Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Reference books

1. James PM. (1983). Handbook of Mariculture. Vol. I. Crustacean Aquaculture. CRC Press.
2. Leung P, Lee CS and O'Bryen JP. (Eds.). (2007). Species and System Selection for Sustainable Aquaculture. Blackwell Publ.
3. Boyd, C. E. and Tucker, C. S. (1992). Water Quality and Pond Soil Analyses for Aquaculture, Alabama Agricultural Experimental Station, Auburn University.
4. De Silva SS & Anderson TA. (1995). Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series.

5. Lavens P & Sorgeloos P. (1996). Manual on the Production and Use of Live Food for Aquaculture. FAO Fisheries Tech. Paper 361, FAO.
6. Shankar KM & Mohan CV. (2002). Fish and Shellfish Health Management. UNESCO Publ.
7. Wedmeyer G, Meyer FP & Smith L. (1999). Environmental Stress and Fish Diseases. Narendra Publ. House. New Delhi.
8. Jhingran VG. (1991). Fish and Fisheries of India. Hindustan Publ.
9. Landau M. (1992). Introduction to Aquaculture. John Wiley & Sons.
10. Mcvey JP. (1983). Handbook of Mariculture. CRC Press.
11. Reddy PVGK, Ayyappan S, Thampy DM & Krishna G. (2005). Text book of Fish Genetics and Biotechnology. ICAR. New Delhi
12. Pillay TVR & Kutty MN. (2005). Aquaculture: Principles and Practices. 2nd Ed. Blackwell.
13. Pandey N & Davendra SM. (2008). Integrated Fish Farming. Daya Publ. House. New Delhi

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4

CO1	S	H	H	H	H
CO2	H	M	M	M	S
CO3	M	H	S	H	H
CO4	H	M	H	M	S

S-Strong **H**- High **M**-Medium **L**-Low

UZO 90

Programme code: 06	B.Sc. Zoology		
	Major Elective Paper 3 – Economic Zoology		
Batch 2018-2019	Hours / Week 4	Total Hours 60	Credits 5

Course Objectives

1. To get knowledge about sustainable agriculture, organic farming and waste management using vermitechnology.
2. To understand the rearing and harvesting techniques in sericulture, apiculture and lac culture.
3. To inculcate knowledge on aquaculture, poultry and animal husbandry aspects.

Course Outcomes

K1	CO1	Get knowledge about the characteristics and role of earthworm in sustainable agriculture.
K2	CO2	Understand the problems in sericulture, apiculture and lac culture.
K3	CO3	Apply the knowledge on disease management in the field of poultry and animal husbandry.
K4	CO4	Analyze the economic importance of fisheries and aquaculture.

SYLLABUS

Unit I:Vermiculture **12 Hours**

Vermiculture - Selection of suitable species based on their characteristics, Vermicomposting and their advantages, role of earthworms in sustainable agriculture and organic farming, Miscellaneous uses of earthworms (Poultry, Fisheries and Medicine).

Unit II:Sericulture **12 Hours**

Types of silkworms - Life cycle - Rearing methods - Harvesting - Processing of Silk - Marketing of Cocoons - Economic importance of sericulture - Problems in sericulture.

Unit III:Apiculture and Lac culture **12 Hours**

Types of honey bees- Diseases and pests of bees and lac insects -Harvesting and processing of honey and lac -Marketing of honey and lac -economic importance of apiculture and lac culture - Problems in apiculture and lac culture.

UZO 91

Unit IV: Fisheries and Aquaculture **12 Hours**

Fishery resources in India, Economically important aquatic floral and faunal resources, Value added fish and fishery products, opportunities in seafood exports, Importance of fisheries (capture, culture and ornamental) sector in Indian economy, Fisheries national income in India.

Unit V:Poultry farming **12 Hours**

Types of birds for poultry - Diseases and pests of bird - Egg and meat production -poultry feed - Economic importance of poultry keeping.

Animal husbandry

Types of animals for animal husbandry - Disease and pests of animals - Milk and meat production and Processing - Economic importance of animal husbandry*

***Self study (Questions may be asked from these topic also)**

Teaching methods

Over Head Projector/ Power Point presentation/ Seminar/ Assignment/Quiz

Text Books

1. Shukla, G.S and V.B. Upadhyay (2008) Economic Zoology, 4 th ed. Rastogi Publication, Meerut
2. Bhatnagar, R.K and Paltra, R. K. (1996), Vermiculture and Vermicomposting, Kalyani Publishers, New Delhi.
3. Madan Mohan Rao M.. (1998). A Text Book of Sericulture, B.S. Publications, Hyderabad.
4. Pradip V.Jabde (1993) Text book of Applied Zoology, Discovery publishing house, New Delhi
5. Ayyappan, S, Jena,J.K, Gopalakrishnan, Aand A. K. Pandey. (2011), Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Reference Books

1. Nayar K.K and T.N. Anathakrishnan and B.V. David.(1983) General and applied Entomology, Tata McGraw Hill publishing Co. Ltd., New Delhi.
2. Fenemore P.G. A. Prakash. (2002) Applied Entomology, New age international (P) publishers, New delhi.
3. ManjuYadav. (2003) Economic Zoology, Discovery Publishing House, New Delhi.
4. Fred V.Theobald. (1989) Economic Zoology, Print well Publisher. Jaipur. India.
5. Cunningham S, Dunn M.R and D.Whitmarsh. (1985) Fisheries Economics. St. Martin's Press.
6. Shang YC. (1981) Aquaculture Economics. Westview Press.
7. LokeshwarR. (2002) Hand Book of Animal Husbandry, ICAR, New Delhi

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	H	S
CO2	H	S	M	M	H
CO3	H	H	S	S	H
CO4	M	H	S	H	M

S – Strong **H** – High **M** – Medium **L** – Low

Programme code 06	(For B.Sc Botany, Biochemistry and Biotechnology)			
Course code 18UZO5X1	Ornamental Fishery Technology (EDC)			
Batch	Semester	Hour/Week	Total hours	Credit

2018-2019	5	2	30	3

Course Objective

1. To study ornamental fishes in world wide
2. To study the techniques of ornamental fish culture for employment opportunities
3. To know about the viable marketing strategies in India and international level

Course Outcomes

K1	COI	Get field knowledge for design and construction of aquarium.
K2	CO2	Understand the formulation of feed and nutrition management for betterment of ornamental fish culture
K3	CO3	Apply knowledge on health management for successful production of aquarium fishes.
K4	CO4	Analyze the breeding and culture techniques for the trading.

SYLLABUS

Unit I: Introduction **6Hrs**

Introduction to aquaculture, ornamental fishes and aquarium accessories. World aquarium trade and present status. Opportunities and its challenges

Unit II: Aquarium and accessories **6Hrs**

Setting up of aquarium – Tank shape and size, Tank fabrication, Type of filters, Aerators and other accessories

Unit III: Freshwater Ornamental Fishes **6Hrs**

Aquarium plants, Aquaponics*, Brood stock and seed productions practices- goldfish, live bearers, gouramies, barbs and tetras, angel, and Molly fishes.

Unit IV: Marine Ornamental Fishes **6Hrs**

Diversity of marine ornamental fishes. Breeding and seed production of ornamental fishes. Quarantine measures. Reef aquarium. Method of collection and transportation of live fish. Applications of anesthetics and packing.

Unit V: Aquarium Management **6Hrs**

Feed Management, Water quality management, Bio security measures- Sanitation and disinfection and Health Management.

*** denotes Self study**

Teaching Methods: Over Head Projector, Power Point Presentation, Seminar, Assignment, Discussion, Quiz.

Text Books

1. Ayyappan S., Jena, J. K. Gopalakrishnan, A. Pandey. A. K. (2011). Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.

2. Dholakia, Anshuman D. (2016). Ornamental Fish Culture and Aquarium Management. Daya Publishing House, New Delhi.

3. Goldstein, R. J. (1971). Diseases of aquarium fishes. T.F.H. Publications. 126 pp

Reference books

1. Kapoor D. and Abidi. R. (2004). Lucrative Alien Ornamental fish species for Aquarium Trade of India. Published by National Bureau of Fish Genetic Resources. Lucknow, India.

2. Fung, J.(2003). Tank bred watchman gobies: essential every reef aquarium. Tropical Fish Hobbyist LI (5):98-104.

3. Murthi.V.S. (2002). Marine ornamental Fishes of Lakshadweep CMFRI, Special publication 72

4. Beyers, C.J. de B. and Wilke, C.G. (1990). A device for maintaining constant consentration of dissolved oxygen and temperature in a closed aquarium system. Special report No. 5. S.F.R.I. iv, 9 pp.

5. De Graaf, F. (1991). Marine aquarium guide. T.F.H. Publications, Inc. 282 pp

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	H	S
CO2	S	M	H	S	H
CO3	S	H	H	H	M
CO4	H	S	M	S	H

S-Strong H- High M-Medium L-Low

Diploma Courses:

Apiculture:

Subject Code	Title of the Paper	Instruction hours/week	Exam. Marks			Duration of Exam (hours)	Credits
			CIA	ESE	TOTAL		
18UDZA101	Core Paper 1.Basics of beekeeping	2	25	75	100	3	2
18UDZA202	Core Paper 2. Beekeeping techniques	2	25	75	100	3	2
18UDZA2CL	Core Practical 1. Beekeeping	2	25	75	100	3	2
	Total	**6**			**300**		**6**

UZO111 18UDZA101

Programme code : 06				
Course code 18UDZA101	Core Paper 1.Basics of beekeeping			
Batch	Semester	Hours/Week	Total hours	Credit
2018-2019		2	30	2

Course Objectives

1. To identify the different species of honey bees
2. To understand the structure and function of a honey bee hive.
3. To understand the basic biology of honey bees
4. To identify the pest and diseases of honey bees

Course Outcomes

K1	COI	Get knowledge and explain the honey bee species and role in agriculture
K2	CO2	Describe biology and structural adaptations of honey bees
K3	CO3	Develop knowledge about honey bee pest and diseases and their control measure.
K4	CO4	Educate the students for the role of honey bees in pollination

Teaching methods : Power point presentation, Seminar, Charts, Models, Assignment, Interaction, Quiz

SYLLABUS

UNIT 1 History and development of apiculture in India **6Hrs**

History of bee keeping: definition, beekeeping in India, in worldwide. Traditional bee keeping, modern beekeeping, urban beekeeping. Importance of beekeeping.

Unit II Honey bee species **6Hrs**

Identification of honey bee species and their races – rock bees, little bees, Indian bee, European bees and Stingless bees. Basic concepts of morphology of Honey bees : External organs and Internal organs.

Unit III-Biology of honey bees **6Hrs**

Colony life and social organization: honey bee castes, structural adaptations of honey bees. Communication in honey bees –dance languages. Swarming and absconding.

UNIT 1V Honeybee Enemies and their management **6Hrs**

Bee enemies: an introduction, bee enemies – Wax Moth, Ants, Wasps, Reptiles, diagnosis and identification. Mites infesting on honey bee colonies: *Varroa destructor* and tracheal mites (*Acarapis woodi*) - control measures of bee mites.

UNIT V Bee diseases and their control **6Hrs**

Bacterial disease - American Foulbrood, European Foulbrood. Viral disease - Deformed Wing Virus, Sacbrood Virus, Black Queen Cell Virus, Kashmir Bee Virus, Acute Bee Paralysis Virus. Fungal disease - Chalkbrood, Stonebrood. Protozoan disease - *Nosema cerana*. Control measures of bacterial, viral, fungal and protozoan diseases.

Text books

1. David B. Vasantharaj (2016). Elements of Economic Entomology (8th Edition) Brillion Publishing, p 400.
2. Pradip V Jabde (1993). Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, Agricultural Pests and their Controls. Discovery Publishing House, New Delhi, p 502.
3. Dewey M. Caron (2013). Honey Bee Biology and Beekeeping, Wicwas Press, Kalamazoo, MI 49001,p 368.

References books

1. VIjayakumar K.and R.Jeyaraaj (2017). Beekeeping and management techniques (Tamil), Kongunadu Arts and Science College, Coimbatore, p 145.
2. Ted Hooper (2010). Guide to Bees and Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books, Oxford.p 276.
3. Eva Crane (1999). The World History of Beekeeping and Honey Hunting. Routledge, Taylor and Francis group, New York, p-675.
4. Ghosh G.K. (1994). Beekeeping in India, APH Publishing, p194.

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	S	M
CO2	S	S	H	M	H
CO3	H	M	S	H	S
CO4	S	H	H	M	M

S-Strong H- High M-Medium L-Low

UZO 113 18UDZA202

Programme code : 06				
Course code 18UDZA202	Core Paper 2. Beekeeping techniques			
Batch	Semester	Hours/Week	Total hours	Credit
2018-2019		2	30	2

Course Objectives

1. To develop skills about beekeeping management techniques.
2. To educate the students for the importance of beekeeping and honey processing in relation with entrepreneurship development
3. To aware the role of honey bees in pollination
4. To educate the students for value added products in honey

Course Outcomes

K1	COI	Get knowledge about basic beekeeping techniques
K2	CO2	Describe parts of bee hive and beekeeping equipments
K3	CO3	Develop knowledge about honey harvest and honey processing methods.
K4	CO4	Educate the students for value added products in honey and role of honey bees in pollination

Teaching methods:

Power point presentation, Seminar, Charts, Models, Assignment, Interaction, Quiz

SYLLABUS

UNIT I Bee botany **6Hrs**

Bee pasturage and pollination: Types of bee pasturage- honey pollen plants for bees, Palynological analysis, preparation of bee floral calendars and installing bee pasturage sources.

UNIT II Bee hive management **6Hrs**

Bee Hive: Traditional and modern beehives and beekeeping equipment, Parts of bee hive, basic requirements for beekeeping.

The Apiary: Some common practices in apiary management. Care during breeding season - supering, swarm control, dividing an established colony and transportation of hives (Migratory beekeeping).

UNIT III Management practices and colony manipulation **6Hrs**

General apiary management practices**:** uniting bee colonies and artificial feeding. Seasonal management of honey bees: honey flow season management, summer management and winter management. Bee hive products - harvesting and extraction methods**.**

UZO 114 18UDZA202

UNIT IV Queen rearing **6Hrs**

Queen rearing and colony multiplication: Raising honey bee queens, developmental stages of queen bee, requirements for rearing good queens, methods of rearing queens.

Unit V Properties of honey and its application **6Hrs**

Honey - nutrients and composition of honey. Value added honey products. Properties of honey products. Types of value added honey products.

Text books

1. David B. Vasantharaj (2016). Elements of Economic Entomology (8th Edition) Brillion Publishing, p 400.
2. Pradip V Jabde, (1993). Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, Agricultural Pests and their Controls. Discovery Publishing House, New Delhi, p 502.

References:

1. Alison Benjamin, Brian McCallum (2008). Keeping Bees and Making Honey. David & Charles, Newton Abbot, p 128.
2. Kim Pezza (2013). Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S.5, p 144.
3. Conner L.J. Kim R. and Muir R. (2009). Queen Rearing Essentials, Wicwas Press, p 346.

4. Kim Flottum (2014). The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Books, p 208.

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	S	S
CO2	S	S	H	S	H
CO3	H	S	S	H	S
CO4	S	H	H	S	S

S-Strong H- High M-Medium L-Low

UZO116 18UDZA2CL

Programme code 06				
Course code 18UDZA2CL	Core Practical-1. Beekeeping			
Batch 2018-2019	Semester	Hours/Week 2	Total hours 30	Credit 2

Course Objectives

1. To identify the honey bee species, races and castes
2. To understand the behavior and physiology of honey bees
3. To know the importance of honey bees and hive products
4. To develop knowledge about value added products in honey

Course outcomes

K1	COI	Spply knowledge in identifying honey bee species, races and castes
K2	CO2	Analyze the behavior, importance and physiology of honey bees
K3	CO3	Field visit to study the apiary management techniques and honey harvesting methods
K4	CO4	Demonstrate the students for value added products in honey

Teaching methods :

Power point presentation, Seminar, Charts, Models, Assignment, Interaction, Quiz

SYLLABUS

1. Identification of different bee species and castes.

2. Hive inspection.

3. Dividing, uniting bee colonies and supering.

4. Supplementary feeding and honey extraction.

5. Swarm management.

6. Identification and management of bee enemies and diseases

7. Honey extraction, processing and bottling.

8. Bee pollen extraction.

9. Value added honey product preparation.

UZO117 18UDZA2CL

Text Books

David Cramp (2012). The Complete Step-by-step Book of Beekeeping: A Practical Guide to Beekeeping, from Setting Up a Colony to Hive Management and Harvesting the Honey. Lorenz Books. London, p 160.

David Cramp (2009). A Practical Manual of Beekeeping: How to Keep Bees and Develop Your Full Potential as an Apiarist. Spring Hill, London, p 304.

CIA Practical Examination

Model Practical Examination	10 marks
Observation Note	05 marks
Attendance	02 marks
Total	**20 marks**

End of Semester Examination

Time 4 Hours Max.marks – 60

1	Major Question	10 Marks
2	Minor Question	06 Marks
3	Spotters 3X3	09 Marks
4	Record submission	05 Marks

	Total	**30 Marks**

ORNAMENTAL FISH PRODUCTION AND TRADE

Semester	Subject code	Title of the paper	Lecture hours	Marks			Duration of Exam (hours)	Credit point
				CIA	ESE	Total		
I	18UDZB101	Paper 1 Aquarium design, fabrications, and entrepreneurship development	75	25	75	100	3	5
	18UDZB102	Paper 2. Aquarium - Best Management Practices (BMP)	75	25	75	100	3	5
II	18UDZB103	Paper 3. Aquarium - Best Management Practices (BMP)	75	25	75	100	3	5
	18UDZB2CL	Paper 4- Practical	60	40	60	100	4	5
	18UDZB3Z1	Paper 5 Project Report and Viva-voce	60	20	(60 +20)	100		5
		Total	**345**	**500**				**25**

I - SEMESTER

PAPER 1 – Aquarium design, fabrications, and entrepreneurship development

TotalCredits:5 Total Hours: 75

Objectives

1) To inculcate importance of ornamental fish production in relation with trade for entrepreneurship development.
2) To give students knowledge about various techniques of Design, fabrication and filtration for aquarium maintenance
3) To teach techniques to understand about aquarium setting and accessories involved for construction of aquarium and its maintenance.

Course Outcomes

K1	COI	Get knowledge about the commercial ornamental fish production of in India

K2	CO2	Understand the practices of ornamental fish culture and its management to export worldwide
K3	CO3	Apply practical knowledge into fish production and marketing to become successful entrepreneur
K4	CO4	Analyze students acquired technical knowledge which is helpful to begin an entrepreneurship in the field of ornamental Fisheries

SYLLABUS

Unit- I : Introduction

Basics of aquaculture and aquaponics and scope. Ornamental fisheries new dimensions in aquaculture entrepreneurship and Trade. World trade of ornamental fish and export potential.

UZO121 18UDZB101

Basic knowledge and profile of some selected exotic and indigenous fishes. Major countries involved in ornamental fish buying and Status of ornamental fish farming in India.

Unit- II: Fabrication and setting up of aquariums

Design and construction of public fresh water and marine aquaria and oceanarium. Different types of fish tanks, Materials required for construction of tanks, Construction of all glass aquarium glass tank, Method of construction of all glass tanks (flow chart), Steps involved in setting up of aquarium

Unit- III : Aeration and filtration

Aerator, Power air-pump, Spray bar, Filters, Canister filter (external or internal type) Page, Trickle filter, Submersible power filter (box filter / corner filter), Submersible air-lifting filter (inside filter / corner filter), Biofilters in aquarium.

Unit- IV: Aquarium accessories and equipments

Aquarium accessories for small scale units, Equipments and accessories needed for small scale recreational ornamental fish culture unit, Aquarium accessories and equipments for large scale units, Equipment and accessories needed by large scale ornamental fish production unit, Pumps and pipe lines, Equipment and accessories for large scale ornamental fish seed production, Food/feed production units.

UNIT- V: Entrepreneurship Development

Government schemes and subsidies for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to ornamental fisheries. Contract farming and joint ventures, public-private partnerships. Fish domestic and foreign export.

Text Books

1. Ayyappan S., Jena, J. K. Gopalakrishnan, A. Pandey. A. K. (2011). Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.

2. Dholakia, Anshuman D. (2016). Ornamental Fish Culture and Aquarium Management. Daya Publishing House, New Delhi.

3. Petrovicky, I., (1993). Tropical Aquarium Fishes. Chancellor press, London. p.258.

UZO122 18UDZB102

Reference Books

1. Dey, V.K., (1993) Ornamental fishes. Marine Products Export Development Authority, Kochi. pp.7-10.

2. FAO, (2007). Fishery statistics, Aquaculture production, 2005. Food and Agriculture Organization of the United Nations, Rome.

3. Shinji Mekino (1972). Home Aquarium, Aquatic Gems – Tropical Fish. Ward Lock Limited, London. p.97.

4. Wainwright, N. (1969). Coldwater Aquarium. Frederick Warne & Co ltd. England. p.75.

Mapping

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	H	S
CO2	S	M	H	S	H
CO3	S	H	H	H	M

CO4	H	S	M	S	H

S-Strong H- High M-Medium L-Low

PAPER 2 – Aquarium - Best Management Practices (BMP)

TotalCredits:5 **Total Hours: 75**

Objectives

1. To impart knowledge about the various management practices for successful production of ornamental fishes
2. To teach students about culture of livefeeds, techniques involved to manufacture artificial feed and health management for ornamental fishes.
3. To understand the cost effective ornamental fish production by adoption of Best Management Practices (BMP)

Course Outcomes

K1	COI	Get field knowledge for design and construction of aquarium.
K2	CO2	Understand the formulation of feed and nutrition management for betterment of ornamental fish culture
K3	CO3	Apply knowledge on health management for successful production of aquarium fishes.
K4	CO4	Analyze the breeding and culture techniques for the trading.

Unit- I Aquarium fish management

Cleaning and disinfection of the aquarium, Commercially important marine and freshwater ornamental fishes- Quality assessment, Handling of live fishes, fish acclimation, Stress management, Grading and stocking ratio, Photoperiod, Brood stock management, larval, fry and juvenile management. Reef aquarium management.

Unit- II- Water management

Water quality parameters – Temperature, Salinity, Turbidity, determination of pH, Electrical conductivity, Dissolved Oxygen, Carbon dioxide, Total alkalinity, Total hardness, Ammonia, Nitrite and Heavy metals. Water culture, Re-circulation, Exchange and sanitation.

UNIT-III: Feed and feeding management

Live food organisms and its nutritional value, Proximate composition of live and artificial feeds, Feeding frequency, Collection and culture of Infusoria, Collection and culture of Artemia sp. Culture of daphnia, Culture of tubifex, Culture of blood worms, Mosquito larvae, Rotifers, Copepods. Preparation of artificial feed, Formulated feeds, Types of feeds, feed for formulation, Manufacturing, Feeding devices and methods and Feed additives

UNIT- IV: Health management

Biosecurity measures, Diseases of ornamental fishes- Bacterial diseases, Protozoan diseases, Fungal diseases, Parasitic diseases, Pathogenecity, Host, Pathogen and environment interactions. Disease diagnostics techniques. Drugs, Chemicals, Antibiotic, Probiotics and their mode of action. Quarantine and health certification for ornamental fishes.

UNIT- V: Transport and packaging

Method of collection and transportation of live fish, Transportation of ornamental fish, Fish packaging system, Steps to be taken while transporting fish, Application of anaesthetics, Conditioning of fish for packaging, Record keeping.

Text Books

1. Ayyappan S., Jena, J. K. Gopalakrishnan, A. Pandey. A. K. (2011). Handbook ofisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.

2. Dholakia, Anshuman D. (2016). Ornamental Fish Culture and Aquarium Management. Daya Publishing House, New Delhi.

3. Goldstein, R. J. (1971). Diseases of aquarium fishes. T.F.H. Publications. 126 pp

Reference Books

1. Bhat, B.V., 2008. Export oriented aquaculture in India: An overview. Fishing Chimes, 27 (10/11): 51-58.

2. Boyd, C.E., 1992. Water quality management for pond fish culture. Elsevier science publishers, Netherland. p.317

3. Lochmann, R.T. and Phillips, H., 1994. Dietry protein requirement of golden shiners (Notemigonus crysoleucas) and goldfish (Carassius auratus) in aquaria. Aquaculture, 128:277-285.

UZO125 18UDZB102

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	H	S
CO2	H	S	H	H	H
CO3	H	M	H	H	H
CO4	H	H	S	H	H

S-Strong H- High M-Medium L-Low

UZO129 18UDZB2CL

PAPER 4 – Practical- 1

TotalCredits:5 **Total Hours: 60**

- Identification of common ornamental fishes and plants.
- Aquarium accessories and equipments.
- Fabrication of all-glass aquarium.
- Setting-up and maintenance.
- Water quality parameters
- Fish Biology
- Fabrication of filters
- Conditioning and packing of ornamental fishes.
- Preparation of feed.
- Setting-up of breeding tank for live bearers, barbs, goldfish, tetras, cichlids, gouramis, fighters and catfishes.
- Identification of ornamental fish diseases and prophylactic measures.

Suggested Field Visits

Field visits are to be organised to facilitate students to have firsthand experience and exposure to technology / production / functioning of an organisation / unit or witness a relevant activity.
Each student must make at least 02 (Two) such visits to the units/markets/public aquarium out of 2 to 3 such visits organised by the college.

i) Visit to one of the units with one or multiple activities such as.

• Ornamental fish farm / Nursery/ Hatchery.

ii) Visit any production units such as

• Ornamental fish Food industry

iii) Govt. Offices such as

• National and state fishery Departments.

iv) Visit to National Laboratories, National Research Labs & Training Institutes such as

(Field visit is desirable to know the organization; however guest lecturers could also be helpful in understanding functioning).

Reference Books

1. Archana Sinha, Prem shankar Pandey and Surya Kumar Prabhakar (2008). Training Manual on Culture and Breeding of Ornamental Fish. Central Institute of Fisheries Education, Kolkatta centre.

2. Fish Biology By C.B.C. Srivastava – Narendra Pub. House.

3. Santhanam. R, Sukumaran. N and Natarajan.P., 1990. A manual of freshwater aquaculture. Oxford & IBH Publishing Co Pvt. Ltd., New Delhi. p.102-120.