Academic Council Meeting No. 09 and Date : 2nd July, 2024
Agenda Number : 3 Resolution Number : 41,42/ 3.6, 3.26

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science
(Autonomous), Thane

Programme Code: BUZO

Programme: Bachelor of Science

Specific Programme: Zoology (Major/Minor/Generic)

S. Y. B.Sc. Zoology

Level 5.0

CHOICE BASED GRADING SYSTEM

Revised Under NEP

From Academic Year: 2024-2025

Preamble

I am glad to introduce this modified syllabus to the Department of Zoology to pursue wise and able aspects of the subject to be instilled in the students of the semester III and semester IV under the quest of '**Autonomy'** sanctioned by the University of Mumbai to VPM's B. N. Bandodkar College of Science, Thane.

It is foresighted to involve experts from all the relevant sectors of society to design this syllabus with their valued advice and suggestions. The syllabus has been finalized unanimously by the priory appointed members of the Board of Studies in Zoology Subject which includes industrial technical advice from Reliable Analytical Laboratory which practices the most advance analytical technics in biological sciences. It gives me great pleasure to involve our meritorious alumni who have successfully made their careers in zoology in this venture.

However, with the constraint of the UGC guidelines in changing the syllabus, it was envisaged to change 20% of the syllabus at the initial phase and has been planned to migrate slowly to a metamorphic pattern of the syllabus, which shall eliminate the existent shortcomings, during forthcoming cycles of syllabus framing.

Also, the syllabus will be framed in accordance with the PG programs of various national and international Universities so that our students will be able to avail their education in them.

Although, due to the guidelines of UGC, the use of animals is excluded from the practical, substituting the same with audiovisual instruction, simulations aids, and the use of ICT to make the syllabus more interesting and interactive. Pedagogy will guide our teachers to know content and objectives along with the desired outcome of every topic. The syllabus will also be provided with question banks and answer keys for the students apart from the question paper patterns as an integral part of the syllabus.

It is expected that the teaching process is expected to be boosted with exciting outcomes of the syllabus with further improvement and enthusiasm of the teachers. At the initiation, the department introduces the 'Choice-Based Credit System' (CBCS) of teaching- learning, under autonomy. The evaluation process involves 60-40 pattern of theory to ensure continuous learning from the academic year 2024-25, onward.

Prof. Dr. Vinda Manjramkar

Chairperson, BOS in Zoology
VPM's B. N. Bandodkar College of Science (Autonomous), Thane

PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B.Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 - Disciplinary Knowledge

Lay a strong foundation of conceptual learning in science. Instill ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude

Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy

Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

PO4 - Sensitization towards Environment

Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Teamwork

Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness

Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build an attitude of unbiased, truthful actions and avoid unethical behavior in all aspects of life.

Eligibility:	FYBSc
Duration:	3 years (Syllabus for Second Year semester III & IV)
Mode of Conduct:	Offline lectures/ Online lectures
Discipline/Subject:	Zoology
Specific Programme:	B.Sc. ZOOLOGY

Qualification Title: UG certificate

Discipline/Subject: ZOOLOGY

Program Specific Outcomes		
No.	**Outcome**	**Level**
1	Describe the diversity and structural organization of animal life that govern biological systems.	L-1
2	Explain cellular, physiological, genetic, and biochemical processes that regulate the life.	L-2
3	Demonstrate laboratory skills, operate scientific instruments and analyze results.	L-3
4	Examine disease-causing agents, evaluate preventive and control strategies with indigenous knowledge.	L-4
5	Examine disease-causing agents, evaluate preventive and control strategies with indigenous knowledge.	L-5
6	Examine disease-causing agents, evaluate preventive and control strategies with indigenous knowledge.	L-6

Specific Programme: S.Y.B.Sc. (Zoology -Major/ Minor)		
Assessment: Weightage for assessments (in percentage) For Major and Minor		
Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40%	60%

Curriculum Structure for the Undergraduate Degree Programme S. Y. B. Sc. Zoology			
	SEMESTER – III		
Course Code	**Major Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO3T01	Fundamentals of genetics and comparative physiology of nutrition and circulation	30	2
24BUZO3T02	Biomolecules	30	2
24BUZO3T03	Ethology and Epidemiology	30	2
24BUZO3P01	Practical based on course **24BUZO3T01**	60	2
24BUZO3P02	Practical based on course **24BUZO3T02 AND 24BUZO3T03**	60	2
Total		**210**	**10**
Course Code	**Minor Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO3T04	Comparative Embryology, Breeding and Parental Care	30	2
Total		**30**	**2**
Course Code	**Generic Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO3T05	Pest Management	15	2
Total		**15**	**2**
Course Code	**VSEC Course**	**No. of Lectures in hrs.**	**Credits**
24BU3VSC03	Aquarium Maintenance	45	2
Total		**45**	**2**
Course Code	**Field Project (FP)**	**No. of Contact hrs.**	**Credits**
24BUZO3P03	Field Project in Zoology I	30	2
Total		**30**	**2**
	Total	**330**	**18**

Curriculum Structure for the Undergraduate Degree Programme S. Y. B. Sc. Zoology			
	SEMESTER – IV		
Course Code	**Major Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO4T01	Cell Biology and Comparative physiology of respiration, locomotion and reproduction	30	2
24BUZO4T02	Apiculture, Vermiculture and Parasitology	30	2
24BUZO4T03	Zoogeography and Pollution	30	2
24BUZO4P01	Practical based on course – **24BUZO4T01 & 24BUZO4T02**	60	2
24BUZO4P02	Practical based on course-- **24BUZO4T02** & **24BUZO4T03**	60	2
Total		**210**	**10**
Course Code	**Minor Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO4T04	Amazing animals, origin and evolution of life	30	2
Total		**30**	**2**
Course Code	**Generic Course**	**No. of Lectures in hrs.**	**Credits**
24BUZO4T05	Sericulture and aquaculture	15	2
Total		**15**	**2**
Course Code	**VSEC Course**	**No. of Lectures in hrs.**	**Credits**
24BU4VSC02	Dairy Farming	45	2
Total		**45**	**2**
Course Code	**Field Project (FP)**	**No. of Contact hrs.**	**Credits**
24BUZO4P03	Field Project in Zoology II	30	2
Total		**30**	**2**
Total	**Total**	**330**	**18**

SEMESTER - III

Major Course Code: 24BUZO3T01	(02 Credits)	No of lecture in Hrs. 30

Fundamentals of Genetics and Comparative Physiology of Nutrition and Circulation

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Demonstrate the basic terms of genetics.	L-2
CO2	Utilize the knowledge of structural aberrations to correlate the disorders.	L-3
CO3	Demonstrate the concept of Physiology.	L-2
CO4	Develop the interest about complexity of physiology.	L-3

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	0	2	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	2	0	0	0	0

Unit	Description	No. of Hrs.
I	**Genetics and Chromosomes**	**15**
1.1	Chromosomes:	
1.1.1	Types of chromosomes–Autosomes and sex chromosomes	
1.1.2	Chromosome structure - Heterochromatin, euchromatin	
1.1.3	Sex- determination:	
1.1.3.1	Chromosomal mechanisms: XX-XO, XX-XY, ZZ-ZW	
1.1.3.2	Sex determination in Honey bees: Haplo-diploidy	
1.1.3.3	Sex determination in Drosophila: Genic balance theory, Intersex, Gynandromorphs	
1.2	Chromosomal aberrations: Structural: Deletion and duplication, Numerical- aneuploidy and polyploidy	
1.2.1	Metabolic disorders: PKU, Alkaptonuria, Albinism	
1.2.2	X-linked recessive disorders: Colour-blindness, G6PD, Hemophilia, Duchenne muscular dystrophy and X-linked dominant.	
1.3	Mendelian genetics:	
1.3.1	Genetics of aging	
1.3.2	Pedigree analysis-autosomal dominant and recessive.	
1.4	Multiple alleles and multiple genes:	
1.4.1	Concept of multiple alleles, coat colour in rabbit, ABO and Rh blood group system.	
1.4.2	Polygenic inheritance with reference to skin colour and eye colour in humans.	
1.4.3	Concept of pleiotropy	

Unit	Description	No. of Hrs.
II	**Comparative physiology of nutrition and circulation**	**15**
2.1	Comparative study of nutritional apparatus (Structure and function): Amoeba, Hydra, Cockroach, Amphioxus, Pigeon.	`
2.2	Physiology of digestion and digestive glands	
2.3	Comparative study of excretory and osmoregulatory structures and functions. a) Amoeba -Contractile vacuole b) Planaria -Flame cells c) Cockroach- Malpighian tubules d) Structure of kidney, uriniferous tubule and physiology of urine formation in man.	
2.4	Comparative study of circulation: a) Open and Closed type b) Single and Double type	
2.5	Comparative study of hearts (structure and function): a) Earthworm, b) Cockroach c) Shark d) Frog e) Crocodile f) Pigeon.	

References	
Major Course Code: 24BUZO3T01	
1	Biological Science, Taylor D.J., Stout G.W., Green N.P. O, Soper R., Cambridge University Press.
2	Chordate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
3	Concepts of Genetics. Klug, W. S., Cummings M. R., Spencer, C.A. Benjamin Cummings
4	Genetics A conceptual approach, Benjamin A. Pierce, Southwestern University, W.H. Freeman and company, New York
5	Genetics A Mendelian approach Peter J. Russel, Pearson Benjamin Cummings
6	Genetics- A Molecular Approach. Russell, P. J Benjamin Cummings
7	Genetics- Weaver, Hedrick, third edition, McGraw Hill Education
8	Genetics, Third Edition, Monroe W. Strick Berger
9	Genetics: Analysis of Genes and Genomes. Daniel L., Hartl, Elizabeth W. Jones & Bartlett Publishers
10	Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
11	Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
12	Modern Textbook of Zoology, Invertebrates, Kotpal R. L
13	Principles of Genetics – Eight edition- Eldon john Gardner, Michael J. Simmons, D. Peter Snustad
14	Principles of Genetics. Gardner, E. J., Simmons, M.J and Snustad, D.P. John Wiley and

	Sons
15	Vertebrate Zoology Volume I- Jordan and Verma, S. Chand and Co.
16	Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill.

Major Course Code: 24BUZO3T02	**(02 Credits)**	**No of lecture in Hrs. 30**

Biomolecules

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Interpret the structure of biomolecules and their clinical significance.	L-2
CO2	Make use of Structure of Biomolecules and their role in life.	L-3
CO3	Illustrate the importance of nucleic acid as genetic material.	L-2
CO4	Apply the principles of inheritance to study heredity.	L-3

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	0	2	0	0	0	0
CO 2	0	3	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	2	0	0	0	0

Unit	**Description**	**No. of Hrs.**
I	**Biomolecules**	**15**
1.1	Biomolecules: Concept of micro molecules and macromolecules	
1.2	Carbohydrates:	
1.2.1	Definition, classification, properties and isomerism, glycosidic bond	
1.2.2	Structure of Monosaccharides (glucose and fructose); Oligosaccharides (lactose and sucrose); Polysaccharides (cellulose, starch, glycogen and chitin)	
1.2.3	Biological role and clinical significance	
1.3	Amino Acids and Proteins:	
1.3.1	Basic structure, classification of amino acids,	
1.3.2	Essential and non-essential amino acids, peptide bond,	
1.3.3	Protein conformation: primary, secondary, tertiary, quaternary	
1.3.4	Types of proteins: Structural (collagen) and functional proteins (hemoglobin)	
1.3.5	Biological role and clinical significance	
1.4	Lipids:	
1.4.1	Definition, classification of lipids with examples, ester linkage	
1.4.2	Physical and chemical properties of lipids	
1.4.3	Saturated and unsaturated fatty acids	
1.4.4	Essential fatty acids; Triacylglycerols; Phospholipids (lecithin and cephalin); Steroids (cholesterol)	
1.4.5	Biological role and clinical significance	
1.5	Vitamins:	

1.5.1	Water soluble vitamins (e.g. Vit C, Vit B12)	
1.5.2	Lipid soluble vitamins (e.g. Vit A, Vit D)	
1.5.3	Biological role and clinical significance	
Unit	**Description**	**No. of Hrs.**
II	**Molecular biology**	**15**
2.1	Chemical composition and structure of nucleic acids	
2.1.1	Double helix nature of DNA, solenoid model of DNA	
2.1.2	Types of DNA – A, B, Z & H forms	
2.1.3	DNA in Prokaryotes - Chromosomal and Plasmid	
2.1.4	Extra nuclear DNA - Mitochondria and Chloroplast	
2.1.5	RNA as a genetic material in virus	
2.1.6	Types of RNA: Structure and function	
2.2	Flow of genetic information in a eukaryotic cell	
2.2.1	DNA replication	
2.2.2	Transcription of mRNA	
2.2.3	Translation	
2.2.4	Genetic code	
2.3	Gene expression and regulation	
2.3.1	Missense Mutation: Sickle-cell anemia	
2.3.2	Frameshift Mutation: CFTR, Crohn's disease	
2.3.3	Difference between in frame and out of frame mutation	

References

Major Course Code: 24BUZO3T02

1	A Textbook of Biochemistry, 9thedition, Dr. Rama Rao A.V.S.S and Dr A Surya Lakshmi.
2	Biochemistry- G Zubay, Addison Wesley, 1983
3	Biochemistry, Dushyant Kumar Shrma, 2010, Narosa Publishing house Pvt. Ltd.
4	Biochemistry, L Stryer, 3rd/4th/5th ed, 1989, Freeman and Co. NY
5	Fundamentals of Biochemistry, Dr AC Deb, 1983, New Central Book Agency Ltd.
6	Harper ‘s Biochemistry,1996, 26thedition, Murray R.K. Granner D.K. Mayes P.A. Rodwell
7	Outline of Biochemistry, 1976, E.E. Conn and P.K. Stumpf. John Wiley and Sons USA
8	Principles of Biochemistry, 2005, 2 and 3 editions. Leininger A.L. Nelson D.L. and Cox M.M,

Major Course Code: 24BUZO3T03	(02 Credits)	No of lecture in Hrs. 30

Ethology and Epidemiology

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Compare the knowledge of animal interaction and behaviour.	L-2
CO2	Identify and sensitize the feeling of animals.	L-3
CO3	Interpret the general epidemiological aspects of diseases	L-2
CO4	Apply the knowledge of epidemiology in disease transmission and prevention.	L-3

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	2	0	0	0	0
CO 2	0	0	0	2	0	0
CO 3	0	2	0	0	0	0
CO4	0	0	0	0	0	2

Unit	Description	No. of Hrs.
I	**Ethology**	**15**
1.1	Introduction to Ethology:	
1.1.1	Definition, History and Scope of Ethology	
1.1.2	Animal behaviour: Innate and Learned behavior	
1.1.3	Types of learning:	
1.1.3.1	Habituation,	
1.1.3.2	Imprinting and types of imprinting- Filial and sexual imprinting.	
1.1.3.3	Classical conditioning	
1.1.3.4	Instrumental learning	
1.1.3.5	Insight learning.	
1.2	Aspects of animal behaviour:	
1.2.1	Communication in bees and ants.	
1.2.2	Mimicry and colorations.	
1.2.3	Displacement activities, Ritualization.	
1.2.4	Migration in fish, schooling behaviour	
1.2.5	Habitat selection, territorial behaviour.	
1.3	Social behaviour:	
1.3.1	Social behaviour in primates-Hanuman langur	
1.3.2	Elements of socio-biology: Altruism and Kinship	

Unit	Description	No. of Hrs.
II	**Epidemiology**	**15**
2.1	Scope of epidemiology: Perspective of epidemiology Descriptive and analytical epidemiology, screening for diseases and Epidemiological traids.	
2.2	Dynamic of disease transmission: Reservoir, route of transmission, incubation.	
2.3	Prevention and control of communicable disease: notification, isolation, quarantine, disinfection, concurrent, terminal, prophylactic methods of disinfection, immunization, health education in India.	

References	
Major Course Code: 24BUZO3T03	
1	Animal Behaviour- David McFarland
2	Animal Behaviour- Mohan Arora
3	Animal Behaviour- Reena Mathur
4	An introduction to Animal Behaviour- Dawkins
5	Animal Behaviour-Agarwal
6	Animal Behaviour- Tinbergen
7	Public Health & Sanitation Part I &II: The All-India Institute of Local Self Government. Sthanikraj Bhavan, C.D. Barfiwala Marg, Andheri (W), 400058.
8	Park's Textbook of Preventive & Social Medicine, 7th Editions, K. Park, M/S Banarsidas Bhanot Publishers, 1167, Premnagar, Jabalpur, 482001.

Major Course Code: 24BUZO3P01	(02 Credits)	No of lecture in Hrs. 30

Practicals based on the 24BUZO3T01

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Construct and interpret pedigree charts to trace inheritance of genetic traits and disorders.	L-6
CO2	Identify structural and numerical chromosomal abnormalities through karyotyping.	L-3
CO3	Compare the anatomy of nutritional apparatus in different animal groups and relate structure to feeding habits.	L-5
CO4	Determine the various excretory products from different animal groups.	L-5

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	3	0	0	0	0
CO 2	2	0	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	2	0	0	0	0

Sr. No.	Name of the Practical
1.	Chromosome morphology: (photograph to be provided)
2.	Study of mitosis- temporary squash preparation of onion root tip.
3.	Study of karyotype.
4.	Study of polytene chromosome.
5.	Problems in genetics: Numerical polyploidy
6.	Pedigree analysis.
7.	Mounting of Barr bodies
8.	Estimation of triglycerides by phospho-vanillin reagent method.
9.	Urine Analysis: normal and abnormal constituents.
10.	Detection of ammonia excreted by fish from aquarium.
11.	Detection of uric acid from excreta of birds.
12.	Study of hearts.
13.	Study of nutritional apparatus: (Amoeba, Hydra, Cockroach, Amphioxus, Pigeon)
14.	Effect of temperature on amylase activity.
15.	Effect of pH on amylase activity.

Major Course Code: 24BUZO3P02	(02 Credits)	No of lecture in Hrs. 30

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Demonstrate qualitative and quantitative biochemical analysis of biomolecules.	L-2
CO2	Estimate nucleic acids from various biological sources.	L-5
CO3	Analyze and record behavioral patterns of animal models.	L-4
CO4	Identify patterns of disease and interpret epidemic curves and surveillance reports.	L-3

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	3	0	0	0	0
CO 2	0	2	0	0	0	0
CO 3	0	2	0	0	0	0
CO4	0	2	0	0	0	0

Sr. No.	Name of the Practical
1.	Extraction and detection of DNA.
2.	Extraction and detection of RNA.
3.	Study of clinical disorder.
4.	Qualitative test for carbohydrates
5.	Qualitative test for proteins.
6.	Qualitative test for lipids.
7.	Problems based on molecular biology.
8.	Study of ethological aspects: a. Warning coloration. b. Animal instinct c. Imprinting d. Communication in animals: Chemical signals and Sound signals e. Displacement activities in animals: Courtship and mating behaviour in animals and Ritualization
9.	Diseases of viral origin: Rabies, Dengue, Swine flu
10.	Diseases of bacterial origin: Tuberculosis.
11.	Study of vector mouth parts - housefly Mosquito – *Anopheles* and *Culex*
12.	Life cycle of Mosquito and Housefly
13.	Study of Ascaris and Liver fluke
14.	Study of Blood glucose by O-toluidine and glucometer
15.	Power point presentation based on Paper II and paper III

Minor Course Code: 24BUZO3T04	(02 Credits)	No of lecture in Hrs. 30

COURSE OUTCOME		
On completion of this course, students will be able to:		
CO1	Relate and compare the different types of eggs and sperms	L-2
CO2	Identify the different pre-embryonic stages.	L-3
CO3	Explain the key concepts of breeding and parental care	L-2
CO4	Compare the Parental care observed in animals	L-4

Grading:			
3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	0	0	0	0	0
CO 2	2	0	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	2	0	0	0	0

Unit	Description	No. of Hrs.
I	**Comparative embryology**	**15**
1.1	Types of Eggs- Based on amount and distribution of yolk	
1.2	Structure and Types of Sperm	
1.3	Types of Cleavages	
1.4	Types of Blastulae	
1.5	Morphogenetic movements of gastrula	

Unit	Description	No. of Hrs.
II	**Breeding and Parental Care**	**15**
2.1	Introduction to breeding and parental care.	
2.2	Methods of parental care in Pisces Nest building Weed nests- Bow fish Pit nests - Salmon Bubble nests – Siamese fighter Mouth Brooder– Tilapia Development of brood pouch – Sea horse	
2.3	Parental care in Amphibians – Salamander	
2.4	Parental care in Reptiles – Crocodile, Sea turtle, King Cobra	
2.5	Parental care in Aves – Hen, Parakeet	
2.6	Parental care in Mammals – Marsupial, Elephant, Monkey	

References	
Major Course Code: 24BUZO3T04	
1	Biological Science. Taylor, Green and Stout. Cambridge Publication
2	Biology. E. P. Solomon, L. R. Berg, D. W. Martin, Thompson Brooks/Cole
3	Chick Embryology- Bradley M. Pattern.
4	Chordate Embryology-Dalela, Verma and Tyagi
5	Developmental Biology- 5th Edition, Scot F. Gilbert, Sinauer Associates Inc.
6	Developmental Biology- Subramaniam T., Narosa Publishers.
7	Developmental Biology-BerrilN.J., Tata McGraw –Hill Publication.
8	Embryology-Mohan P. Arora.
9	Essential Reproduction-Martin H. Johnson, Wiley-Blackwell Publication.
10	Human Anatomy and Physiology. E. L. Marieb, Pearson Education Low Price Edition
11	Human Biology-Daniel D. Chiras Jones and Bartlett

Generic Course Code: 24BUZO3T05	Generic (02 Credits)	No of lecture in Hrs. 30

Pest management

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Illustrate the species specificity and mode of infection.	L-2
CO2	Experiment with prevention and eradication of pest.	L-3
CO3	Interpret the pest management strategy	L-2
CO4	Develop the concept biological control methods	L-3

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	0	0	0	0	0	2
CO 3	3	0	0	0	0	0
CO4	0	1	0	0	0	0

Unit	Description	No. of Hrs.
I	**Pest management – I**	**15**
1.1	Introduction to Pest- types (household and plant pest), specificity	
1.2	Pest management using chemical control	
1.3	Natural, organic and inorganic pesticides	

Unit	Description	No. of Hrs.
II	**Pest management – II**	**15**
2.1	Ecological consideration	
2.2	Biological control- Predators, parasitoids, entomopathogens, weed killers and their mass production.	
2.3	Advantages and disadvantages of pest management.	

References

Generic Course Code: 24BUZO3T05

1	40 Natural homemade insect repellent- Tyler Halse.
2	Household pets and their management- Renuka Gupta
3	Integrated pest and disease management-Ramesh Arora
4	Organic gardener’s handbook of natural pest and disease control- Fern Marshall Bradly, Barbara W. Ellis and Deborah L Martin
5	Royal horticulture society-pest and disease

VSEC COURSE CODE: 24BU3VSC03	VSEC (02 Credits)	No of lecture in Hrs. 45

Aquarium Maintenance

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Outline the small-scale aquarium business skills.	L-2
CO2	Develop the skills of aquarium setting and maintenance.	L-3
CO3	Construct the home aquariums in the laboratory.	L-3
CO4	Identify aquarium equipment, diseases and sexual dimorphism in fishes.	L-3

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	0	0	0	2	0
CO 2	0	0	0	0	3	0
CO 3	0	0	0	0	2	0
CO4	3	0	0	0	0	0

Unit	Description	No. of Hrs.
I	**Aquarium Maintenance**	**15**
1.1	Introduction and Scope of aquarium maintenance	
1.2	Identification of aquarium fishes.	
1.3	Nutritional requirements of aquarium fishes.	
1.4	Setting of fresh water and marine water tank	
1.5	General maintenance of aquarium.	

Sr. No.	Name of the Practical
1.	Construction of home aquariums
2.	Aquarium equipment's
3.	Diseases of aquarium fishes.
4.	Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Molly, Sword tail, Gold fish, Angel fish.

References

VSEC Course Code: 24BU3VSC03

1	Aquarium and its management, Dr. Nandita Singh, AKINIK (1), 2023.
2	Aquarium fish, Andrew Cleave, Mason Crest (1),2019.
3	Freshwater Aquariums, David Alderton, Bowtie Press (1),2001.
4	The Complete Guide to Aquarium Fish Keeping, Mary Bailey, Anness (1),1999
5	Aquarium and its management, Dr. Nandita Singh, AKINIK (1), 2023.

FIELD PROJECT COURSE CODE: 24BUZO3P03	FIELD PROJECT (02 Credits)	No of lecture in Hrs. 60

FIELD PROJECT IN ZOOLOGY I

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	List the basic field tools and zoological terms.	L-1
CO2	Summarize the data and make a field report.	L-2
CO3	Analyze collected data to find patterns of animal behaviour.	L-4
CO4	Evaluate field techniques and findings.	L-5

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	0	0	0	3	0
CO 2	0	0	0	0	3	0
CO 3	0	0	0	0	2	0
CO4	0	0	0	0	2	0

SEMESTER - IV

Major Course Code: 24BUZO4T01	(02 Credits)	No of lecture in Hrs. 30

Cell biology and Comparative Physiology of respiration, locomotion and reproduction

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Interpret the structural and functional organization of cell.	L-2
CO2	Identify the composition of the transport mechanisms.	L-3
CO3	Demonstrate the concept of Physiology.	L-2
CO4	Develop the interest about complexity of physiology.	L-3

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	2	0	0	0	0
CO 2	3	0	0	0	0	0
CO 3	3	0	0	0	0	0
CO4	3	0	0	0	0	0

Unit	Description	No. of Hrs.
I	**Cell Biology**	**15**
1.1	Introduction to cell biology	
1.1.1	Definition and scope	
1.1.2	Generalized prokaryotic, eukaryotic cell: size and shape	
1.2	Nucleus	
1.2.1	Size, shape, number and position	
1.2.2	Structure and functions of interphase nucleus	
1.2.3	Ultrastructure of nuclear membrane and pore complex	
1.2.4	Nucleolus: general organization, chemical composition & functions	
1.3	Plasma membrane	
1.3.1	Fluid Mosaic Model	
1.3.2	Junctional complexes	
1.3.3	Membrane receptors	
1.4	Cytoskeletal structures	
1.4.1	Microtubules and microfilaments: Composition and functions	
1.5	Endoplasmic reticulum (ER)	
1.5.1	General morphology of endomembrane system,	
1.5.2	Ultrastructure, types of ER and biogenesis of ER,	
1.5.3	Functions of Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER)	
1.5.4	Endoplasmic reticulum (ER)	
1.6	Golgi complex	
1.6.1	Ultrastructure of Golgi complex, functions of Golgi complex	
1.7	Lysosomes	
1.7.1	Origin, occurrence,	
1.7.2	Polymorphism and functions	
1.7.3	Peroxisomes	

1.7.4	Origin, morphology & functions	
1.8	Mitochondria	
1.8.1	Ultrastructure,	
1.8.2	Chemical composition,	
1.8.3	Functions of mitochondria and bioenergetics	

Unit	Description	No. of Hrs.
II	**Comparative Physiology of respiration, locomotion and reproduction – II**	**15**
2.1	Respiration	
2.2.1	Structure of lungs and physiology of respiration in man	
2.2	Control and co-ordination	
2.2.1	Irritability in *Paramecium*, nerve net in *Hydra*, nerve ring and nerve cord in earthworm.	
2.3	Types of neurons based on the structure and function.	
2.3.1	Movement and Locomotion	
2.3.2	Locomotory organs- structure and functions:	
2.3.3	a) Pseudopodia in Amoeba (Sol- Gel theory),	
2.3.4	b) Cilia in Paramecium	
2.3.5	c) Legs of Cockroach, Fins of fish	
2.3.6	Striated and non-striated muscles: Sliding muscle theory.	
2.4	Reproduction	
2.4.1	a. Asexual Reproduction-	
	i. Fission,	
	ii. Fragmentation,	
	iii. Gemmule formation and	
	iv. Budding	
2.4.2	b. Sexual reproduction	
	i. Gametogenesis	
	ii. Structure of male and female gametes in human	
2.4.3	c. Types of fertilization-	
	Oviparity, Viviparity, Ovo-viviparity	
2.5	Hormonal regulation of reproduction and impact of age on reproduction - menopause and andropause.	

References

Major Course Code: 24BUZO4T01

1	A textbook of cytology Suruchi Tyagi Dominant Publishers and Distributors New Delhi.
2	Cell and Molecular Biology, E.D.P De Robertis and E.M.R Robertis, CBS Publishers and Distributors.
3	Cell and molecular biology, Gupta P. K., Rastogi Publication, India.
4	Cell Biology, Pawar C.B. Himalaya publication
5	Cell Biology, Singh and Tomar, Rastogi Publication.
6	Molecular Biology of the cell, (6 ed) by the Insertus
7	The cell, A molecular approach, Goeffrey M. Coper ASM Press Washington D.C.

Major Course Code: 24BUZO4T02	(02 Credits)	No of lecture in Hrs. 30

Apiculture, Vermiculture and Parasitology

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Outline on economical aspect on animals	L-2
CO2	Utilize the knowledge on animals useful to humankind	L-3
CO3	Summarize the concepts of parasitism.	L-2
CO4	Categories the lifecycle and modes of transmission	L-4

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	0	0	2	0	0
CO 2	0	0	0	0	0	2
CO 3	2	0	0	0	0	0
CO4	3	0	0	0	0	0

Unit	Description Apiculture and Vermiculture	No. of Hrs.
1	**Apiculture**	**15**
1.1	Methods of bee keeping and management	
1.1.1	Introduction to different species of honey bees used in apiculture.	
1.1.2	Selection of flora and bees for apiculture.	
1.1.3	Advantages and disadvantages of traditional and modern methods of apiculture.	
1.1.4	Pests and Bee enemies- Wax moth, wasp, black ants, bee-eaters, king crow and disease control	
1.1.5	Honey- Production, chemical composition and economic importance	
1.1.6	Bee wax- Composition and economic importance.	
1.1.7	Role of honey bee in pollination	
1.2	Vermiculture: Rearing methods, management and economic importance	
1.2.1	Introduction to different species of earthworms used in vermiculture.	
1.2.2	Methods of vermiculture.	
1.2.3	Maintenance and harvesting	
1.2.4	Economic importance: Advantages of vermiculture,	
1.2.5	Demand for earthworms; market for vermicompost and scope for entrepreneurship.	

Unit	Description	No. of Hrs.
II	**Parasitology**	**15**
2.1	Introduction to Parasitology and Types of Parasites	
2.1.1	Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical	
2.1.2	Types of parasites- Ectoparasite, Endoparasite and their subtypes	
2.1.3	Parasitic adaptations in Ectoparasites and Endoparasites	
2.1.4	Types of hosts: Intermediate and definitive, reservoir	
2.2	Host-parasite relationship and host specificity	
2.2.1	Different types of hosts- parasite relationship, structural specificity, physiological specificity and ecological specificity	
2.3	Life cycle, pathogenicity, control measures and treatment **:**	
	Entamoeba histolytica, Viruses: Malaria, Herpes, Viruses; COVID- 19 variants	
2.4	Morphology, life cycle, pathogenicity, control measures and treatment:	
	Head louse (*Pediculus humanus capittis*), Mite (*Sarcoptes scabei)*, Bed bug (*Cimex lectularis)*	
2.5	Zoonosis	
	Bird flu, Anthrax, Rabies and Toxoplasmosis	

References	
Major Course Code: 24BUZO4T02	
1	A handbook on Economic Zoology, S. Chand & Co.
2	A text book of Parasitology- Kochhar S. K. Dominant Pub. & Dis, New Delhi.
3	Bee and Bee Keeping- Roger A. Morse, Cornell University Press London
4	Biology of Insects- 1992 Saxena S. C. Oxford and IBH Publishing Co New Delhi.
5	Economic Zoology Biostatistics and Animal behaviour – S. Mathur, Rastogi Pub.
6	Economic Zoology- Shukla G.S. & Upadhyay V. B., Rastogi Publications.
7	Essentials of Parasitology- Gerald D. Schmidt: Universal Bookstall, New Delhi.
8	Introduction to Parasitology- Chandler and Read John Wiley & Sons
9	Introduction to Parasitology- Sharma P. N. and Ratnu L.S., Chand S & Co. Pvt. Ltd.
10	Medical Parasitology- Arora
11	Parasitology- Chatterjee K. D., Chatterjee Medical Publishers.
12	Textbook of Medical Parasitology-.C.K Jayaram Paniker, Jaypee Brothers.
13	Vermiculture Technology - Clive A. Edwards, Norman Q. Arancon & Rhonda Sherman

Major Course Code: 24BUZO4T03	(02 Credits)	No of lecture in Hrs. 30

Zoogeography and Pollution

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Interpret the geographical distribution of animals.	L-2
CO2	Identify animal distribution and barriers	L-3
CO3	Compare the different types of pollution	L-2
CO4	Analyze the adverse effects of pollution	L-4

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	3	0	0	0	0	0
CO 3	0	0	0	2	0	0
CO4	0	0	0	3	0	0

Unit	Description	No. of Hrs.
I	**Zoogeography**	**15**
1.1	Introduction: Plate tectonics and continental drift theory	
1.2	Animal Distribution and Barriers:	
1.2.1	Isolating Mechanisms	
1.2.2	Patterns of animal distribution - continuous, discontinuous and bipolar	
1.2.3	Barriers of distribution -Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct).	
1.2.4	Means of dispersal - land bridges, natural rafts and drift wood, favoring gales, migration by host, accidental transportation and by human agencies	
1.3	Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic.	

Unit	Description	No. of Hrs.
II	**Pollution and its effect on organisms**	**15**
2.1	Air Pollution	
2.1.1	Types and sources of air pollutant	
2.1.2	Effects of air pollution on organisms, its control and abatement measures	
2.2	Water Pollution	
2.2.1	Types and sources of water pollutant	
2.2.2	Effects of water pollution on organisms, its control and abatement measures	
2.3	Soil Pollution	
2.3.1	Types and sources of soil pollutant	
2.3.2	Effects of soil pollution on organisms, its control and abatement measures	
2.4	Pollution by solid wastes	
2.4.1	Remediation	
2.4.2	Effects of solid waste pollution, Biomedical and plastic waste, its control and abatement measures	
2.5	Noise pollution	
2.5.1	Different sources of noise pollution	
2.5.2	Effects of noise pollution on organisms, its control and abatement measures	
2.6	Pollution by radioactive substances	
2.7	Pollution – Climate Change and Global Warming	
2.8	Environmental Laws	
2.8.1	Ramsar convention and mission	
2.8.2	Wildlife and forest protection	

References	
Major Course Code: 24BUZO4T03	
1	A text book of Environmental Chemistry and Pollution Control, S. S. Dogra, Swastik Pub, New Delhi
2	A text book of Environmental Chemistry and Pollution Control, S. S. Dogra, Swastik Pub, New Delhi
3	A Text Book of Environmental Studies, Gurdeep R. Chatwal, Harish Sharma, Madhu Arora
4	Air Pollution, Kudesia V. P. Pragati Prakashan, Meerut
5	Aquatic Pollution by Edward A. Laws
6	Environmental Chemistry, A. K. De, New Age International
7	Environmental Science and Technology, Stanely E. Manahan
8	Fundamentals of Air Pollution Daniel A. Vallero, Academic press 5th Edition
9	Hand Book of Water and waste water Analysis, Kanwaljit Kaur, Atlantic
10	Practical Methods for water and Air Pollution Monitoring, S. K. Bhargava, New Age International
11	Principles and Practices of Air Pollution Control and Analysis J. R. MudakaniI K International Pub. House Pvt. Ltd.
12	Text Book of Air Pollution and its Control, S. C. Bhatia Atlantic
13	Water Pollution, Kudesia V. P., Pragati Prakashan, Meerut

Major Course Code: 24BUZO4P01	(02 Credits)	No of lecture in Hrs. 30

Practicals based on 24BUZ04T01

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Identify and describe the structure and function of cell organelles	L-3
CO2	Interpret experiments related to permeability and osmosis	L.-5
CO3	Compare respiratory systems and mechanisms in invertebrates and vertebrates	L-5
CO4	Relate structural adaptations in the reproductive and locomotory systems in animals.	L-2

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	0	2	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

Sr. No.	Name of the Practical
1.	Study of prokaryotic cells (bacteria) by gram staining technique
2.	Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain
3.	Study of cell diameter by Occulometer.
4.	Study of permeability of cell through plasma membrane
5.	Disease associated with cell organelles
6.	Study of striated and non-straited muscles fibers
7.	Study of respiratory structures
8.	Study of locomotory organs
9.	Ultrastructure of endomembrane system
10.	Comparative histology of muscles, ligament, tendon, bone
11.	Study of lung capacity by Spirometer
12.	Detection of pregnancy from given urine sample
13.	Study of birth control
14.	Study of reproductive structures.
15.	Study of Cockroach- compound eye and nervous system

Major Course Code: 24BUZO4P02	(02 Credits)	No of lecture in Hrs. 30

Practicals based on 24BUZ04T02 and 24BUZ04T03

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Identify representative animals of different biogeographic realms and understand their ecological adaptations	L-3
CO2	Evaluate the ecological impact of pollutants and suggest possible mitigation or control measures	L-5
CO3	Identify and classify common endoparasites and ectoparasites of humans and domestic animals.	L-3
CO4	Explain and understand the economic and ecological importance of apiculture through field visits.	L-5

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	0	2	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	0	0	2	0	0

Sr. No.	Name of the Practical
1.	Study of Zoogeographical realms: Arctic, Antarctic and Australian realm
2.	Study of Zoogeographical realms: Palearctic and Nearctic realm
3.	Study of Zoogeographical realms: Ethiopian, Oriental and Neotropical realm
4.	Estimation of dissolved oxygen from the given water sample.
5.	Estimation of salinity by refractometer from the given water sample.
6.	Estimation of conductivity by conductometer from the given water sample.
7.	Study of physical properties of soil: temperature, moisture and texture
8.	Study of chemical properties of soil- pH, organic matter
9.	Study of noise pollution monitoring device
10.	Study of protozoan parasites
11.	Study of helminth parasite
12.	Parasitic adaptation in tapeworm
13.	Ectoparasites: Leech, tick, mite
14.	Study of honeybee and its sting apparatus
15.	Study of natural ecosystem and field report of the visit

Minor Course Code: 24BUZO4T04	(02 Credits)	No of lecture in Hrs. 30

Amazing Animals and Origin & Evolution of life

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Outline the life of amazing animals.	L-2
CO2	Categories natural history of incredible animals	L-4
CO3	Illustrate the scientific knowledge on origin of life.	L-2
CO4	Identify and analyze theories of evolution	L-3

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	3	0	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	3	0	0	0	0	0

Unit	Description	No. of Hrs.
I	**Amazing animals**	**15**
1.1	Natural History	
1.1.1	Introduction and life timeline	
1.1.2	Herpetofauna of India-	
1.1.3	Flying frog, Fan Throated lizard and Gharial	
1.1.4	Feathered Bipeds: Kingfisher, Drongo	
1.1.5	Mammals of India: Malabar giant squirrel	
1.2	The world's most amazing animals	
1.2.1	Octopus	
1.2.2	Spider	
1.2.3	Mudskipper	
1.2.4	Flying fish	
1.2.5	Pebble toad	
1.2.6	Lesser flamingo	
1.2.7	Great white pelican	
1.2.8	Spatule-tailed hummingbird	
1.2.9	Cheetah	
1.3	Five most incredible animals discovered within the last decade	
1.3.1	The Purple (joker) crab,	
1.32	The African dwarf saw-shark (stabbing shark),	
1.3.3	The Psychedelic (crime fighting) gecko,	
1.3.4	The Matilda viper	
1.3.5	The Myanmar snub-nosed monkey	
1.4	Marvels of Animals	
1.4.1	Mantis shrimp: Fastest punch	
1.4.2	Homing in Pacific salmon	
1.4.3	Sperm whale: Mechanism of deep-sea diving.	

Unit	Description	No. of Hrs.
II	**Origin and evolution of life**	**15**
2.1	Introduction	
2.1.1	Origin of the Universe	
2.1.2	Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory	
2.1.3	Origin of life	
2.1.4	Origin of eukaryotic cell	
2.2	Evidences in favor of organic evolution	
2.2.1	Evidences from geographical distribution, paleontology, anatomy, embryology, physiology and genetics	
2.3	Theories of organic evolution	
2.3.1	Theory of Lamarck	
2.3.2	Theory of Darwin and Neo- Darwinism	
2.3.3	Mutation Theory	
2.3.4	Modern synthesis theory	

References	
Minor Course Code: 24BUZO4T04	
1	Biology -The Unity and Diversity of Life. C. Starr, R. Taggart, C. Evers, L. Starr, Brooks/Cole Cengage learning International Edition
2	Biology. E. P. Solomon, L. R. Berg, D. W. Martin, Thompson Brooks/Cole
3	Evolution - Strick Berger, CBS publication
4	Evolution- P. S. Verma and Agarwal
5	Introduction to Evolution by Moody
6	Research Methodology, Methods and Techniques- by C.R. Kothari, Wiley Eastern Ltd.
7	Theory of Evolution- Smith, Cambridge Press, and Low-price Edn.

Generic Course Code: 24BUZO4T05	Generic (02 Credits)	No of lecture in Hrs. 30

Sericulture and Aquaculture

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Outline the life history of silkworm and production of silkworm	L-2
CO2	Survey of sericulture industry and its scope in India	L-4
CO3	Show aqua cultural practices and scope in India	L-2
CO4	Make use of techniques employed in aquaculture practices	L-3

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	0	1	0	0	0	0
CO 3	2	0	0	0	0	0
CO4	0	0	0	0	2	0

Unit	Description	No. of Hrs.
I	**Sericulture**	**15**
1.1	Introduction and scope of sericulture	
1.2	Varieties of silk worm, host plants	
1.3	Life history and rearing of *Bombyx mori*	
1.4	Harvesting and processing of cocoon	
1.5	Reeling and extraction of silk	
1.6	Diseases and control measures	

Unit	Description	No. of Hrs.
II	**Aquaculture**	**15**
2.1	**Pisciculture:**	
2.1.1	Definition and scope of fishery resources in India	
2.1.2	Finfish culture – monoculture and polyculture	
2.1.3	Methods in polyculture: Intensive and extensive	
2.1.4	Cage culture	
2.1.5	Fish seed transport	
2.1.6	Fish diseases - symptoms and control	
2.2	**Prawn/shrimp culture:** Sources, seed, culture methods –	
2.2.1	Giant fresh water prawn (*Macrobrachium rosenbergii*)	
2.2.2	White shrimp (*Penaeus vannamei*)	
2.3	**Pearl culture:**	
2.3.1	Pearl producing species and their distribution	
2.3.2	Pearl culture methods	
2.3.3	Composition of pearl	

References	
Major Course Code: 24BUZO4T05	
1	Ganga, G., & Chetty, S. (1991). An introduction to sericulture (2nd ed.). Oxford & IBH Publishing Co. Pvt. Ltd.
2	Jolly, M. S. (1987). Sericulture in tropical countries. Food and Agriculture Organization of the United Nations.
3	Bose, P. C., & Majumder, S. K. (1990). Mulberry cultivation. Central Sericultural Research and Training Institute.
4	Krishnaswami, S (2001). New technology of silkworm rearing. Indian Silk, 39(11),9–12.
5	Jhingran, V. G. (1991). Fish and fisheries of India (3rd ed.). Hindustan Publishing Corporation.
6	Pillay, T. V. R. (1993). Aquaculture: Principles and practices (2nd ed.). Wiley-Blackwell.
7	Santhanam, R., Ramadhas, V., Natarajan, P., & Gopalakrishnan, A. (1990). A manual of freshwater aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd.
8	Ayyappan, S., & Jena, J. K. (2001). Sustainable aquaculture in India. Current Science, 81(9), 1033–103.
9	Sengupta, K. (1989). Manual on sericulture (Vols. 1–3). Central Silk Board, Government of India.

VSEC COURSE CODE: 24BU3VSC02	VSEC (02 Credits)	No of lecture in Hrs. 45

Dairy Farming

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	Interpret the functioning of various aspects of the dairy industry.	L-2
CO2	Categorize the indigenous and exotic cattle breeds.	L-4
CO3	Estimate and compare the biochemical tests from milk samples.	L-5
CO4	Develop the skills to prepare various dairy products.	L-6

Grading:

3: High (>60%)	2: Moderate (40%-60%)	1: Low (<40%),	0: No mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	0	0	0	0	0
CO 2	3	0	0	0	0	0
CO 3	0	2	0	0	0	0
CO4	0	0	0	0	2	0

Unit	Description	No. of Hrs.
I	**Dairy Farming**	**15**
1.1	Introduction and scope in dairy farming.	
1.2	Indian Cattle breeds (Malvi, Red sindhi, Khillari).	
1.3	Indian buffalo breeds (Nagpuri, Murrah, Jafrabadi).	
1.4	Exotic breeds (Jersy, Holstein).	
1.5	Maintenance of dairy farm.	
1.6	Diseases and control.	

Sr. No.	Name of the Practical
1.	Estimation and comparison of protein content in Cow and Buffalo milk sample.
2.	Estimation and comparison of fat content in Cow and Buffalo milk sample.
3.	Quantitative estimation of protein content in Whey.
4.	Measurement of density of milk using different samples by Lactometer.
5.	Preparation of paneer.
6.	Preparation of Rasogulla (Chhena).

References

VSEC Course Code: 24BU3VSC02

1	Dairy plant engineering and management, Tufail Ahmed, Kitab Mahal (9), 2021.
2	Fundamentals of dairy chemistry, B.H. Webb, CBS (2), 2005.
3	Quality of milk production and processing technology, D.K. Thompkinson and Lathasabikhi, New India Publishing Agency (1), 2012.

FIELD PROJECT COURSE CODE: 24BUZO3P03	FIELD PROJECT (02 Credits)	No of lecture in Hrs. 60

FIELD PROJECT IN ZOOLOGY II

COURSE OUTCOME

On completion of this course, students will be able to:

CO1	List the basic field tools and zoological terms.	L-1
CO2	Summarize the data and make a field report.	L-2
CO3	Analyze collected data to find patterns of animal behaviour.	L-4
CO4	Evaluate field techniques and findings.	L-5

Grading:

3: High (>60%)	**2: Moderate (40%-60%)**	**1: Low (<40%),**	**0: No mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	0	0	0	0	3	0
CO 2	0	0	0	0	3	0
CO 3	0	0	0	0	2	0
CO4	0	0	0	0	2	0

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme S.Y.B. Sc Zoology

	SEMESTER – III	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Major Course**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
24BUZO3T01	Fundamentals of Genetics and Comparative Physiology of nutrition and circulation	--	--	√	--	√	√	--
24BUZO3T02	Biomolecules	--	--	√	--	--	--	--
24BUZO3T03	Ethology and Epidemiology	√	√	√	√	--	√	√
23BUZO3P01	Zoology Practicals based on 23BUZO3T01 and 23BUZO3T02	--	--	√	--	√	√	--
23BUZO3P02	Zoology Practicals based on 23BUZO3T02 and 23BUZO3T03	√	√	√	√	--	√	√
24BU3VSC03	Aquarium Maintenance	√	√	√	√	--	--	√
24BUZO3T01	Fundamentals of Genetics and Comparative Physiology	--	--	√	--	√	√	--
Minor Course								
24BUZO3T04	Comparative embryology, Breeding and Parental Care	√	√	-	√	--	--	--
Generic Course								
23BUZO2T05	Pest management	√	√	-	√	--	--	√
Field Project Course								
24BUZO3PO3	Field Project in Zoology I	√	√	√	-	--	√	√
Total		**06**	**06**	**08**	**05**	**03**	**06**	**05**

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme S.Y.B. Sc Zoology

	SEMESTER – IV	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Major Course**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
24BUZO4T01	Cell Biology & Comparative physiology of respiration, locomotion and reproduction	--	--	--	--	--	√	--
24BUZO4T02	Apiculture, Vermiculture and Parasitology	√	√	√	√	--	--	√
24BUZO4T03	Zoogeography and Pollution	--	--	--	--	--	--	√
23BUZO4P01	Zoology Practicals based on 23BUZO4T01	√	√	√	√	--	√	√
23BUZO4P02	Zoology Practicals based on 23BUZO4T02 and 23BUZO4T03	√	√	√	√	--	--	√
24BU4VSC02	Dairy Farming	√	√	√	√	--	--	√
24BUZO4T01	Cell Biology & Comparative physiology II	--	--	--	--	--	√	--
Minor Course								
24BUZO4T04	Amazing Animals and Origin, Evolution of life	--	--	--	--	--	--	√
Generic Course								
23BUZO4T05	Sericulture and Aquaculture	√	√	-	√	--	--	√
Field Project Course								
24BUZO4PO3	Field Project in Zoology II	√	√	√	-	--	√	√
Total		**06**	**06**	**05**	**05**	**-**	**04**	**08**