ಬೆಂಗಳೂರು
ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

BENGALURU
CITY UNIVERSITY

Office of the Registrar, Central College Campus, Dr. B.R. Ambedkar Veedhi, Bengaluru – 560 001.
PhNo.080-22131385, E-mail: registrarbcu@gmail.com

No.BCU/BoS/Syllabus-PG/Science/ 332 /2025-26 Date: 23.09.2025

NOTIFICATION

Sub: Syllabus for the Post Graduate Courses in the Faculty of Science– reg

Ref: 1. Recommendations of the Boards of Studies in the Faculty of Science
2. Academic Council resolution No.04 dated.22.09.2025
3. Orders of Vice-Chancellor dated. 23.09.2025

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The Academic Council in its meeting held on 22.09.2025 has approved the syllabus prepared by different Board of Studies for the Post Graduate Courses in the Faculty of Science. Accordingly, the following CBCS Syllabus for the Semester PG Courses of Science Faculty are hereby notified for implementation effective from the academic year 2025-26.

Sl. No.	Programmes
1.	M.Sc. Chemistry – I & II Semester
2.	M.Sc. Biochemistry – I to IV Semester
3.	M.Sc. Physics – I & II Semester
4.	M.Sc. Mathematics – I to IV Semester
5.	M.Sc. Psychology– I to IV Semester
6.	M.Sc. Counselling Psychology – I to IV Semester
7.	M.Sc. Fashion & Apparel Design – I to IV Semester
8.	M.Sc. Zoology – I & II Semester
9.	M.Sc. Botany – I to IV Semester
10.	M.Sc. Computer Science – I & II Semester
11.	M.Sc. Speech Language Pathology – I to IV Semester
12.	Master of Computer Applications – I & II Semester

The detailed Syllabi for above subjects are notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

Copy to;

1. The Registrar(Evaluation), Bengaluru City University
2. The Dean, Faculty of Science, BCU.
3. The Principals of the concerned affiliated Colleges of BCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), BCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in

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BENGALURU CITY UNIVERSITY

BENGALURU CITY UNIVERSITY

Curriculum/Syllabus for

Postgraduate Programme

Master of Science

in

Zoology

Choice Based Credit System

Faculty of Science
(With Effect from Academic Year 2025-26)

BENGALURU CITY UNIVERSITY, BENGALURU
Proceedings of the meeting of BOS (PG) in Zoology

Ref: 1) BCU/BOS-PG/Revise-Syllabi/34/2025-26Dated 19-04-2025
2) BCU/BOS/Zoology-PG/379/2024-25 Dated 01-02-2025

The Chairperson- BOS in Zoology, Bengaluru City University, Bengaluru greeted the BOS Members before the commencement of the meeting

A meeting of Board of Studies in Zoology of BCU was held on 13th September 2025 (during 10.30Am to 4.30pm) at Department of Zoology, Bangalore University, Bengaluru to scrutinize the drafted syllabus pertaining to M.Sc., Zoology Bengaluru City university, Bangalore

Agenda 1: Approval of syllabi for 1st, 2nd, 3rd and 4th semester M.Sc., Zoology

Resolution: The proposed syllabus for **1st, 2nd, 3rd and 4th semester M.Sc., Zoology** (both theory and practical) and as well as the scheme of examination were scrutinized thoroughly, finalized with appropriate inclusion(s)and deletion(s) of the contents and finally approved on 13th September 2025.

Agenda 2: Approval of panel of examiners for M.Sc., Zoology for the academic year 2025-2026

Resolution: The given panel of examiners for PG Zoology and Genetics for the year 2025-2026 were scrutinized thoroughly, finalized with appropriate inclusion(s)and deletion(s) of the contents and finally approved.

The meeting was concluded with the chairperson thanking all the members for rendering cooperation for the smooth conduct of the meeting.

The following BOS members attended the meeting

Sl. No.	Name of Chairman/Member	Designation	Signature
1.	Dr. B.P. Harini Professor and Chairperson Department of Zoology, Bangalore University Bangalore-560056 Email: dr.bpharini@gmail.com; Phone No.: 9448939066	Chairperson	
2.	Dr. S.S. Malini Professor, Department of Zoology, University of Mysore, Mysuru Email:ssmalinisri@yahoo.com; Phone.No.96862612	Member	Online e-sign
3.	Dr. M. Shiva Shankar, Professor, Department of Life Sciences, Bangalore University, Bangalore-560056 Phone No.:8722048456; shivashankarseri@gmail.com	Member	
4.	Dr. Sree Priya, Professor, Department of Microbiology/ Biotechnology, Bangalore University, Bangalore-560056 Phone No.: 9448060936; mpriya7@yahoo.com	Member	
5.	Dr. Shakunthala. V, Professor, Department of Studies in Zoology, University of Mysore, Mysore Phone No.:9483670892; drshakunthalav2@gmail.com	Member	
6.	Dr. K. Nagaraja Professor, Department of Applied Zoology, Kuvempu University, Jnana Sahyadri, Shankaraghatta, Shimoga – 577 451, Phone No.: 9620485338; Email: knagarajv@gmail.com	Member	Online e-sign
7.	Dr. MS. Mustak Professor	Member	Online e-sign

	Department of Applied Zoology, Mangalagangothri, Mangalore University Email: msmustak@gmail.com; Phone No.: 9743289671		
8.	Dr. Bhushanam.M Professor Department of Zoology, Maharanis Cluster University, Bengaluru Email: bhushanam.honey@gmail.com; Phone No.: 886192132	Member	
9.	Dr. Annappa Poojari Professor Department of Zoology Nrupathunga University, Bengaluru Email: annu1967@gmail.com; Phone No.: 8762972974	Member	Online e-sign
10.	Dr. N.G. Raju Professor, Department of Zoology, Karnataka State Open University, Mukthagangothri,Mysuru Email:raju_119@yahoo.com; Phone No.: 9448267255	Member	
11.	Dr. Prabhu. BM Faculty Department of Zoology, BCU Phone No. 8197226540 Email: prabhubm1@yahoo.com	Co- opted Member	
12.	Dr. Venkatesh.M.D Faculty Department of Zoology, BCU Phone No. 9844358420 Email: mandayam.venkatesh@gmail.com	Co- opted Member	
13.	Dr. V. Kurinji Faculty Department of Zoology, BCU Phone No. 9480452340 Email: kurinjiv7@gmail.com	Co- opted Member	
14.	Dr. Rakesh. H Faculty Department of Zoology, BUB Phone No.: 9916311539	Co- opted Member	
15.	Dr. Shalini. M Faculty Centre for Applied Genetics, BUB Phone No.: 8050663448 Email: shalinimoses77@gmail.com	Co- opted Member	

Thanking You

Yours Sincerely,

(B.P. HARINI)

BOS Chairperson- Bengaluru City University

Dr. B. P. HARINI
Professor
Department of Zoology
Chairperson-BOS in Zoology
Bangalore University, Jnana Bharathi,
Bengaluru - 560 056, INDIA.

CHAIRPERSONS NOTE

The M.Sc. Zoology program aims to provide students with a comprehensive understanding of recent advances in Zoology, ranging from organismic to reductionist biology. It is designed to empower students to address societal and national challenges related to Zoology. The core subjects include the systematics of Chordates and Non-Chordates, Insect Biology, Aquaculture, Endocrinology, Behavioral and Evolutionary Mechanisms, Cancer Biology, Genetics, Genomics, Bioinformatics, Biostatistics, Biophysics, Immunology, Neurophysiology and their roles in health and disease, Applied Zoology, Environmental Biology, Pollutants and Pesticides, among others.

The program also offers a series of elective (softcore) courses, allowing students to specialize in areas of interest within Zoology. In alignment with the choice-based credit system, nearly 40% of the total credits are from elective courses. Core courses are taught in the first and second semesters, with 33% of credits dedicated to laboratory work and hands-on experience, emphasizing skill development.

In the third semester, students can select open elective courses from a variety of disciplines, such as Anthropology, Environmental Studies, and Biomedical Sciences, encouraging interdisciplinary engagement. These courses are intended to inspire research in interdisciplinary fields.

The fourth semester offers one elective course, two core courses, and an 8-credit project, providing students with practical experience in research design and execution. This semester also focuses heavily on skill-based training in socially relevant areas of Zoology.

This program is open to students with undergraduate degrees in Zoology or related Life Sciences.

(B.P. HARINI)
CHAIRPERSON - BOS IN ZOOLOGY (PG)
BANGALORE CITY UNIVERSITY

Graduate Attributes

Attribute1:
Students will have In-depth knowledge and Advanced understanding of zoological concepts, theories, principles and ability to effectively communicate scientific information through written reports, oral presentations, and publications.

Attribute 2:
Critical thinking: Capacity to evaluate scientific evidence, critically analyze data, and draw informed conclusions. Expertise in a specific core area of Zoology, such as Wildlife conservation, Animal behavior, Molecular biology, Immunology, Animal physiology, Endocrinology etc.

Attribute 3:
Laboratory skills: With practical components in each area students achieve Proficiency in laboratory techniques, including microscopy, dissection, and molecular biology methods, clinical physiology, Computational biology, Systematic, knowledge on human disorders, environmental issues, human wild life conflicts etc.

Attribute 4:
Research skills: Ability to design, conduct, and analyze research in zoology, including data collection and statistical analysis and Analytical skills, Capacity to analyze complex data sets, identify patterns, and draw meaningful conclusions.

Attribute 5:
Problem-solving skills: Ability to apply zoological principles to solve real-world problems, such as conservation issues or animal welfare concerns, wildlife-man conflicts, climate change and its consequences.

Attribute 6:
Interdisciplinary understanding: Appreciation of the intersections between Zoology and other disciplines, such as Ecology, Evolution, and Environmental biology that make the students to acquire. Professional skills and preparation for careers in Zoology, including skills in Grants writing, Project management and Science communication. Awareness about the Ethics and Plagiarism.

Programme Details

Name of the Department: Department of Zoology
Subject: Zoology
Faculty: Science
Name of the Course: Master of Science in Zoology (M.Sc.)
Duration of the Course: 2 years- divided into 4 semesters

Programme Objectives

The main objective of this M.Sc., programme is to provide strong foundation to the students in the subject of Zoology. The programme encompasses various courses spread across the four semesters, which intend to make the students conceptually and practically fit to handle the Classical, Molecular and Cellular aspects of Zoology.
To Prepare the students to take up teaching and research careers as Faculties in undergraduate colleges, Academic Institutions and Universities

- Researchers in reputed research institutions, Fishery, Animal husbandry, Forest Department Forensic Department
- Entrepreneur to start their own Life Science based company in Animal husbandry
- Biotechnology, Fisheries, Aquaculture etc.,
- Programme Outcomes M.Sc., programme in Zoology is a highly reputed programme among Life sciences in the University.

On successful completion of this programme each student will:

- Have a strong foundation in understanding the Classical and the most modern aspects of Animal sciences.
- Be able to learn Concepts and technology in the field of Genetics, Cell Biology, Human Genetics, Molecular Biology, Immunology, Cancer Biology, Molecular basis of Animal development, Environmental biology, Animal Biotechnology, Biodiversity and Wildlife Biology, Behavioral and Evolutionary biology.
- Develop practical skills along with their theory components, which will help in their research programme both in academic institutions and in R & D programmes of different national and international institutes.
- Inculcate skills for teaching in academic institutions for undergraduate and postgraduate students.
- Develop confidence in taking competitive examination in the field of Life science both in India and abroad so that they can pursue higher education.

Aims:

- Understanding animal structure and function: Studying the Anatomy, Physiology, and Biochemistry of Animals.
- Exploring animal diversity: Discovering the vast range of Animal species, their evolution and classification.
- Understanding animal behavior: Studying animal behavior, including social behavior, communication and migration patterns.
- Conservation and management: Learning about Conservation biology, Wildlife management and Animal welfare.
- Advancing human health: Applying zoological principles to improve human health, such as understanding disease mechanisms and developing new treatment methods.
- Improving animal production: Applying zoological principles to improve Animal farming, such as Breeding and Nutrition, Aquaculture and Bio-prospecting.
- Understanding ecosystems: Studying the interactions between animals and their environments, including Ecology and Biodiversity for sustainable development.
- Developing research skills: Learning scientific methods, Experimental design and Data analysis techniques.
- Preparing for careers: Preparing students for careers in Zoology, Wildlife conservation, Research and related fields.
- Promoting environmental awareness: Fostering an appreciation for the natural world and promoting environmental sustainability.

	COURSE TITLES AND SYLLABUS OF I SEMESTER						
Sl. No.	**Course/ Paper Code**	**Title of the Paper**	**Teaching Hours/ week**	**End Semester Evaluation (Maximum**		**Total Marks**	**Credits**
				Formative Assessment	**Summative Assessment**		
1	HCT-101	Animal Systematics	4	30	70	100	4
2	HCT-102	Ecology,Biodiversity and Evolution	4	30	70	100	4
3	HCT-103	Biochemistry and Biophysics	4	30	70	100	4
4	HCT-104	Cell biology and Advanced Genetics	4	30	70	100	4
5	HCP-101	Animal Systematics	4	15	35	50	2
6	HCP-102	Ecology, Biodiversity and Evolution	4	15	35	50	2
7	HCP-103	Biochemistry and Biophysics	4	15	35	50	2
8	HCP-104	Cell biology and Advanced Genetics	4	15	35	50	2
Softcore							
7	SCT-105	Ethology	3	30	70	100	2
Total							**26**

Note: Hard core Theory: HCT, Soft core Theory: SCT and HCP: Hard core Practical's

	COURSE TITLES AND SYLLABUS OF II SEMESTER						
Sl. No	**Course/ Paper Code**	**Title of the Paper**	**Teaching Hours/ week**	**End Semester Evaluation (Maximum Marks)**		**Total Marks**	**Credits**
				Formative Assessment	**Summative Assessment**		
1	HCT-201	Comparative Anatomy	4	30	70	100	4
2	HCT-202	Animal Physiology	4	30	70	100	4
3	HCT-203	Vector biology and Parasitology	4	30	70	100	4
4	HCT-204	Economic Zoology	4	30	70	100	4
5	HCP-201	Comparative Anatomy	2	15	35	50	2
6	HCP-202	Animal Physiology	2	15	35	50	2
7	HCP-203	Vector biology and Parasitology	2	15	35	50	2
8	HCP-204	Economic Zoology	2	15	35	50	2
Softcore							
7	SCT-205	Biostatistics and Computational biology	3	30	70	100	2
Total							**26**
Note: Hard core Theory: HCT, Soft core Theory: SCT and HCP: Hard core Practicals							

	COURSE TITLES AND SYLLABUS OF III SEMESTER						
Sl. No	**Course/ Paper Code**	**Title of the Paper**	**Teaching Hours/ week**	**End Semester Evaluation (Maximum Marks)**		**Total Marks**	**Credits**
				Formative Assessment	**Summative Assessment**		
1	HCT-301	Developmental Biology	4	30	70	100	4
2	HCT-302	Endocrinology, Neuro and Sensory biology.	4	30	70	100	4
3	HCT-303	Immunology and Cancer biology	4	30	70	100	4
4	OE-304	Applied Zoology	4	30	70	100	4
5	HCP-301	Developmental Biology	4	15	35	50	2
6	HCP-302	Endocrinology, Neuro and Sensory biology.	4	15	35	50	2
7	HCP-303	Immunology and Cancer biology	4	15	35	50	2
8	HCP-304	Tools and Techniques.	4	15	35	50	2
Total							**24**
Note: Hard core Theory: HCT, Soft core Theory: SCT and HCP: Hard core Practicals							

	COURSE TITLES AND SYLLABUS OF IV SEMESTER						
Sl. No	**Course/ Paper Code**	**Title of the Paper**	**Teaching Hours/ week**	**End Semester Evaluation (Maximum Marks)**		**Total Mark s**	**Credits**
				Summative Assessment	**Formative Assessment**		
1	HCT-401	Molecular biology and Genetic Engineering	4	30	70	100	4
2	HCT-402	Human health and diseases	4	30	70	100	4
3	HCT-403	Toxicology and Advanced biology	4	30	70	100	4
4	HCT-404	Research Methodology	4	30	70	100	4
5	HCP-405	Molecular biology & Genetic Engineering and Human health & diseases	4	15	35	50	2
6	HCP-406	Toxicology & Advanced biology and Research Methodology	4	15	35	50	2
7	PR-407	Project work	4	30	70	100	4
Total							**24**
Note: Hard core Theory: HCT, HCP: Hard core Practical's, and Project work: PR							

Program Name	M.Sc.	Semester	I
Course Title	ANIMAL SYSTEMATICS (Theory)		
Course Code	HCT-101	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	ANIMAL SYSTEMATICS	52hrs
	Contents	**Teaching Hours**
Unit 1	**Fundamentals of Systematics:** Biological classification, hierarchy of categories and higher taxa. Taxonomical characters - Procedures and keys. Species concepts: varieties, subspecies, sibling species and race. International code of Zoological Nomenclature (ICZN). Binomial nomenclature, Outline classification of kingdom Animalia. **Methods of Biosystematics**: Classical and modern methods- Morphology based taxonomy, Numerical taxonomy, Cytotaxonomy, Typological, Phenetics, Evolutionary, Phylogenetic, Cladistics and Molecular Taxonomy, Chemotaxonomy. Markers for detection/evaluation of polymorphism DNA fingerprinting, Phylocode, Tree of Life and Bar-coding of Life.	**13 Hrs**
Unit 2	**Systematics of Lower Invertebrates**: Classification, general characters of phylum Protozoa, General account on Beneficial and Harmful protozoa, Porifera, Coelenterate, coral reefs and theories of formation, Platyhelminthes and Nematoda Origin of parasitism, Morphological and physiological adaptations in helminthes. Systematics of Minor phyla: General characteristics and classification. Structural affinities and life history of Minor Phyla Rotifera, Entoprocta, Phoronida and Ectoprocta. **Systematics of Higher Invertebrates:** General characteristics, classification of phylum Annelida, General account on Nephridia and coelom ducts in annelids, Arthropoda, Mollusca, torsion in gastropods and Echinodermata.	**13 Hrs**
Unit 3	**Systematics of Protochordates and Chordates:** General characters and outline of classification of Protochordates and Chordates (up to orders). Origin of Chordates in the light of recent theories. Systematic position and Phylogenetic interrelationship between Protochordates and Chordates; Class Pisces. General account on Lung fishes, origin and evolution of paired fins in fishes, Accessory respiratory organs and swim bladder in fishes, viviparity in fishes, Migration in fishes. Parental care in fishes.	**13 Hrs**
Unit 4	General characters and outline of classification of Protochordates and Chordates (up to orders). Origin of tetrapoda, Class Amphibia to Mammalia, South Indian amphibians, lizards, turtles and tortoise, Parental care in amphibians. Origin of birds, mechanism of flight/adaptations, Migration in birds. Adaptive radiations in birds, reptiles and mammals. Types of Placenta in mammalia, Aquatic mammals.	**13 Hrs**

Program Name	M.Sc.	Semester	I
Course Title	ANIMAL SYSTEMATICS (Practicals)		
Course Code	HCP-101	Credits	2
Contact Hours per Week	4	Duration of Exam	4
Summative Assessment Marks	35	Formative Assessment Marks	15

Practicals	1. Construction of Dichotomous key and cladogram. 2. Identification, classification of representative organisms from Protozoa (Trypanosoma, elphidium), Porifera (Leucosolenia, spongilla and Cnidaria (Physalia, corollium rubrum). 3. Identification, classification of representative organisms from Platyhelminthes (Schistosoma) Nematoda (Ancylostoma duodenale) Annelida (Nereis, Tubifex, leech). 4. Identification, classification of representative organisms from Arthropoda (lepas, scorpion), Mollusca (Chiton, Murex), Echinodermata (Heart urchin, Antedon) 5. Diversity of mouth parts in insects; Mounting of Mouth Parts of cockroach/mosquito 6. Adaptation for aquatic movements; Mounting of Appendages in Prawn. 7. Protochordates (Balanoglossus, doliolum, amphioxus) Fishes (Shark, clarius, cat fish) 8. Morphometrics /metrics of fish 9. Identification, classification of representative organisms from Amphibia (Hyla, Ichthyophis), Reptiles (King cobra and crocodile). Aves(pigeon) Mammalia (Squirrel). 10. Listing of invertebrate (at least 3 to 5) species identified in Indian sub-continent across all phylum 11. Listing of Vertebrate (at least 5) species identified in Indian sub-continent across all classes 12. Visit to museum/ Zoological Garden/ national park.	**52 hrs**

REFERENCES:

1. Cleveland Hickman, Jr., Susan Keen, Allan Larson, David Eisenhour and Larry Roberts. (2018). Animal Diversity, 8th edition, Philadelphia, USA: McGraw Hill.
2. Kapoor VC. (2019). Theory and Practice of Animal Taxonomy, 8th edition. Delhi: Oxford and IBH Publ.
3. Simpson G G. (2024). Principles of Animal Taxonomy. Scientific Publishers
4. Sinha A K, Adhikari S and Ganguly B B, 2011. Biology of Animals (vol. I & II), Kolkata; New Central Book Agency.
5. Robert D. Barnes, Richard S. Fox, Edward E. Ruppert. (2003). Invertebrate Zoology. Brooks/Cole.
6. Hymen LH, The invertebrates (all volumes). Philadelphia, USA: McGraw Hill,
7. Prasad S N. (2010). Life of Invertebrates, New Delhi: Vikas Publ.
8. Young J Z. (2002). The Life of Vertebrates, Oxford university press.

Prasad S N. (2011). A Textbook of Vertebrate Zoology: New Age International Private Limited

Program Name	M. Sc.	Semester	I
Course Title	ECOLOGY, BIODIVERSITY AND EVOLUTION (Theory)		
Course Code	HCT-102	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	ECOLOGY, BIODIVERSITY AND EVOLUTION.	52hrs
	Contents	
Unit 1	Scope and approaches to study Ecology. Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - food chains and food webs. Energy flow in ecosystems, energy flow models, Productivity, homeostasis and cybernetics, significance of ecosystem studies. Ecosystem services. Ecological Succession: Stages and mechanism of succession, Concept of Habitat and Ecological Niche, niche types, niche width and overlap, ecological equivalent, niche segregation, concept of climax.	**13Hrs**
Unit 2	**Community structure and organization**: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect. Concept of population; Concept of limiting Factors-Liebig's law of the minimum, Shelford's law of tolerance. characteristics of population: density, natality, mortality, life tables, survivorship curves, age structure; population growth form: exponential, logistic; r- and k- selection; dispersion, distribution, Concept of metapopulation. **Dynamics of population**: Parasitism, predation, competition, Antibiosis, commensalism, proto co- operation, mutualism. Global issues; carbon sequestering, Kyoto protocol.	**13Hrs**
Unit 3	**Biodiversity in Biosphere**: Basic principles: Biodiversity, Introduced Biodiversity and Native Biodiversity. Components of Biodiversity, Classification of Habitats, Biomes, Eco-system diversity, Species Diversity: α, β and γ diversity, Genetic diversity. Endemic species and patterns of distribution with special reference to India. Species distribution, species area relations, Western Ghats and Silent valley as "biodiversity hot spots". **Threats to Biodiversity (loss)**: Factors for loss of biodiversity (Natural and Anthropogenic), effect of manmade alterations of environment on biospheres, David Tillman's field experiment, Rivet popper hypothesis. Human animal conflict Conservation; Habitat protection strategies, Biosphere reserves, resources and management. Global programs and concept of endangered species and categories. **Conservation-approach**: Landscape approach to biodiversity conservation (sacred grooves, species), Wild life Corridor approach, individual species approach, habitat conservation approach. National biodiversity strategy and action plan. Biodiversity Indices. Modern tools and techniques to assess biodiversity.	**13Hrs**

Unit 4	Overview of Lamarckism, Darwinism, Neo-Darwinism. Paleobiological-concepts of stratigraphy and geological time scale; fossil study. Anatomical-vestigial organs; homologous and analogous organs (concept of parallelism and convergence in evolution). **Forces of Evolution that affect the allelic frequencies**: Genetic drift, Mutation, Migration, Selection, Directional selection, Disruptive selection, Group selection, Allelic frequency and gene frequency, Gene pool, Hardy-Weinberg genetic equilibrium. **Isolating Mechanisms and speciation**: Species concepts, geographic, reproductive isolation- Premating isolation and Post mating isolation. Hybrid sterility, Origin of reproduction isolation Muller's and Dobzhansky's Approaches, Models of speciation – Sympatric, Allopatric, peripatric, parapatric and quantum speciation. Overview of evolution- Horse and Man. **Molecular evolution**: Molecular clock- Conversion of genetic distance into divergence time, Neutral theory of molecular evolution.	**13Hrs**

Program Name	M. Sc.	Semester	I
Course Title	ECOLOGY, BIODIVERSITY AND EVOLUTION (Practical)		
Course Code	HCP-102	Credits	2
Contact Hours per Week	4	Duration of Exam	4
Summative Assessment Marks	35	Formative Assessment Marks	15

Practicals	1. To determine the pH of soil solution and water samples, soil biomass. 2. To determine the temporary/permanent hardness in water samples. 3. To determine the chlorides/sulphates in water samples. 4. To determine the phytoplankton density in sample obtained from lake/tank. 5. Population ecology; To assess population Growth- *Drosophila melanogaster*/paramecium. 6. Determination of BOD in samples. 7. Identification (photographs)-Critically endangered, endangered and vulnerable and animals of India. 8. Biodiversity indices -Sorenson index, Evenness index, and Marglef species richness index. 9. Evidence for Evolution: Types of fossils, connecting links/transitional forms, Living fossils, Vestigial, Analogous and Homologous organs. 10. Adaptive strategies: Coloration, Mimicry, co-adaptation and co-evolution, aquatic, terrestrial, arboreal adaptations. 11. Case studies: Students can survey/collect information and make a case study in (**any one**) concept listed; i) Traditional ecological knowledge, ii) urban heat maps, iii) integrated water shed management, iv) Remedy for plastic waste: Recycled plastic used to make road at Bangalore university, v) E- wastes management, vi) People's participation in conservation activities.	**52 hrs**

REFERENCES:

1. Michael Begon, Colin R. Townsend, and John L. Harper. (2006). Ecology: From Individuals to Ecosystems, 4th edition, Oxford, UK: Blackwell Publishing.
2. Charles J. Krebs. (2009). Ecology: The Experimental Analysis of Distribution and Abundance, 6th edition, San Francisco, USA: Benjamin Cummings.
3. Eugene P. Odum and Gary W. Barrett. (2005). Fundamentals of Ecology, 5th edition, Belmont, USA: Thomson Brooks/Cole.
4. Colin R. Townsend, Michael Begon, and John L. Harper. (2014). Essentials of Ecology, 4th edition, Hoboken, USA: Wiley-Blackwell.
5. Vir Singh. (2024). Textbook of Environment and Ecology, Singapore: Springer Nature.
6. Pranav Kumar. (2018). Fundamentals of Ecology and Environment, Delhi, India: Pathfinder Publication.
7. C. Barry Cox, Peter D. Moore, and Richard J. Ladle. (2016). Biogeography: An Ecological and Evolutionary Approach, 9th edition, Hoboken, USA: Wiley-Blackwell.
8. Douglas J. Futuyma and Mark Kirkpatrick. (2017). Evolution, 4th edition, Sunderland, USA: Sinauer Associates.
9. Veer Bala Rastogi. (2015). Fundamentals of Evolutionary Biology, Meerut, India: Rastogi Publications.
10. Cleveland Hickman, Jr., Susan Keen, Allan Larson, David Eisenhour, and Larry Roberts. (2018). Animal Diversity, 8th edition, Philadelphia, USA: McGraw Hill.

Program Name	M.Sc.	Semester	I
Course Title	BIO-CHEMISTRY AND BIOPHYSICS (Theory)		
Course Code	HCT-103	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	HCT-103: BIO-CHEMISTRY AND BIOPHYSICS	52hrs
	Contents	**Teaching Hours**
Unit 1	**BIOMOLECULES** **Molecules and their characteristic features:** Review of basic concepts of solution chemistry acid, base, ionic strength, principles of thermodynamics: chemical potential, free energy, entropy, enthalpy, heat capacity; dimensions of atoms, covalent and non-covalent bonds. Dihedral angles, steric conflict, classes of organic compounds and functional groups. **Nutrients and their biological significance;** Carbohydrates - Chemistry and classification, structure of starch and cellulose. Amino acids - classification, structure, function. Peptides, Proteins- basic properties, classification- primary, secondary, tertiary and quaternary structures. Lipids- basic properties; classification. Nucleic acids- Structure, Composition and function of Nucleic acids Vitamins- Water soluble and fat-soluble Vitamins.	**13Hrs**
Unit 2	**METABOLISM** **Metabolism of carbohydrates:** Glycolysis. Metabolic basis of Pasteur and Warburg effects, Transformations of pyruvate: fermentations and oxidative decarboxylation. Pentose phosphate pathway. Gluconeogenesis, Synthesis and degradation of glycogen. **Metabolism of lipids:** β-Oxidation pathway, Cholesterol synthesis Plasmatic lipoproteins, Fatty acid degradation, Isoprenoid metabolism. Prostaglandins and eicosanoids. **Metabolism of amino acids:** Biosynthesis and degradation of amino acids. Transaminases. **Metabolism of nucleotides**: Degradation of purine and pyrimidine nucleotides, Recycling and biosynthesis of purines and pyrimidines. **ENZYMOLOGY:** Properties, Classification, coenzymes. Isozymes, Enzyme kinetics: Michelis-Menten Equation (MM and Line weaver–Burk Plots); Mechanism of enzyme action; concept of enzyme activity, Ribozyme, Apoenzyme. Enzyme inhibition.	**13Hrs**

Unit 3	**BIOPHYSICS** **Light and Biomolecules:** Properties of light and laser light, Polarisation of light, linear and circular dichroism (cD), cD spectra of protein and nucleic acids. Spectrometry and X-ray diffraction: Principles of spectroscopy, ionization, protein mass determination, MALDI-MS, ESI-MS. Methods of glowing crystals, theory of x-ray diffraction, Bragg's law.	**13Hrs**
Unit 4	**Fluorescence and Infrared spectroscopy (IR):** Phenomenon of fluorescence, fluorescence decay, fluorescence anisotropy, fluorophores, linear polarization of fluorescence, Fluorescence microscopy and Fluorescence resonance energy transfer (FRET) and its biological applications. Electron Spin Resonance (ESR) and Nuclear Magnetic Resonance (NMR) spectroscopy: NMR in bio-medical research.	**13Hrs**

Program Name	**M.Sc.**	**Semester**	**I**
Course Title	**BIO-CHEMISTRY AND BIOPHYSICS (Practical)**		
Course Code	**HCP-103**	**Credits**	**4**
Contact Hours per Week	**4**	**Duration of Exam**	**3**
Summative Assessment Marks	**70**	**Formative Assessment Marks**	**30**

Practicals	1. Preparation of citrate and phosphate buffer solutions and measurement of pH 2. Determination of isoelectric pH. 3. Estimation of total protein (Lowry method) 4. Estimation of total amino acid (ninhydrin reagent method). 5. Estimation of cholesterol (Zlatkis Method). 6. Determination of pyruvate in biological fluids (blood and urine). 7. Saponification value of fat. 8. Effect of different pH and Temperature on the activity of salivary amylase on starch. 9. Determine the absorption spectrum for colored compounds. 10. Verification of Beer-Lambert's law.	**52 Hrs.**

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Program Name	M.Sc.	Semester	1
Course Title	CELL BIOLOGY AND ADVANCED GENETICS (Theory)		
Course Code	HCT-104	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	CELL BIOLOGY AND ADVANCED GENETICS	56 hrs
Contents		Teaching Hours
Unit 1	**Molecular organization of cell**: Cell membrane structure; lipid bilayers-fluid mosaic model; Membrane proteins of small molecular transport and membrane potentials; Structure and biogenesis of endoplasmic reticulum, Golgi, mitochondria and nucleus; Vesicular transport-from ER through Golgi, trans Golgi network to lysosomes; Endo-exocytosis. **Cytoskeleton, cell interaction and communication**: Structure of cytoskeletal filaments and their regulation; Molecular motor proteins; Cell junctions, cell-cell adhesion and extracellular matrix; Cell communication-principles, signaling through G-protein coupled receptors, enzyme-linked receptors, **Cell cycle, cell division:** Components of cell cycle control system, Intracellular events to control cell–cycle; Extracellular control of cell growth and division; Molecular mechanism of cell division (Mitosis and cytokinesis).	13Hrs
Unit 2	**Concept of gene and Mendelism and deviation**: Fine structure and function of gene, split gene, jumping gene, Overlapping gene and multiple genes. **Extensions of Mendelian principles:** Overview of Mendelian inheritance, Inheritance of mitochondrial and chloroplast genes, penetrance and expressivity, genomic imprinting. **Chromosomal Mapping in Eukaryotes:** Linkage and crossing over (mechanism and theories). Linkage maps, Physical Mapping- restriction mapping, mapping with molecular markers, somatic cell hybrids. Polygenic inheritance, heritability and its measurements, QTL mapping, LOD score for Linkage testing. **Mutations and mutagenesis**: Types of Mutations- Spontaneous mutation, induced mutation, conditional mutation, lethal mutations; Gene mutation - base substitution mutation, Missense, Nonsense and Silent mutations; Mutagenesis - Chemical, Physical and Biological mutagenesis, Detection of mutations. Molecular basis of mutation and its applications. **DNA damage**: Causes and consequences of DNA damage, DNA repair- Direct, Excision, Mismatch and SOS repair.	13Hrs
Unit 3	**Gene expression and regulation** **Transcription** - RNA polymerase, prokaryotic and eukaryotic transcription mechanism, post transcriptional modification. Characteristics of Genetic code, Translation- tRNA, rRNA, prokaryotic and eukaryotic translation mechanism and post translation modification. **DNA recombination** - Types and models of homologous recombination, evolutionary significance of recombination. **Regulation of gene expression in Prokaryotes** - constitutive and inducible gene regulation, Positive regulation and Negative regulation of Arb Operon, Gal operon and Trp operon- attenuation. **Regulation of gene expression in Eukaryotes** - Regulation of transcription in eukaryotes – Eukaryotic promoters, transcription factors, enhancers, Post transcriptional regulation of gene	13Hrs

Unit 4	**Human Genetics and disorders** Human karyotype, Chromosomal anomalies - Trisomy, Inborn errors of metabolism- Phenylketonuria and Alkaptonuria. Autosomal dominant - Huntington's diseases and Achondroplasia; Autosomal recessive - Sickle cell anemia and Cystic fibrosis; X-linked dominant - X-linked hypophosphatemia and fragile X syndrome; X linked recessive - Colour blindness and Duchenne Muscular Dystrophy and Multi-factorial diseases - Diabetes and Neural tube defects. Mitochondrial diseases in man- LHON and MERRF. Human genetic disorders- Charcot-Marie tooth syndrome, Spino-muscular atrophy, Alzheimer's diseases, Parkinson's disease. Management of genetic disorders: Genetic counselling, Prenatal diagnosis, Calculation of genetic risk, Dermatoglyphics, Pedigree analysis, Gene therapy.	**13Hrs**

Program Name	M.Sc.	Semester	1
Course Title	CELL BIOLOGY AND ADVANCED GENETICS (Practical)		
Course Code	HCP-104	Credits	2
Contact Hours per Week	4	Duration of Exam	4
Summative Assessment Marks	35	Formative Assessment Marks	15

Practicals	1. Culture and maintenance of *Drosophila melanogaster.* 2. Study of Mutants in *Drosophila melanogaster.* 3. Isolation of DNA from Animal tissue/Coconut endosperm. 4. Estimation of DNA content by Diphenylamine method. 5. Estimation of RNA by Orcinol method. 6. Demonstration of Agarose gel electrophoresis of DNA. 7. Karyotyping and preparing idiogram of the banded chromosomes from photographs. 8. Study of Aneuploidy in humans (Down's, Klinefelter's and Turner's syndrome) 9. Pedigree drawing and analysis for inheritance pattern (any two). 10. Study of Mendelian traits in Human. 11. Dermatoglyphics.	**52 Hrs.**

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Program Name	M.Sc.	Semester	I
Course Title	ETHOLOGY		
Course Code	SCT -105	Credits	2
Contact Hours per Week	3	Duration of Exam	3 Hrs
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	ETHOLOGY	39 hrs
Contents		Teaching Hours
	PART-1 : ETHOLOGY	
Unit 1	**Development of behaviour**: History of behavioural studies, Development of behaviour, Development of bird song Causes of behavioural changes during development Analysis of behaviour (ethogram) **Innate behaviour**: orientation, kineses, taxes, motivation, tropism, reflex, and nest building. **Learning and memory**: Learning: sensitization and habituation, associative learning, imprinting, latent and insight learning, reasoning, instrumental conditioning, trial-and-error, discrimination, neural mechanism of learning Memory: nature, types, anatomy of memory, memory storage.	**13Hrs**
Unit 2	**Evolution and Genetics of behaviour**: Genes and behavioural evolution, Evolutionary stable strategies, Cultural transmission of behaviour, Hamilton's rule, kin selection, and inclusive fitness, Altruism, cost and benefits of social life, Sex and sexual selection, Phylogeny of behaviour, Genetic control of behaviour (single and multiple gene effect).	**13Hrs**
Unit 3	**Animal communication**: Types: auditory, visual, vocalization, tactile, chemical signaling, pheromones, vibration, echolocation in bats, bee dance, and infrasound communications (elephant and whales). Signals: cost and benefit of signaling, adaptive value of communication signals. **Social behaviour**: Types of social groups, Advantages of grouping, Social organization: insects (honey bees, ants, termites) and primates, Feeding and mating strategies in animals, Cooperation and conflict in birds and mammals, Evolution of eusocial behaviour.	**13Hrs**

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Program Name	M.Sc.	Semester	II
Course Title	COMPARATIVE ANATOMY (Theory)		
Course Code	HCT 201	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	HCT 201: COMPARATIVE ANATOMY	52hrs
	Contents	Teaching Hours
Unit 1	**Invertebrate Structure and Locomotion Nervous System**: Locomotion mechanisms: Flagellar and ciliary movement in protozoa Hydrostatic movement in Coelenterata, Annelida, Echinodermata Skeletal and integumentary features: Spicules in sponges Exoskeletons in coelenterates, echinoderms, molluscs **Feeding habits of animals:** feeding diversity in insects, filter feeding in lower metazoans, crustaceans, molluscans and echinodermates. Digestive organization in coelenterates and other invertebrate groups. **Neural organization**: Nerve nets (Cnidaria), Ladder-like nervous system (Platyhelminthes), Ganglia and nerve cords (Annelida, Arthropoda, Mollusca). Evolutionary trends in centralization and cephalization	13Hrs
Unit 2	**Invertebrate Organ Systems and Reproduction:** Excretory and osmoregulatory systems across phyla; Respiratory systems in aquatic and terrestrial invertebrates Reproductive systems and strategies: Comparison of male and female organs Developmental patterns and phylogenetic significance of larval forms of arthropods and Echinodermata **Sensory Organs:** Statocysts, ocelli, compound eyes, Chemoreceptors and	13Hrs
Unit 3	**Vertebrate Organ Systems and Integration:** Respiratory organs: structure and function from fishes to mammals. Excretory systems: urinary system structure and comparative overview Circulatory system: heart evolution and vascular organization Nervous system: central and peripheral components Comparative account of sensory organ.	13Hrs
Unit 4	**Vertebrate Integument, Skeleton, and Reproduction:** Integument and derivatives: scales, feathers, hair, nails, claws, horns, teeth. Skeletal system: axial and appendicular skeleton, skull types, jaw suspension. Vertebral column modifications. Reproductive systems and development: Comparative anatomy of male and female organ.	13Hrs

Program Name	M.Sc.	Semester	II
Course Title	COMPARATIVE ANATOMY (Practical)		
Course Code	HCP-201	Credits	2
Contact Hours per Week	4	Duration of Exam	4
Summative Assessment Marks	35	Formative Assessment Marks	15

Practicals	COMPARATIVE ANATOMY	52 Hrs
	1. Computer based study of artery, vein, lung, kidney, oesophagus, stomach, intestine, liver, testis and ovary of frog /fish /reptiles/ mammals. 2. Mounting of Gills (tilapia fish), Tracheal gills (mosquito larvae) 3. Specimens of filter feeding species-Metazoa, Crustacea, Mollusca and Echinodermata 4. Study of *Naupilus, Zoea* and Mysis larvae. 5. Types of feathers, beaks and feet of birds 6. Dissection: Reproductive system of male and female cockroach 7. Dissection: Nervous system of silkworm larva and adult cockroach 8. Demonstration of skeletal muscle fibre types. 9. Skull of reptiles, birds and mammals. 10. Demonstration of 3D morphing of skull / bones using interactive anatomy platforms suggested(BioDigital or sketch fab) and its application.	

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Program Name	M.Sc.	Semester	II
Course Title	ANIMAL PHYSIOLOGY (Theory)		
Course Code	HCT-202	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	Animal physiology	52 hrs
Contents		Teaching Hours
Unit 1	**CELLULAR PHYSIOLOGY** **Homeostasis:** Positive and negative feedback. **Thermoreguation**: General patterns of acclimation, Precht and Prosser pattern of temperature tolerance, temperature regulation in poikilotherms, homeotherms and heterotherms, and their mechanisms of survival; Role of brown fat in temperature regulation. Cold death, cold resistance, heat death; Torpor, hibernation and aestivation. **Osmoregulation:** Concepts of Osmoregulation, mechanism of ionic balance in freshwater fishes, elasmobranchs, eels, salmon and teleost's. Osmo-regulators and osmo-conformers. Water balance in turtle, camel and man. Mechanism of thirst.	13Hrs
Unit 2	**Digestive System**: Digestion in animals, Human Digestive System, Digestion and adsorption of proteins, carbohydrates and lipids and role of gastrointestinal hormones in digestion, Role of dietary fibers in digestion, Energy balance and BMR. Standard metabolic Rate (SMR) and its relation to body size and growth. Ruminant and non-ruminant digestive patterns, Endo parasitism, Role of gut microbiota in health.	13Hrs
Unit 3	**Cardiovascular:** Blood and body Fluids: composition of blood, Extrinsic and intrinsic pathways of coagulation, Anti-coagulants. Neurogenic and myogenic heart, Human Heart, Regulation of arterial blood pressure. Electrical activity of Heart, Cardiac cycle, Regulation of Heart Rate, Blood Vessels, Capillary Exchange and Electrocardiogram. **Respiration:** Mechanism of respiration in vertebrates; oxygen curves (Bohr effect), Respiratory volumes and transport of respiratory gases, physiology of high altitude and deep-sea diving.	13Hrs
Unit 4	**Excretion:** Nitrogenous wastes in animals ammonotelic, ureotelic, Uricotelic and formation of ammonia, urea, and uric acid. Overview of urine formation in mammals and its regulation, fluid volume, blood pressure, waste elimination, micturition, Buffering mechanisms by body fluids: regulation of water balance, electrolyte balance, acid-base balance. renin angiotensin aldosterone system RAAS mechanism. **Reproduction**: Spermatogenesis, Oogenesis, Reproductive cycles, ovulation, implantation, gestation, parturition and lactation and their hormonal regulation.	13Hrs

Program Name	M.Sc.	Semester	II
Course Title	ANIMAL PHYSIOLOGY (Practical)		
Course Code	HCT-202	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Practicals	1. To determine the rate of bacterial fermentation of different carbohydrates using Lactobacilli. 2. Estimation of glycogen in liver and muscle. 3. Determination of Iodine number of fats to evaluate the bioactive value. 4. Determination of excretory products in ammonotelic, ureotelic and uricotelic animals. 5. Effect of cold acclimation on serum copper levels in fresh water crabs. 6. Active transport of glucose through intestinal wall. 7. Electrocardiogram and its interpretation. 8. Effect of gentle exercise and posture on Blood pressure. 9. Estimation of Hb, ESR and blood clotting time 10. Determination of cell fragility. 11. Calculation of BMR and BMI calibrating height and weight parameters. 12. Histology slides (T.S) of testis, ovary, (for observation of spermatogenesis, oogenesis, graafian follicle, corpus luteum). Estrous cycle-stages.	**52 Hrs**

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Program Name	M.Sc.	Semester	II
Course Title	VECTOR BIOLOGY AND PARASITOLOGY (Theory)		
Course Code	HCT-203	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	VECTOR BIOLOGY AND PARASITOLOGY	52 hrs
	Contents	**Teaching Hours**
Unit 1	**INTRODUCTION TO VECTOR BIOLOGY** Scope and importance of vectors. Origin and evolution of vectors Historical perspective – epidemics, scientists involved in the discovery of vectors and Pathogens of communicable diseases. Pathogens and communicable diseases Epidemiology, bio-ecology, life cycle of biological and mechanical vectors Vector-host-parasite interactions, host-pathogen interaction and insects transmitting Bacteria and Viruses.	**13Hrs**
Unit 2	**BIOLOGICAL VECTORS AND COMMUNICABLE DISEASES** Epidemiology and biology of vectors and pathogens, Transmission cycles and symptoms of Yellow Fewer, Anthrax, Dengue, Chikungunya, Japanese Encephalitis and KFD. Cultural control methods, chemical methods, genetic and environmental methods, biological methods to control biological vectors. Insecticide resistance in biological vectors, Drug resistance in viral and bacterial pathogens. Covid-19 Pandemics: Epidemiology of corona virus and its mutants. Importance of education, awareness and community participation to control biological vectors.	**13Hrs**
Unit 3	**MECHANICAL VECTORS AND THEIR TRANSMITTING DISEASES** House flies, Cockroaches and Bedbugs - life cycles and their vectorial nature. Transmission of Dysentery, Diarrhea, Typhoid, Cholera, Epidemic conjunctivitis and skin infections. Ticks: Morphology and life history of *Argas* and Fleas. Cultural control methods, chemical methods, genetic, environmental methods, biological methods to control mechanical vectors and their transmitting diseases. Insecticide resistance in mechanical vectors. Importance of education, awareness and community participation in the control of mechanical vectors and their diseases.	**13Hrs**

Unit 4	**INTRODUCTION TO PARASITES** Parasites, distribution, origin and evolution. Parasitism. Types of parasites, ecto-parasites, endo-parasites and their adaptations. Pathogenic micro-organisms, brief outline and classification of parasitic protozoan's: *Entamoeba, Balantidium, Giardia, Trichomonus, Plasmodium*, *Leishmania* and *Trypanosoma* and their diseases. *Malaria, Filariasis, Leishmaniasis* and *Schistosomiasis* diseases and their control. Nematodes: *Ancylostoma, Ascaris, Enterobius* and *Wuchereria*. Control measures, diagnosis and therapy for nematode borne diseases.	**13Hrs**

Program Name	M.Sc.	Semester	II
Course Title	VECTOR BIOLOGY AND PARASITOLOGY (Practial)		
Course Code	HCP-203	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Practicals		52 Hrs.
	Identification and economic importance of parasites and vectors: 1. Slides/museum specimens of selected parasites of representative groups of protozoans and helminths (*Plasmodium*, *Trypanosoma*, *Leishmenia*, Roundworm (male & female), Hookworm, Filarial worm. 2. Vectors: *Anopheles*, *Culex* and *Aedes* speices (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug. 3. Ticks and mites: *Argas, Sarcoptes, Psoroptes* , *Hemaphysalis spinigera* 4. Demonstration of life cycle stages of mosquitoes. 5. Dissection and mounting of mouth parts: mosquito/housefly. 6. Analysis of abiotic factors affecting larvae/adult survival 7. Demonstration of ametabolous, hemimetabolous, and holometabolous conditions 8. Residue analysis of common pesticide (Colorimetric methods) 9. Characterization of mosquito breeding habitats. 10. Field visit to research institutes and report writing.	

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Program Name	M.Sc.	Semester	II
Course Title	ECONOMIC ZOOLOGY (Theory)		
Course Code	HCT-204	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	ECONOMIC ZOOLOGY	52 hrs
	Contents	**Teaching Hours**
Unit 1	**BENEFICIAL INSECTS** Scope and importance of economic zoology. Apiculture: Honeybee species, Bee forage, Pollen calendar, Modern beekeeping activity, migratory beekeeping, bee hive products. Honeybee diseases, their control and management. Lac culture: Importance, Lac insects, host plants, Lac culture and by products. Sericulture: Importance, types of silkworms, silkworm races, Life cycle of *Bombyx mori*, Modern Silkworm Rearing methods. Grainage activity, Bivoltine and multivoltine varieties. Silkworm diseases and their control. Pests and predators of silkworms.	**13Hrs.**
Unit 2	**HARMFUL INSECTS** Host plant interactions: Origin of insect Pests. Pests of cereals and pulses: Rice, Wheat, Jowar and Zea mays, Green gram, Bengal gram (one pest from each category). Pests of millets and commercial crops: Finger millet, Pearl millet, Cotton, coffee, tea (one pest from each category). Venomous insects and chemical composition of venom and its applications Forensic entomology. IPM (Integrated pest management) and its scope.	**13 Hrs**
Unit 3	**FISHERIES** Fisheries resources of India: Scope and importance of coastal, deep sea and inland fisheries. Fresh water and marine aquaculture. Culturable organisms: Shell fishery: Prawn, Pearl and Oyster culture. Fin fishery: Intensive freshwater fish culture: Carps and Cat fishes, Integrated Fish farming. Composite and polyculture. Ornamental fish, algal culture and sea weeds.	**13 Hrs**

Unit 4	**ANIMAL FARMING** Poultry: Poultry breeds, hatcheries, broiler, layers rearing, duck and emu rearing. Poultry diseases and their management and poultry by products. Dairy: Dairy breeds, dairy farming, dairy management and by products of dairy. Laboratory Animal Science: General principle of breeding and maintenance of small laboratory animals – Rat, Mouse. CPCSEA Guide lines and Animal Ethics Committee. Piggery: Pig species, rearing and bi products. Sheep and Goat farming.	**13 Hrs**

Program Name	M.Sc.	Semester	II
Course Title	ECONOMIC ZOOLOGY (Practical)		
Course Code	HCP-204	Credits	4
Contact Hours per Week	4	Duration of Exam	3
Summative Assessment Marks	70	Formative Assessment Marks	30

Practicals	**Apiculture** Study of honeybee species (*Apis cerana* and *A. mellifera*) and honeybee colony members (queen, drone & worker honeybee). Mounting of mouth parts, sting apparatus and pollen basket from honeybee worker. Analysis of honey quality: Physical and biochemical parameters. **Sericulture** Life cycle of Silkworm; bivoltine and multivoltine cocoons, non- mulberry silkworm cocoons, Dissection of silkworm – Silkgland; Demonstration of tensile strength of silk fibres; silkworm Pest- Uzi fly. **Harmful insects** Insect pests: Rice, coconut, coffee, cotton, millet and Pulses pests. **Rice:** *Nilaparvata lugens* (Brown planthopper); ***coconut***: *Oryctus rhinoceros* (Rhinoceros beetle); ***mango***: *Sternochetus mangiferae* (Mango Seed Weevil); ***coffee***: *Xylotrechus quadripes* (Coffee white stem borer); ***cotton***: *Helicoverpa armigera* (American Bollworm); **polyphagous pests**: White grubs, *Holotrichia* sp., mealybugs. *Sitophilus oryzae* (Rice weevil), *Callosobruchus maculates, C. chinensis* (Pulse beetles). Venomous insects (wasps) and insects of Forensic Science (Flesh fly). **Poultry & Dairy** Study of Dairy and Poultry breeds **Aquaculture** Commercially important inland and marine fishes, ornamental Fishes and pearl culture. Fixing and presentation of dead insects by Plastination Technique. **Field Visits (any one)** : Fish Farm, Sheep and goat farms, Sericulture farms, Apiculture and Lac culture Farms, Dairy and Poultry Farms and Visit to Animal House.	**52 Hrs.**

REFERENCES:

1. Anonymous. (2000). Moriculture. FAO Manual, Vol. 1. WHO, Rome, Italy.
2. Anonymous. (2000). Silkworm rearing. FAO Mannual, Vol. 2. WHO, Rome, Italy.
3. Arumugam, N., Murugan, T., Johnson Rajeswar, J. and R. Ram Prabu. (2016.). Applied Zoology. Saras Publication, Nagercoil, India.
4. Cedric, G. (1995). Entomology. Plenum Press, New York, USA and London, UK.
5. Eckert, J.E. and F.R. Shaw. (1960) Beekeeping. The Macmillan Co. New York, USA
6. Fenemore, P.G. (1992). Applied Entomology. Wiley Eastern Ltd. New Delhi, India.
7. Gullan, P.J. and Cranston (1994). The Insects: An outline of Entomology. Chapman and Hall, London.
8. Mani, M.S. (1982). General Entomology. Oxford and IBH Publishing Co. New Delhi, India.
9. Pedigo, L.P. (2002). Entomology and Pest Management. Prentice Hall of India Pvt. Ltd. New Delhi, India.
10. Shukla, G.S. and V.B. Upadhyay. (2007). Economic Zoology. Rastogi Publications, Meerut, India.

Program Name	M.Sc.	Semester	II
Course Title	BIOSTATISTICS AND COMPUTATIONAL BIOLOGY (Theory)		
Course Code	SCT-205	Credits	2
Contact Hours per Week	3	Duration of Exam	3 Hrs
Summative Assessment Marks	70	Formative Assessment Marks	30

Course Title	BIOSTATISTICS AND COMPUTATIONAL BIOLOGY	39hrs
	Contents	**Teaching Hours**
Unit 1	**Statistics in biology:** Importance of statistics in biology, samples and populations, variables in biology, accuracy and precision, collection and condensation of data, types of biological data and graphical representation of the data (histogram/ogive curve/frequency curve). **Descriptive Statistics:** Measures of central tendency; mean, mode and median, standard deviation, Concept of variation, measure of variation such as variance, coefficient of variation **Regression and correlation analysis, curve fitting:** Simple linear regression equation and testing significance of regression, data transformation in regression, hypothesis about correlation coefficient, multiple regression equation, polynomial regression and curve fitting. **Hypothesis testing**: Tests of simple hypothesis using normal and t-distribution. Types of errors. Test of significance: parametric and non-parametric tests, T-tests, Chi-square test for goodness of fit. F-test of comparing variance, one-way ANOVA. Mann-Whitney test, Kruskal- Wallis test.	**13Hrs**
Unit 2	**Introduction to Bioinformatics:** Branches of Bioinformatics, applications of Bioinformatics, Biological databases: Classification, Biological data retrieval systems. **Sequence comparison and Database Search:** Global alignment, Pair wise alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods. Progressive alignment, iterative methods, pattern searching in DNA and protein sequences, PAM matrices. Identification of peptide finger print by nano LC-MS/MS database searching by using MASCOT and OMSSA. Introduction to microarray technology. **Molecular phylogenetics:** Application of phylogenetic trees, basic terminology-taxa, taxonomy, root, leaf, node, branch, clad, dendrogram, rooted tree, unrooted tree and scaled tree. **Molecular Clocks:** Basic steps of phylogenetic tree construction, Data based methods-UPGMA, NJ algorithm, Character based methods-Maximum parsimony method, maximum likelihood method, validating phylogenetic methods-bootstrapping and jack-knifing, study of Phylip, NJ plot, Clustal X softwares.	**13Hrs**

Unit 3	**Protein structure prediction:** Chou Fasman method- p(a), p(b) and p(turn) propensities, Garnier Osguthorpe and Robson(GOR) method, Threading, Homology modeling, CASP, Abinitio prediction, Molecular dynamics & conformational energy calculation, Prediction of function. **Genomics and proteomics databases and tools** **Nucleic acid sequence databases and tools:** GenBank, Database of genomic structural varioanton (dbVar), Database of genotypes and Phenotypes(dbGaP), Database of short genetic variations (dbSNP), Gene Expression omnibus (GEO) database, Genome Reference Consortium (GRC), Online Mendelian Inheritance in Man(OMIM), BLAST vs FASTA, file formats-FASTA, Comparative Gene Viewer (CGV), Genetics Computer Group(GCG), Genscan and ClustalW. **Protein sequence databases and tools:** UniProtKB/Swiss-Prot, Interpro, PIR, PDB, SCOP & CATH, ProDom, database of Protein clusters, PFAM; Protein visualization tools- Swiss PDB Viewer, Pymol. Expasy proteomic tools: AA CompIdent, MultiDent, Peptide Mass etc. **Applications of Genomics and Proteomics:** Pharmacogenomics, Genomics in Forensic analysis, agriculture, Human health,	**13Hrs**

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1. Claverie J. M., Notredame C. (2007). Bioinformatics for Dummies, 2nd Ed.: Wiley Publishing, Inc., New York, USA
2. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis, 2nd Ed.: Cold Spring Harbor Laboratory Press, New York, USA
3. Brown T. A. (2007). Genomes 3: Garland Science Publishing, New York.
4. Malcolm A, Campbell and Laurie J Heyer. (2004). Discovering Genomimcs, Proteomics and Bioinformatics: Low Price edition. Pearson Education, Inc.
5. Fall, C P, Marland, E S, Wagner, J M, Tyson, J J. (2002). Computational Cell Biology: Springer.
6. Moody, G. (2004). Digital code of life: how bioinformatics is revolutionizing science, medicine, and business: John Wiley & Sons.
7. Zvelebil, M J, & Baum, J O. (2008). Understanding bioinformatics: Garland Science.

Scheme of Examination for I, and II, Semester (M. Sc. Zoology) Rigorous Assessment and Evaluation: Formative and Summative Assessments

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Test – 1	**10**
Test – 2	**10**
Seminars/Presentations/Assignment	**05**
Attendance	**05**
Total	**30**
Formative Assessment for Practical's	
Assessment Occasion / Type	**Marks**
Test – 1	**10**
Record	**05**
Total	**15**

PATTERN OF SEMESTER END EXAMINATION QUESTION PAPER

SECTION – A	Comprises 4 Compulsory questions. Each question carries 2 marks	**(4 x 2 = 08 Marks)**
SECTION – B	Comprises 1 question with internal choice from each unit. Each question carries 8 marks	**(4 X 8 = 32 Marks)**
SECTION – C	Comprises 1 question with internal choice from each unit. Each question carries 15 marks	**(2 X 15 = 30 Marks)**
	TOTAL	**70 Marks**

PATTERN OF SEMESTER END - PRACTICAL EXAMINATION QUESTION PAPER

SECTION – A	Comprises 1 major experiments with choice. Each question carries 12 marks	**(1 X 12 = 12 Marks)**
SECTION – B	Comprises 1 Minor experiments with choice. Each question carries 8 marks	**(1 X 8 = 8 Marks)**
SECTION – C	Comprises of Spotters/specimen	**(10 Marks)**
SECTION – D	Viva	**(05 marks)**
	TOTAL	**35 Marks**

THANK YOU