

University of Mumbai



No. AAMS_UGS/ICC/2024-25/178

CIRCULAR:-

Attention of all the Principals of the Affiliated Colleges, Directors of the Recognized Institutions is invited to this office Circular No. AAMS_UGS/ICC/2024-25/115 dated 23rd August, 2024 relating to the introduction of the syllabus of M3 Pattern (Scheme –III) Major 4 Credits Science Programs.

They are hereby informed that the recommendations made by the Board of Deans at its meeting held on 23rd October, 2024 vide item No. 6.2 (N) has been accepted by the Hon'ble Vice Chancellor as per the powers confirmed upon him under Section 12(7) of the Maharashtra Public Universities Act, 2016 and that in accordance therewith the syllabus of **M1, M2 Pattern (Scheme –II)** of following Science Programs is introduced as per appendix (NEP 2020) with effect from the academic year 2024-25.

M1, M2 Pattern (Scheme –II)

- 1) B.Sc. (Botany) Sem. I & II
- 2) B.Sc. (Mathematics) Sem. I & II
- 3) B.Sc. (Zoology) Sem. I & II
- 4) B.Sc. (Physics) Sem. I & II
- 5) B.Sc. (Microbiology) Sem. I & II

(The said circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

30th October, 2024

To,

(Dr. Prasad Karande)
REGISTRAR

All the Principals of the Affiliated Colleges, Directors of the Recognized Institutions.

BOD/6.2 (N)/23/10/2024

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans,
- 2) The Dean, Faculty of Science & Technology,
- 3) The Chairman, Board of Studies,
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Department of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanaagari.
- 8) The Deputy Registrar, Admissions, Enrolment, Eligibility & Migration Department (AEM).

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentre@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), Dlleuniversityofmumbai@gmail.com

Copy for information :-

1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	Faculty of Humanities, Dean 1. Prof.Anil Singh Dranilsingh129@gmail.com Associate Dean 2. Dr.Suchitra Naik Naiksuchitra27@gmail.com 3.Prof.Manisha Karne mkarne@economics.mu.ac.in
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6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

As Per NEP 2020

University of Mumbai



Title of the program

- A- U.G. Certificate in Zoology
- B- U.G. Diploma in Zoology
- C- B.Sc. (Zoology)
- D- B.Sc. (Hons.) in Zoology
- E- B.Sc. (Hons. with Research) in Zoology

Syllabus for

Semester – Sem I & II (Scheme – II)

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25
Progressively)

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program	A	U.G. Certificate in Zoology
	O: _____ A	B	U.G. Diploma in Zoology
	O: _____ B	C	B.Sc. (Zoology)
	O: _____ C	D	B.Sc. (Hons.) in Zoology
	O: _____ D	E	B.Sc. (Hons. with Research) in Zoology
2	Eligibility	A	HSC(Science) OR Passed Equivalent Academic Level 4.0
	O: _____ A	B	Under Graduate Certificate in Zoology OR Passed Equivalent Academic Level 4.5
	O: _____ B	C	Under Graduate Diploma in Zoology OR Passed Equivalent Academic Level 5.0
	O: _____ C	D	Bachelors of Zoology with minimum CGPA of 7.5 OR Passed Equivalent Academic Level 5.5
	O: _____ D	E	Bachelors of Zoology with minimum CGPA of 7.5 OR Passed Equivalent Academic Level 5.5
3	Duration of program	A	One Year
	R: _____	B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years

4	Intake Capacity R: _____	120	
5	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	R: _____ Standards of Passing	40%	
7	Credit Structure Sem. I - R: _____ A	Attached herewith	
	Sem. II - R: _____ B		
	Credit Structure Sem. III - R: _____ C		
	Sem. IV - R: _____ D		
	Credit Structure Sem. V - R: _____ E		
	Sem. VI - R: _____ F		
8	Semesters	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
9	Program Academic Level	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	Pattern	Semester	
11	Status	New	
12	To be implemented from Academic Year Progressively	From Academic Year: 2024-25	

Sign of the BOS
Coordinator
Dr. Vaishali Somani
BOS in Zoology

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

Preamble

1) Introduction

The FYBSc Zoology syllabus (Under Graduate Certificate in Zoology) is designed as per the objectives and guidelines of National Education Policy 2020. This programme is designed to provide a basic understanding of the principles of life processes, evolution of life, animal behaviour, ecology and laboratory techniques through an academic curriculum of theory and practical courses. We aim to provide not only subject knowledge but also make the learners understand the core values of the Zoology. This syllabus is framed to equip learners with a basic theoretical and practical knowledge for developing analytical abilities for problem solving, exploring opportunities, and also to develop entrepreneurship skills. There will be continuous evaluation of learners based on both practical skills and theoretical / mental abilities through class tests, group engagement and assignments.

2) Aims and Objectives

The aims and objectives of the FYBSc Zoology (Under Graduate Certificate in Zoology) curriculum is to provide learners with a basic understanding of the principles of life processes, evolution of life, animal behaviour, ecology and laboratory techniques, developing applications of knowledge Zoology for academic and entrepreneurial pursuits. The aims and objectives align with broader educational goals, focusing on academic and professional goals. The syllabus aims in imparting knowledge related to animal sciences, current trends and advancements in the field to develop entrepreneurial aptitude and skills.

3) Learning Outcomes

The learners will develop an understanding of fundamental principles of life processes, evolution of life, ecological interactions, and animal behaviour and acquire laboratory skills for applications in allied industries, research, and academia. The learners will develop an aptitude for exploring the opportunities for self-employment and entrepreneurship activities.

4) Any other point (if any)

The skills and knowledge acquired through this programme will make the learners well-equipped for exploring the diverse fields of Zoology and applying them to entrepreneurial activities or higher academic pursuits.

5) Credit Structure of the Program (Sem I, II, III, IV, V & VI)

Under Graduate Certificate in Zoology

Credit Structure (Sem. I & II)

	R: _____A									
Level	Semester	Major (M1)		Minor (M2)	OE	VSC, SEC (VSEC)	AEC, VEC,IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	MJ1: Life Processes (2) MJP1: Practical based on MJ1 (2)	--	MJ1: Life Processes (2) MJP1: Practical based on MJ1 (2)	2	VSC1a: Ornament al fish Breeding and mainten an ce (2) OR VSC1b: Pet rearing and care. (2) SEC1: Aquarium Managem ent (2)	AEC:2, VEC:2, IKS:2	CC:2	22	UG Certificate 44
	R: _____B									
	II	MJ2: Ecology and Biodiversity (2) MJ3: Ethology and Evolution (2) MJP2: Practical based on MJ2 &MJ3 (2)	--	MJ2: Ecology and Biodivers ity (2) MJ3: Ethology and Evolution (2) MJP2: Practical based on MJ2 &MJ3 (2)	2	SEC2: Fish value added products (2)	AEC:2, VEC:2	CC:2	22	
	Cum Cr.	10	-	10	4	6 (4+2)	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Majorand Minor										

Under Graduate Diploma in Zoology

Credit Structure (Sem. III & IV)

	R: _____ C									
Level	Semester	Major (M1)		Minor (M2)	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Mandator y							
5.0	III	8	-	4	2	VSC:4	AEC:2	FP: 2	22	UG Diploma 88
	R: _____ D									
	IV	6	-	6	2+2	SEC:2	AEC:2	CEP: 2	22	
	Cum Cr.	24		20	10	6+6	8+4+2	4+2+2	88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continuewith Major and Minor										

B.Sc. (Zoology)**Credit Structure (Sem. V & VI)**

	R:_____E									
Level	Semester	Major (M1)		Minor (M2)	OE	VSC, SEC (VSEC)	AEC, VEC,IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Mandatory							
5.5	V	10	4	4		VSC: 2		FP/CEP :2	22	UG Degree 132
	R:_____F									
	VI	10	4	4				OJT :4	22	
	Cum. Cr.	44	8	28	10	8+6	8+4+2	4+2+2+2+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

[Abbreviation: OE– Open Electives, VSEC-Vocational and Skill Enhancement Course, VSC– Vocation Skill Course, SEC– Skill Enhancement Course, AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – On Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project, ZIKS- Zoological Indian Knowledge System, NSQF- National Skills Qualification Framework]

F.Y.B.Sc. Zoology (USZO) Course Structure

Mandatory courses (MJ), Vocation Skill Courses (VSC) and Skill Enhancement Courses (SEC)

Offered as Major / Minor courses

Semester I

Ladder	Course Type	Title	Credits	Hours	Marks
Major 1 (MJ1)	Theory	Life Processes	2	30	50
Major P1 (MJP1)	Practical	Practical based on MJ1	2	60	50
VSC1a	Practical	Ornamental fish Breeding and maintenance	2	60	50
VSC1b	Practical	Pet rearing and care	2	60	50
SEC-1	Practical	Aquarium Management	2	60	50

Semester II

Ladder	Course Type	Title	Credits	Hours	Marks
Major 2 (MJ2)	Theory	Ecology and Biodiversity	2	30	50
Major 3 (MJ3)	Theory	Ethology and Evolution	2	30	50
Major P2 (MJP2)	Practical	Practical based on MJ2 & MJ3	2	60	50
SEC-2	Practical	Fish value added products	2	60	50

Sem. - I

Mandatory course
Syllabus
B.Sc. (Zoology)
(Sem.- I)

Name of the course: MJ1: Life processes

Course Objectives (CO):

- CO1. To develop the understanding of learners about the basic of life processes including locomotion, respiration, reproduction, excretion, circulation, and nutrition.
- CO2. To develop understanding of learners about coordination in life processes of the living organism.

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

- OC1. Describe the co-ordination of physiological processes in organisms, including transport systems and responses to stimuli
- OC2. Apply detailed knowledge to explain the processes by which organisms develop, move, breath and excrete.

Paper-1

MJ1: Life Processes

Module 1: Life Processes-I	15hr
1.1 Movement and locomotion 1.1.1: Amoeboid movement, tube feet, flagellum 1.1.2: Ultra-structure of cilia and ciliary movements 1.1.3: Action of muscles (Role of muscles in movement)	03hr
1.2 Nutrition 1.2.1 Types of nutrition: Autotrophic and Heterotrophic. 1.2.2. Apparatus for nutrition: 1.2.2.1 Animals without alimentary canal, ex. Amoeba 1.2.2.2. Animals with incomplete alimentary canal, ex. Hydra, 1.2.2.3. Animals with complete alimentary canal, ex. ruminants and non-ruminants 1.2.3 Brief account of physiology of digestion in vertebrates and symbiotic digestion in Ruminants.	05hr
1.3 Respiration 1.3.1 Aerobic and anaerobic respiration 1.3.2 Types of respiratory surfaces: 1.3.2.1 General body surface: Cell membrane - ex. Amoeba, 1.3.2.2 Skin - ex. Earthworm and Frog 1.3.2.3 Trachea and spiracles, 1.3.2.4 Gills of fish, 1.3.2.5 Accessory respiratory organ in Fish, 1.3.2.6 Lungs of Human.	04hr
1.4 Circulation 1.4.1 Types of circulating fluids: 1.4.1.1 Water, 1.4.1.2 Coelomic fluid, 1.4.1.3 Lymph and 1.4.1.4 Blood 1.4.2 Types of circulation 1.4.2.1 Protoplasmic streaming, 1.4.2.2 open and closed circulation, 1.4.2.3 single and double circulation. 1.4.3 Hearts Types, 1.4.3.1 Heart in Daphnia, 1.4.3.2 Heart of Cockroach 1.4.3.3 Heart in chordates (2, 3 and 4 chambered heart)	03hr

Module 2: Life Processes-II	15 hr
2.1 Excretion and osmoregulation 2.1.1 Concepts of osmoregulation and excretion. 2.1.2 Categorization of animals on the basis of principle nitrogenous excretory products.	4hr
2.2 Control and Coordination 2.2.1 Irritability in Paramoecium 2.2.2 Structure of neuron, 2.2.3 Conduction of nerve impulse 2.2.3.1 Resting potential, 2.2.3.2 Action potential 2.2.3.3 Refractory period. 2.2.4 Endocrine regulation: 2.2.4.1 Hormones as chemical messengers, 2.2.4.2 Feedback mechanisms.	5 hr
2.3 Reproduction 2.3.1 Asexual Reproduction: 2.3.1.1 Binary fission in Paramoecium, 2.3.1.2. Gemmule in Sponges, 2.3.1.3. Budding in Hydra, 2.3.1.4. Regeneration in planaria, 2.3.2 Sexual mode of reproduction 2.3.2.1 Gametogenesis, 2.3.2.2 structures of Mammalian Ovum 2.3.2.3 Structure of Mammalian Spermatozoa	3hr
2.4 Fertilization: 2.4.1 External and internal fertilization 2.4.2 Oviparity, 2.4.3. Viviparity 2.4.4 Ovo-viviparity	3hr

Reference Books

1. Campbell Biology, 11th Ed. (2017) Lisa Urry et al. Pearson Publication. ISBN. 978-0134093413
2. Biology (1994) by John W. Kimball, 6th Ed. ISBN. 978-0697142573
3. Invertebrate Zoology: A functional and evolutionary approach. 7th Ed. (2006) Robert D Barns. ISBN: 978-8131501047.
4. Modern Textbook of Zoology Vertebrates. (2020) 4th Ed. R L Kotpal. Rastogi Publication. ISBN: 978-9350780954
5. Modern Textbook of Zoology Invertebrates (2020) 12th Ed. R L Kotpal. Rastogi Publication. ISBN: 978-8193887554.
6. Embryology (2017) Mohan P Arora. Himalaya Publishing House. ISBN: 978-9352730964.

Major Practical-1

Name of the Course: MJP1: Practical based on MJ1

Course Objectives (CO):

- CO1. To upgrade the skill in handling of basic laboratory instruments.
- CO2. To enhance learners' skills in calibration of instruments and calculation techniques.
- CO3. To upgrade the skill of learners in minimization of Error minimization in the laboratory.
- CO4. To upgrade the skill good laboratory practices.

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

- OC1. Safely practice, basic laboratory procedures and protocols inside a laboratory
- OC2. Acquire the skills of basic calibration and handling of instrumentation in laboratory.
- OC3. Appreciate the basics of life process in animals and their coordination in animal body.
- OC4. Acquire skills for preparation of various solutions required in experimental research.

Major Practical-1

Name of the Course: MJP1: Practical based on MJ1 and MJ2

1. Study of *Paramecium* culture to observe food vacuole, contractile vacuole and ciliary movement.
2. Study of nutritional apparatus: Amoeba, L.S. of Hydra, Digestive system of Cockroach, Fish, Bird, and Mammals (ruminant and non-ruminant).
3. Study of effect of pH and temperature on amylase/ trypsin activity.
4. Study of heart of Cockroach, Fish, Frog, *Calotes*, Crocodile and Mammal.
5. Excretory apparatus in Amoeba, Planaria, Earthworm, Cockroach and Fish, Mammal.
6. Study of Reproductive system in Ameoba, Hydra, Planaria, Cockroach, Mammals (T.S Testes and T.S ovary).
7. Study of respiratory apparatus in Amoeba, Cockroach, Spider, Fish and Frog, Mammal.
8. Introduction to basic laboratory safety practices, precautions and safety rules and symbols.
9. Use of Fire extinguisher,
10. Precaution and first aid for acid burn,
11. Precaution and first aid of chemical inhalation and the accident
12. Study of compound microscope, care and functions of its components,
13. Handling of common laboratory equipment (instrument and glassware): burner, autoclave, burette, and pipette (analytical and serological.
14. Handling of weighing Balance and preparation of solution of different concentration (Percentage, ppm, molarity, normality).
15. Packaging and autoclaving of test tubes, pipettes, Petri plates, and conical flask.
16. Measurement of pH of Milk, aerated drinks, Lemon juice, etc. using pH paper and pH meter.
17. Demonstration of aseptic transfer of liquids between burners.
18. Visit to clinical lab/ pathology lab, OR Central Instrumentation facility OR R & D center, and submission of report OR Participation in Instrumentation workshop.

(Additional activity which the center may consider: Fractionation of tissue extract / cellular extract by centrifugation.)

Reference Books

1. A course in electronic measurements and instrumentation. (2015) A K Sawhney Dhanpat Rai and Co. Pvt Ltd. ISBN: 978-8177001006
2. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology. 8th Ed. ISBN: 978-1316614761.
3. An Introduction to Practical Biochemistry. (2017) David Plummer. 3rd Ed. McGraw Hill Education. ISBN: 978-0070994874.
4. Bioinstrumentation. (2019) Bhawana Pandey and MH Fulekar. Dreamtech Press ISBN: 978-9389520286.
5. Guidelines for good laboratory practices-Indian council of medical research, New Delhi (2008).
7. Invertebrate Zoology: A functional and evolutionary approach. 7th Ed. (2006) Robert D Barnes. ISBN: 978-8131501047.
8. Modern Textbook of Zoology Vertebrates. (2020) 4th Ed. R L Kotpal. Rastogi Publication. ISBN: 978-9350780954
9. Modern Textbook of Zoology Invertebrates (2020) 12th Ed. R L Kotpal. Rastogi Publication. ISBN: 978-8193887554.
10. Embryology (2017) Mohan P Arora. Himalaya Publishing House. ISBN: 978-9352730964.
11. Comparative anatomy of vertebrates (2008) R. K. Saxena, Sumitra Saxena. ISBN: 978-1905740994.

Vocational Skill Course

Name of the Course: VSC1a: Ornamental fish Breeding and maintenance

Course Objectives (CO):

- CO1. To introduce learners to the fundamental concepts of ornamental fish species identification and classification.
- CO2. To provide knowledge of breeding methodologies and the factors influencing successful reproduction in ornamental fish.
- CO3. To impart skills in designing and managing suitable habitats for various ornamental fish species.

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

- OC1. Understand the diverse species of ornamental fish and their specific care requirements.
- OC2. Apply various breeding techniques to successfully propagate ornamental fish.
- OC3. Demonstrate proficiency in maintaining optimal aquatic environments for ornamental fish.

Module-1: Ornamental fish Breeding and maintenance

1. Identification of ornamental fishes (freshwater and marine).
2. Breeding set up for live bearers (Guppy, swordtail, molly)
3. Breeding set up for egg bearers (Egg scatters goldfish, zebra fish, Egg depositors -Discus, Egg barriers- Killi fish, Mouth breeders-Arowana, Nest builders- Gourami, Siamese fighter)
4. Setting of rearing and breeding tank.
5. Estimation of water parameters-pH, DO, CO₂ and Salinity
6. Experiment: Study of separation of fries from parents
 1. Selecting the Right Time
 2. Using a Breeding Trap
 3. Separate Tank or Nursery Tank
 4. Using a Siphon
 5. Providing Hiding Places in the Nursery Tank
 6. Monitoring and Feeding
 7. Gradual Introduction to Larger Tank
7. Record behaviours (swimming patterns, schooling behaviour, changes in coloration, and interactions with other fish) in ornamental Fish.
8. Study of diseases and its prevention during fish breeding.
9. Assignment on breeding of an ornamental fish species (e.g. Siamese fighter, guppy, etc.).
10. Visit to a fish breeding centre / facility / aquarium shop.
11. Feasibility report for setting up an ornamental fish breeding facility.
12. Case study - Hatchery and nursery management of ornamental fishes.
13. Additional practical as per the center's requirement / facility available.

Reference Books

1. Emmens, C. W. (2013). Keeping and breeding aquarium fishes. Academic Press.
2. Dholakia, A. D. (2009). Ornamental fish culture and Aquarium management. Daya Publishing House.
3. Sinha, A., & Pandey, P. K. (2023). Breeding and Culture of Freshwater Ornamental Fish. CRC Press.
4. Dey, V.K., 1993. Ornamental fishes. Marine Products Export Development Authority, Kochi. pp.7-10.
5. Dey, V.K., 2008. Global Trade in Ornamental Fish: Trends, Prospects and Issues. Abstract, International seminar on Ornamental fish breeding, farming and trade, Cochin, India. pp.2.
6. Petrovicky, I., 1993. Tropical Aquarium Fishes. Chancellor press, London. p.258.
7. Beaven C.R., Hand Book of Fresh Water Fishes of India. Narendra Pub. House.
8. C.B.C. Srivastava. Fish Biology. Narendra Pub. House

Vocational Skill Course

Name of the Course: VSC1b: Pet Rearing and Care

Course Objectives (CO):

- CO1. To familiarize learners with the characteristics and distinguishing features of exotic and indigenous dog and cat breeds commonly found in India and to provide learners with tools for understanding pet behaviour through the study of body language charts.
- CO2. To teach learners practical grooming techniques for dogs and cats and to provide learners with essential first aid tips for common pet emergencies.
- CO3. To enable learners to formulate balanced and nutrient-rich dry food suitable for the dietary needs of dogs and cats.
- CO4. To emphasize the importance of preventative healthcare in maintaining the health of pets and to foster responsible pet ownership practices.

Course Outcomes (OC):

- OC1. Learners will acquire skills to identify and differentiate between various exotic and indigenous dog, cat breeds and learners will be able to interpret and analyse the body language of dogs and cats through the use of body language charts, enabling them to understand the behaviour of pets.
- OC2. Learners will comprehend the stages of the oestrus cycle in female cats and dogs and will develop practical skills in grooming and providing first aid.
- OC3. Learners will demonstrate understanding of common parasites affecting dogs and cats.
- OC4. Learners will be equipped with the knowledge and skills to administer confidently and effectively immediate first aid to pets in various emergency situations.

Module: Pet Rearing and Care

1. Identification of exotic breeds of dogs in India- German shepherd, Beagle, Bull dog, Great dane, Indian spitz, Pug, Labrador, Golden retriever, Shih Tzu, Siberian Husky.
2. Identification of Indian breeds of dogs- Indian Pariah dog, Rajapalayam, Gaddi, Rampur hound, Mudhol hound, Chippiparai, Kanni dog, Himalayan sheepdog (Bhutia), Kaikadi, Jonangi.
3. Identification of common breeds of cats- Persian cats, Bombay cats, maine coons, Turkish van, Siamese cat, Ragdoll.
4. Identification of behaviour of a pet animal from its body language- Dog and Cats (Body language charts).
5. Study of the stages of the oestrus cycle in female cats and dogs through behavioural changes, vocalization, and physical signs.
6. Study of grooming techniques- brushing, bathing, nail trimming, and ear cleaning, teeth brushing, hair trimming.
7. Pet First Aid tips- wound care, seizures, choking and poison.
8. Study of Body Condition Scoring (BCS) techniques for Weight assessment and overall Well-being in Dogs and Cats.
9. Estimation of moisture content in dry pet food.
10. Formulation of Nutrient-Rich Dry Food for Dogs and Cats.
11. Study of common parasites in pets: Understanding, Treating, and Preventing in Dogs and Cats – Fleas, Ticks, Mites (Ear mites and Sarcoptic mites), Tapeworm and Giardia.
12. Study of deworming, vaccination schedules, and other preventive healthcare measures for cats and dogs.
13. Study of Zoonotic and reverse zoonotic diseases.
14. Study and preparation of reports on rights and responsibilities of pet owners in India.
15. Assignment on rearing and care of lesser-known pet animals.
16. Visit to an animal rescue centre/ animal care centre and prepare a report based on it.
17. Visit to animal training centre/ veterinary hospital/ pet grooming centre and prepare a report based on it.
18. Additional practical as per the center's requirement / facility available.

Reference Books

1. Yeates, J. (Ed.). (2019). Companion animal care and welfare: The UFAW companion animal handbook. John Wiley & Sons. ISBN:9781118688793
2. Alderton, D., Edwards, A., Edwards, A., Larkin, P., Stockman, M. The Complete Book of Pets & Petcare: The Essential Family Reference Guide to Pet Breeds and Petcare T Hong Kong: Anness Publishing. 2018. ISBN:9781844779338.
3. Companion Animals: Their Biology, Care, Health, and Management. Campbell, Karen L., and Campbell, John R.. United Kingdom, Pearson Prentice Hall, 2009. ISBN:9780135047675
4. The Book of Indian Dogs. Baskaran, S. Theodore. Aleph. 2017. ISBN:9789384067571.
5. Encyclopedia of Dogs: A Comprehensive Guide to Dog Breeds. United Kingdom, NPP Books, 2014. ISBN:9780755494958

Skill Enhancement Course (SEC)

Name of the Course: SEC1: Aquarium Management

Course Objectives (CO):

- CO 1. Develop entrepreneurial skill in aquarium management.
- CO 2. Enhance professional skill with proper scientific knowledge.
- CO 3. Acquaint learners to practical skills of aquarium management .

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

- OC 1. Work as aquarium maintenance professional.
- OC 2. Generate source of employment.
- OC 3. Construct and set aquarium for ornamental fishes.
- OC 4. Disease management of ornamental fish.

Module: Aquarium Management

1. Types of aquariums: Freshwater (warm water, cold water), nano, marine, reef tank.
2. Accessories/equipment used in aquarium: Filters (mechanical, biological, chemical), Aerator, Heater, Thermometer, Lights, protein skimmer.
3. Identification of freshwater ornamental fishes: Guppy, Molly (*Poecilia* spp.), Goldfish (*Carassius auratus auratus*), Oscars (*Astronotus ocellatus*), Asian arowana (*Scleropages formosus*), Siamese fighting fish (*Betta splendens*), Zebra fish (*Danio rerio*), Reticulated loach (*Botia lohachata*), Dwarf gourami (*Trichogaster lalius*), Denison barb (*Sahyadria denisonii*), and Rosy Barb (*Puntius conchonius*)
4. Identification of marine ornamental fishes: Yellowtail damselfish (*Chrysiptera parasema*), Royal Gramma (*Gramma loreto*), Powder Blue Tang (*Acanthurus leucosternon*), Ocellaris Clown Fish (*Amphiprion ocellaris*), Blue Devil (*Paraplesiops meleagris*), and Butterfly fish (*Chaetodon* spp).
5. Types of plants: Vallisneria, Hydrilla, Azolla, Pistia, Sagittaria, Amazon Sword, *Limnophila*, *Limnophila aquatica*, *Ceratophyllum*, *Chara*,
6. Live fish feed: Infusoria, Rotifers, Artemia, Cladocerans, Tubifex worms, Chironomid Larvae (Blood worm),
7. Preparation of formulated fish feed.
8. Symptoms and treatment of fish diseases: Parasitic/Protozoa: Whit spot diseases, costiasis, whirling disease, Trichodiniasis; Bacterial: Bacterial gill rot, Dropsy, Ulcer disease, Furunculosis, Vibriosis, Columnaris, and Fish T.B.; Fungal- Saprolegniasis, Brachiomycosis, Ichthyophonosis.
9. Estimation of ammonia and pH of aquarium water.
10. Determination of hardness of water.
11. Determination of dissolved oxygen of water.
12. Determination of salinity.
13. Assignment on setting of freshwater and / or marine aquarium.
14. Report Submission: Visit to aquarium fish keeping entrepreneur.
15. Submission of feasibility report or budget for setting up an aquarium fish farm.

Reference Books

1. Amita Saxena (2009). Aquarium Management-Daya Publishing House, New Delhi
2. Nandita Singh, Surekha Gupta and Geeta Joshi (2023). Aquarium and its Management-AkiNik Publication, New Delhi
3. Dholakia A.D. (2016). Ornamental Fish Culture and Aquarium Management, Daya Publishing House, New Delhi
4. Taylor J.E. (2018). The Aquarium: Its Inhabitants, Structure, and Management- Unikum Verlag.
5. Mundy Obilor Jim (2015). Aquarium Making, JimArts Publishing, Norway
6. Tappan Frank (2016). Aquaria Fish, Createspace Independent Publishing Platform
7. Untergasser Dieter (1992). Handbook of fish disease, T.F.H. Publication.
8. Arumugam N. (2014). Aquaculture and Fisheries, Saras Publication, New Delhi.
9. Alderton David (2003). Freshwater Aquarium, Fox Chapel Publishing.
10. Dawes John (2001). Complete Encyclopaedia of the Freshwater Aquarium, Firefly Books.
11. Pawar Prabhakar (2013). A Complete Guide to Setting Up and Maintenance of an Aquarium, Lap Lambert Academic Publishing GmbH KG

Sem. – II

**Mandatory course
Syllabus
B.Sc. (Zoology)
(Sem.- II)**

MJ2: Ecology and Biodiversity

Module 1: Ecology	15hr
1.1 Concepts of Ecology: Study of Environment, Hydrosphere, lithosphere and Biosphere, Community, Population, Types of Ecology Autecology and synecology.	03hr
1.2 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine and terrestrial (Forest, Grassland and Desert) 1.2.1 Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids: Number, Biomass, and Energy.	05hr
1.3 Population dynamics: Density, Natality, Mortality, Fecundity, sex ratio, survivorship curves, age pyramid, dispersal and dispersion. 1.3.1 Exponential and logistic growth,	04hr
1.4 Study of Animal interactions 1.4.1 Competition: Interspecific and intraspecific (any two example); 1.4.2 Commensalism (remora fish on shark, Cattle egrets on livestock), 1.4.3. Mutualism (Termite and <i>Trichonympha</i> , bees and flowers, cleaning symbiosis in fish by prawns. 1.4.4 Parasitism (<i>Ascaris</i> and man, lice and humans), 1.4.5 Prey predation (Lion and deer).	03hr
Module 2: Biodiversity	15hr
2.1 Introduction to Biodiversity: Definition, Concepts, types, scope and Significance.	01hr
2.2 Value of Biodiversity: 2.2.1 Consumptive value, 2.2.2 Productive value, 2.2.3 Social value, 2.2.4. Ethical value, 2.2.5 Aesthetic value, 2.2.6 Option value. 2.3. Patterns of Biodiversity: 2.3.1 Latitudinal gradients, 2.3.2 Species area relationship	06hr

2.4. Threats to Biodiversity	03hr
2.4.1 Habitat loss and Man-Wildlife conflict	
2.4.2 Biodiversity Conservation:	05hr
2.4.2.1 Species Conservation: <i>In-situ</i> and <i>Ex-situ</i> conservation	
2.4.2.2 Habitat Conservation	

Reference Books

1. Fundamentals of Ecology, 5th Ed. (2004). Odum, E.P. and Barrett G. W. Publisher: Brooks/Cole. ISBN: 978-0534420666
2. Elements of Ecology. 9th International Edition (2014). Smith T. M. and Smith R. L. Benjamin Cummings publication
3. Wildlife Biology, An Indian Perspective (2017). Saha G.K. and Mazumdar S. PHI Learning Private Limited. ISBN: 978-8120353138
4. Ecology – Principle and application (1999) Chapman J. L. and Reiss M. J., Cambridge University press, Low priced edition. ISBN: 0521588022
5. Essentials of Ecology, 3rd edition (2011) G. Tyler and Miller Jr. Thompson Books. ISBN: 978-0538735377
6. Essentials of ecology and environmental sciences. 5th Ed. (2013) S. V. S. Rana. PHI publisher. ISBN: 978-8120347861
7. Biodiversity- (2000) K.C. Agarwal- Agro Botanica Publications
8. Zoology, 5th Ed. (1999). S. A. Miller and J. B. Harley, Tata McGraw hill. ISBN: 978-0071158107

MJ3: Ethology and Evolution

Module 1: Ethology	15hr
2.1 Introduction to Ethology: 2.1.1 Definition, and Scope of Ethology 2.1.2 Animal behaviour: Innate and Learned behaviour 2.1.3 Types of learning: Habituation, Imprinting and Types of imprinting - Filial and sexual, Classical conditioning 2.1.4 Instrumental learning and insight learning.	05hr
2.2 Aspects of animal behaviour: 2.2.1 Communication in bees and ants 2.2.2 Mimicry and colourations 2.2.3 Displacement activities, Ritualization 2.2.4 Migration in fish, schooling behaviour 2.2.5 Habitat selection, territorial behaviour.	03hr
2.3 Social behaviour: 2.3.1 Social behaviour in primates-Hanuman langur 2.3.2 Elements of socio-biology: Altruism and Kinship	04hr
2.4 Cognitive aspects of learning: 2.4.1 Nature of cognitive process, 2.4.2 Insight learning, 2.4.3 Associative learning and representation.	03hr
Module 2: Evolution	15hr
1.1.1. Early ideas of evolution: Origin of Life on Earth: Theories of Biogenesis, Lamarkism and Darwinism 1.1 Urey-Miller's Experiment, Protobiont 1.1.2. Natural selection: Stabilizing, Directional, Disruptive selection	01hr
1.2 Reproductive isolating mechanisms 1.2.1 The nature of evolutionary units 1.2.1.1 Species concepts, 1.2.1.2 The Biological Species concept 1.2.2 A general theory of speciation: Sympatric, Allopatric, Parapatric and Peripatric	06hr
1.3 The causes of evolution 1.3.1 Mutation: causes and types, Gene flow, Genetic Drift 1.3.2 Hardy-Weinberg equilibrium	03hr
1.4 Variation in natural populations 1.4.1 Phenotypic variation: Polygenic traits; Heritability 1.4.2 Geographical Variation: The "niche" concept	05hr

Reference Books

1. Biological science, 3rd edition – D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition
2. Survival Strategies – Cooperation & Conflict in Animal Societies (OIPSE): Cooperation and Conflict in Animal Societies. (2001) Raghavendra Gadagkar. Harvard University Press. ISBN: 978-0674005570.
3. An introduction to animal behaviour, 4th edition - Aubrey Manning and M. S. Dawkins. Cambridge University press, Low priced edition.
4. Animal behaviour (2019) Mohan P. Arora & Himanshu Arora. Himalaya publication. ISBN: 978-9352997367.
5. Bishop, B. A., & Anderson, C. W. (1990). Students' conceptions of natural selection and its role in evolution. Journal of Research in Science Teaching, 27, 415-427.
6. Hafner, M.S. (1994). Evolution laboratory: Laboratory exercises and discussions in evolutionary biology. Baton Rouge, LA: Louisiana State University.
7. Hartl, D. L. (1988). A primer of population genetics (2nd edition). Sunderland, MA: Sinauer Associates.
8. Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company.
9. Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.
10. Zoology – S. A. Miller and J. B. Harley, Tata McGraw hill
11. Animal Behaviour- (2014) Reena Mathur, Rastogi Publications ISBN. 978-9350780480
12. Animal Behaviour (2010) V.K Agarwal. S Chand and Company . ISBN 978-8121932103.
13. Animal Behaviour (2015) 2nd Ed. Michael D Breed and Janice Moore. Elsevier Press. ISBN: 978-0-12-801532-2

Major Practical-2

Name of the Course: MJP2: Practical based on MJ2 and MJ3

Course Objectives (CO):

- CO1. To equip learners in basic practical knowledge of population dynamics.
- CO2. To train learners in basic understanding of animal behaviour and its role in animal development.
- CO3. It will help learners to understand rich biodiversity of India, its significance, and its role in human welfare.

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

- OC1. Apply the concept the origin of life and the causes behind organic evolution
- OC2. Correlate the animal behaviour and its cognitive aspects.
- OC3. Identify the threats to biodiversity and its possible solution
- OC4. Apply the understanding of the dynamics of population density to discover the impact of population on ecology and biodiversity.

Major Practical-2

Name of the Course: MJP2: Practical based on MJ2 and MJ3

- 1 Identification of mammalian fauna, avian fauna, and herpeto-fauna of India.
- 2 To study the various animal tracking system: Global Positioning System, Remote Sensing and Biotelemetry
- 3 Effect of climate change on biodiversity: Case study
- 4 Population estimation through Capture recapture method.
- 5 Study of r/k selection in *Catla catla*, *Hoplobatrachus tigrinus*, *Panthera leo*, *Canis lupus*, Olive Ridley and *Gyps indicus*.
- 6 Determination of hardness of water sample.
- 7 Determination of dissolved oxygen.
- 8 Determination of salinity of the water sample by Refractometer / argentometric method.
- 9 Study of population dynamics, food chain food web: (Grassland, Forest, Desert and Aquatic).
- 10 Study of animal interaction: Ectoparasite (Head Louse) and Endoparasite (Tape worm), Exoparasite (Bed Bug), mutualism (Clownfish and anemones/ hermit crab and anemone), commensalism (Sharks and Remora).
- 11 Estimation of water holding capacity of given soil sample.
- 12 Study of animal community structure by quadrat method (Field or Simulation).
- 13 Study of aquatic fauna and their ecological role; fresh water (Cladocera), Intertidal (Sea Star, Sea Anemone, Barnacles), deep sea (Coral, Squids, Sperm Whale) (pictures / diagrams only).

- 14 Using photographs / paintings / coloured drawings identify and study ecological role of characteristic animal species (Desert- Camel, Himalayan- Marmots, Himalayan thar, Grassland- One horned Rhinoceros, Gaur) of terrestrial environment.
- 15 Identification, biology & ecological role of the following using suitable diagram / picture; Pangolin, blind cave fish, Ganges Dolphin.
- 16 Mimicry: Leaf insect, stick insect, stick worm (caterpillar), Kallima butterfly, Monarch butterfly and common tiger butterfly (Danids)
- 17 Study of evidences of evolution: A) Analogy – Leg of grasshopper and leg of mammal Wing of insect, wing of bird, wing of bat B) Homology - Fore limb of amphibian/a reptilian, and wing of bird / bat. Fossils: Ammonite, trilobite Archeopterix
- 18 Paper chromatography for separation of amino acids
- 19 Separation of lipids by thin layer chromatography.
- 20 Separation of pigments by chalk chromatography.
- 21 Measurement of optical density using colorimeter.

(Additional activity which the center may consider: Study of IUCN red data book status of brand animals (India only))

Reference Books

1. Biological Science, 3rd Ed. (2005) D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition. ISBN: 978-0521684170
2. Animal Behaviour: Psychobiology, Ethology and Evolution (1999). David McFarland. Pearson Publication. ISBN: 978-0582327320
3. An introduction to animal behaviour, 6th edition – (2012) Aubrey Manning and M. S. Dawkins. Cambridge University press, ISBN: 978-0521165143.
4. National Geographic Vol. 193 (3) March 1998: Rise of life on Earth p. 54-81
5. Scientific American Oct. 1994: Origin of life on Earth p. 53-61.
6. Essentials of human genetics. 5th Ed. (2009) –M.L. Kothari, L.A. Mehta and S.S. Roychoudhary, University Press. SBN: 978-8173716478.
7. Essentials of Ecology, 3rd edition (2011) G. Tyler and Miller Jr. Thompson Books. ISBN: 978-0538735377
8. Biodiversity: An Introduction.(2004) 2nd Ed. Kevin J. Gaston & John I. Spicer . Blackwell Publishing. ISBN: 1-4051-1857-1.
9. Essentials of ecology and environmental sciences. 5th Ed. (2013) S. V. S. Rana. PHI publisher. ISBN: 978-8120347861
10. Strickberger's Evolution (2007) Monroe W. Strickberger, J. & B. Publication. ISBN: 978-0763700669.
11. National Parks of India. (2016) R.S. Bisht. Publication Division, Ministry of I & B Govt. India. eBook.
12. Indian National Parks. R. Pathak. ISBN: 978-8184200355.
13. Indian Wild life Sanctuaries and National parks (2013). By Prakash Chandra. Cyber Tech Publications. ISBN: 978-9350531914.

Skill Enhancement Course (SEC)

Name of the Course: SEC2: Fish Value Added Products

Course Objectives (CO):

CO 1. To acquaint learners to various fish value added products.

CO 2. To acquaint learner with the methods of seafood processing and entrepreneurial opportunities

Course Outcomes (OC):

Upon completion of the course, the learners should be able to:

OC 1. Prepare a few fish value added products.

OC 2. Conduct a feasibility study for starting a new venture on fish value added products.

Module: Fish Value Added Products

1. Basic methods of fish preservation techniques: salting, sun-drying, smoking and deep-freezing.
2. *Preparation of prawn or prawn pickle / chutney.
3. *Preparation of fish soup / sauce.
4. *Preparation of fish or prawn or squid or cuttlefish cutlets.
5. Identification of Packaging materials - Modified atmosphere packaging (MAP) rigid trays with lidding films, expanded polystyrene (EPS) trays, micro perforated EPS trays, Low density polyethylene (LPDE) bags, High density polyethylene (HPDE) containers, Fiberglass cans / trays, Aluminium / steel trays, Paperboard cartons.
6. Selecting a fish and fish cleaning methodology:

- a. Selecting a fresh fish

Basic cleaning and storing procedure of fish:

- a. Scaling and requisites for scaling a fish.
- b. Cleaning a fish
- c. Gutting techniques
- d. Methods of head removal
- e. Filleting a fish
- f. Refrigerating a fish
- g. Waste disposal

7. Storing an ungutted fish
8. Study of fish value added marketing strategy:
 - a. **Elements of marketing:** assemblage, storing, sorting, grading, packaging, labelling, storage before transport, transportation, advertisement, selling and buying.
 - b. **Packaging of fish products:** principle, forms of packaging and skill
 - c. **Labelling methodology**
 - d. **Marketing Agents:** Producer, auctioneer, fishermen co-operative societies, wholesaler, retailers, exporter, vendors.
 - e. **Marketing channels:** local market, commodity exchange market, commission brokers and agents.

9. Project / Survey on packaged fish food products available in the market.
10. Survey of challenges to commercial market of fish products.
11. Survey of market driving factors of fish products.
12. Visit to fish processing centre/cold-storage facilities/ fish landing centres/ fishery institutes and preparation of report with photographs.
13. Preparation of Feasibility report on starting a small-scale fish value added processing unit.

*Preparation of any recipe from available fish or crabs or mollusc can be done from home and its recipe along with nutritional values can be submitted as additional activity.

Reference Books

1. K K Balachandran (2002) - Post Harvest Technology of Fish and Fish Products, Daya Publications.
2. G M Hall - Text Book of Fish Processing Technology. ICAR. (Ed). 1992.
3. K Gopakumar - Textbook of fish processing technology
4. Ninawe and Rathnakumar (2008) - Fish Processing Technology and Product Development, Narendra Publishing House.
5. Wheaton and Lawson (1985) Processing Aquatic Food Products, John Wiley & Sons.
6. Prasanna Chandra (2020). Fundamentals of Financial Management, 7th Edition, McGraw Hill.
7. Aitken A (1982). Fish handling & Processing: 2nd edition, Ministry of Agriculture, Fisheries & Food, Torry Research Station; Edinburgh.

Web Resources:

- 1 Hassoun et al., (2022) Seafood Processing, Preservation, and Analytical Techniques in the Age of Industry 4.0 <https://doi.org/10.3390/app12031703>
- 2 Quality Assurance in seafood processing (2005) - CIFT Publication Seafood quality assurance https://krishi.icar.gov.in/jspui/bitstream/123456789/24957/1/15_Seafood%20quality%20assurance.pdf
- 3 Value addition: <https://egyankosh.ac.in/bitstream/123456789/9798/1/Unit-12.pdf>
- 4 Value Added Fish Products: https://www.researchgate.net/publication/259345025_Value_Added_Fish_Products
- 5 Value added fish products: https://krishi.icar.gov.in/jspui/bitstream/123456789/25126/1/12_Value%20added%20fish%20products.pdf
- 6 Prospects of Value added Fish Products & it's future in Indian Market: https://www.researchgate.net/publication/280876943_Prospects_of_Value_added_Fish_Products_it%27s_future_in_Indian_Market
- 7 Asogwa VC and Asogwa (2019). Marketing of fish products. Journal of Aquaculture & Marine Biology. 8(2):55–61. <https://doi.org/10.15406/jamb.2019.08.00243>

QUESTION PAPER PATTERN (External and Internal)

FYBSc Zoology Evaluation pattern and Question paper pattern for Semester End Theory Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.	As per paper pattern	01.00 hour
Format of Theory Question Paper: Semester end examination		
Time 1.0 Hr	Attempt any two out of four	Max. Marks 30
Attempt any two out of four		
Q. 1. Write short note on the following a. Module I b. Module I c. Module II		05 05 05
Q. 2. Write short note on the a. Module II b. Module II c. Module I		05 05 05
Q. 3. Answer the following a. Module I b. Module II		08 07
Q. 4. Answer the following a. Module II b. Module I		08 07

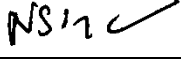
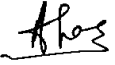
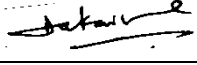
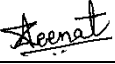
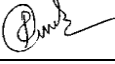
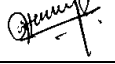
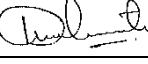
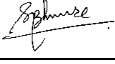
FYBSc Zoology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	As per paper pattern	1 h 30 minutes
Format of Question Paper:		
Time 1 hr 30 min		Max. Marks 30
Q.1 One Major experiment		10
Q.2 One Minor experiment		7
Q. 3. Identification (any four)		8
Q.4. Journal and Viva (practical)		5

**FYBSc Zoology Evaluation pattern and Question paper pattern for
Semester End Practical Examination of Vocational Skill Courses and
Skill Enhancement Courses**

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	As per paper pattern	1 h 30 minutes
Format of Question Paper:		
Time 1 hr 30 min		Max. Marks 30
Q.1 Major experiment		08
Q.2 Minor experiment / ID based questions		06
Q.3 Minor experiment / ID based questions		04
Q.4. Project / Assignment and Viva (based on project / assignment)		10
Q5. Journal		02

Signatures of Team Members

Sr. No.	Name of committee member	Name of College	Signature
1	Dr. Anita Jadhav (Convenor)	ICLES Motilal Jhunjhunwala College, Vashi.	
2	Dr. Nandita Singh (Co-convenor)	G. M. Momin College, Bhiwandi.	
3	Dr. Aamod N. Thakkar (Co-convenor)	Veer Wajekar Arts, Science & Commerce College, Phunde.	
4	Dr. Shashibhal M. Pandey (Co-convenor)	C. H. M. College, Ulhasnagar.	
5	Dr. Dilip Kakavipure (Member, BoS)	B. N. N. College, Bhiwandi.	
6	Dr. Kantilal Nagare (Member, BoS)	B. K. Birla College, Kalyan.	
7	Dr. Kiran Pariya (Member, BoS)	B. N. Bandhodkar College, Thane.	
8	Dr. Rishikesh S. Dalvi (Member, BoS)	Maharshi Dayanand College, Parel, Mumbai-400012.	
9	Dr. Minakshi Gurav (Member, BoS)	D. G. Ruparel College, Mahim, Mumbai-400016.	
10	Dr. Ambadas Rodge (Member, BoS)	Gogate Jogalekar College, Ratnagiri-415612.	
11	Dr. Vishal Kadu (Member)	Sathaye College (Autonomous), Vile Parle (E), Mumbai 400057.	
12	Dr. Conrad Cabral (Member)	Xavier's College, Mumbai	
13	Dr. Zeenat Surve (Member)	Maharashtra College, Mumbai.	
14	Dr. Vishal Nangare (Member)	Siddharth College, Mumbai.	
15	Dr Swapnil Shewale (Member)	Hazarimal Somani College, Chowpatti, Mumbai.	
16	Mr. Kuldeep Mhatre (Member)	Seva Sadan's R K Talreja College, Ulhasnagar.	
17	Dr. Mahesh Mudgal (Member)	ACS College, Jawhar.	
18	Dr. Rahul Patil (Member)	Veer Wajekar Arts, Science & Commerce College, Phunde	
19	Dr. Nanda Jagtap (Member)	Dapoli Urban Bank Senior Science College, Dapoli, 415712	
20	Dr. Digvijay Lawate (Member)	ACS College, Lanja.	
21	Dr. Budharatna G. Bhaware (Member)	G. M. Vedak College of Science, Tala-Raigad.	
22	Dr. Gayathri N. (Member)	D. G. Ruparel College, Mahim, Mumbai 400016.	
23	Dr. Smita Subramanian (Member)	Viva College, Virar.	
24	Mr. Manoj D. Kadam (Member)	RD National College, Bandra	

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

This syllabus is applicable to IDOL learners as well, w.e.f. 2025-26.

Justification for B.Sc. (Zoology)

1.	Necessity for starting the course:	The B.Sc. (Zoology) course is necessary because it serves as a fundamental, multidisciplinary, and practical programme that prepares students for pursuing higher education, allows them to explore numerous career options, and actively participate in tackling scientific and societal challenges.
2.	Whether the UGC has recommended the course:	Yes
3.	Whether all the courses have commenced from the academic year 2023-24.	The course has already commenced in the university and in the academic year 2024-25 it is restructured under NEP 2020
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	This course is aided / self-financed based on the sanction given by University of Mumbai to affiliated colleges time to time.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	The duration of the program is three years (6 semesters). It is not possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	120 per division
7.	Opportunities of Employability / Employment available after undertaking these courses:	Graduation in Zoology provides students with a greater awareness of the intricate relationships within the animal kingdom and the environment, as well as the ability to think critically and practically, allowing them to enhance their career prospects and open up novel opportunities.

**Sign of the BOS
Coordinator
Dr. Vaishali Somani
BOS in Zoology**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**