M.Sc. ZOOLOGY SYLLABUS

Course Structure Under

Choice Based Credit System (CBCS)

(Effective from-2024-2025)

MAHARAJA SRIRAM CHANDRA BHANJA DEO UNIVERSITY
SRIRAM CHANDRAVIHAR, TAKATPUR, BARIPADA-757003

M.Sc. ZOOLOGY EXAMINATION

SEMESTER SYSTEM

(Choice Based Credit System)

1. The P.G. Programme is of two years duration comprising four semesters of theory and laboratory works.
2. One course of 2 credits on Indian Knowledge System is compulsory for all in semester - I.
3. A non-credit course on Life-Skills will be given in semester - I.
4. There will one open elective paper in semester-II. This paper is offered for other departments of the university and is of five units and five credits.
5. Each student has to carry out project work from semester-III and submit a dissertation at the end of Semester-IV.
6. The student can opt one elective course out of two offered papers in III & IV semesters.
7. Each course will be evaluated through a continuous examination system comprising quiz (10 marks of 10 minutes), assignment (10 marks), Internal Assessment Examinations (IAE) (20 marks of 60 minutes), and End Semester Examination (60 marks of 3 hours duration).
8. Each Semester will have one Practical Paper of 100 marks and an examination will be of 6 hours duration.
9. A student has to take a MOOCS course from Swayam Portal of at least 3 credits in Semester – III and has to pass before the completion of the P. G. programme.
10. For passing semester examinations a candidate must secure a minimum of 40% marks in practical and 30% marks in theory papers.
11. A student securing cumulative Grade Point Average (CGPA) 5.5 shall be declared as passed the Post-Graduation Examination.
12. Calculation of percentage of mark from CGPA(CGPA–0.75) X10 =Percentage of mark

Example: {7.85 (CGPA) – 0.75} ×10 =7.10 × 10=71.0%

13. A candidate securing at least 6.75 CGPA (minimum 60% marks in aggregate) shall be declared as First Class. The First Class First student shall receive the University Gold Medal in the concerned regular P.G. Course provided that he/she has cleared all the papers of the semester examinations in one chance.
14. If candidate passes all the four semester examinations, he/she will be declared to have passed the M.Sc. examinations in Zoology, provided further that in no case a candidate shall be allowed to appear any Semester Examination after twice the duration of course period.
15. In order to be eligible to appear at the University examination, a student has to secure atleast 75% of attendance.

M.Sc. Zoology–Course Structure under CBCS
(From the session: 2024-25)

Program Specific outcomes M.Sc. Zoology

1. Understanding the diversity of animals and the importance of classifying animals.
2. Develop a deep understanding on key concepts of Biochemistry, Cell Biology, Developmental Biology, Molecular Biology, Immunology, Physiology and Genetics of animals.
3. Identifying the economic importance of animals in day-to-day life and their use for commercial purposes.
4. Comprehending the importance and the intimate association of environment and natural resources with human beings.
5. Deciphering the diversity of microbial life and the defense mechanisms in human body to deal with microbial infections.
6. Gaining knowledge of various tool and techniques used for performing basic experiments in Zoology.

M.Sc. Zoology–Course Structure under CBCS

(From the session: 2024-25)

The entire P.G. Syllabus of Zoology is spread over four semesters consisting of 100 Credits of which 95Credits are assigned to the **Core Courses** and the remaining 5 Credits are assigned to **open** to be offered in Semester-II.

Course code	**Course title**	**Credit**	**Marks**				**Total**
			Internal assessment			**End semester**	
			Quiz	**Assignment**	**Mid-term**		
ZO-101	Biosystematics and Biodiversity	5	10	10	20	60	100
ZO-102	Structure and function in Non-chordates	5	10	10	20	60	100
ZO-103	Physiology and endocrinology	5	10	10	20	60	100
ZO-104	Cell Biology & Genetics	5	10	10	20	60	100
ZO-105	Practical pertaining to above papers	5	30			70	100
ZO-106	Indian Knowledge System (IKS)	2	20			30	50
ZO-107	Life Skill	Non-Credited					
TOTAL		***27***	***210***			***340***	***550***
ZO-201*	Applied Zoology	5	10	10	20	60	100
ZO-202	Developmental Biology	5	10	10	20	60	100
ZO-203	Biostatistics, Techniques and Tools in Biology	5	10	10	20	60	100
ZO-204	Microbiology, Immunology and Toxicology	5	10	10	20	60	100
ZO-205	Practical pertaining to above papers	5	30			70	100
ZO-206**	Fundamentals of Cell Biology	5	10	10	20	60	100
TOTAL		***30***	***230***			***370***	***600***
ZO-301	Environmental Biology and Natural Resource Management	5	10	10	20	60	100
ZO-302	Biosystematics and Taxonomy **Elective I (A)** Cell and Molecular Biology **Elective I(B)**	5	10	10	20	60	100
ZO-303	Biochemistry	5	10	10	20	60	100
ZO-304	Practical pertaining to above papers	5	30			70	100
ZO-305***	Swayam MOOCS (As per availability)	Not less than 3	As per the course			As per the course	100
TOTAL		***23***	***150(+ MOOCS)***			***250(+ MOOCS)***	***500***
ZO-401	Chordata, Comparative Anatomy, Evolution &Animal Behavior	5	10	10	20	60	100
ZO-402	Biosystematics and Taxonomy **Elective II(A)** Cell and Molecular Biology **Elective II(B)**	5	10	10	20	60	100
ZO-403	Practical pertaining to above papers	5	30			70	100
ZO-404	Project work and Viva	5	-			100	100
TOTAL		***20***	***110***			***290***	***400***
GRAND TOTAL		**100**	**605**			**1445**	**2050**

Core Elective: The student can opt for any one out of Biosystematics and Taxonomy (**Group –A**)/ Cell and Molecular Biology **Group–B** groups for Elective-I and Elective-II.

***Skill Based Paper**

****Open Elective:** Students from other departments can opt for it.

***** **Swayam MOOCS -**– Fundamentals of Protein Chemistry - for this year.

INSTRUCTION FOR CONDUCTING INTERNAL AND END-TERM EXAMINATIONS

A. Internal Examination

1. 1st quiz - End of Unit-I
2. 2nd Quiz- End of Unit –II
3. Midterm-End of Unit-III (covering all three units), having 6 questions compulsory with 2 marks each from all three units and three questions of 4 marks each from which 2 to be answered covering all 3 units.
4. Assignment- End of Unit-IV
5. A teacher can conduct three quizzes to consider the average of best two and also two assignments to consider the best one from among those.
6. Quizzes/Assignment can be conducted without prior notice. But a notice in general can be served to students to make them aware of quizzes without notice.
7. The questions in quizzes may be MCP but sets may be prepared for the class to avoid cheating in the class/team answering. Or. The question may be with expected one-line answer.
8. There shall be at least 10 questions and time should not exceed 10 minutes.
9. Home assignment may be done through class room presentation with one/two days prior assignment. It should not have unlimited/two weeks/one-week time for submission of answers.

B. End Term

(a) There should be three Groups.

Group-A: 5 questions of 2 mark each which is compulsory,

Group-B: 4 questions to be answered out of 5 with 5 mark each.

Group-C: 3 questions to be answered out of 5 with 10 marks each

(b) Each group must have one question from each unit. Questions are to be easy, little difficult and difficult type.

(c) For midterm open book system may be adopted, provided questions encourage critical thinking or interpretation. But it depends on the teacher concerned with seriousness for conducting it.

C. Attendance

75% attendance is a must and there is no medical certificate provision. This is to be ensured as it is statutory provision.

Semester I

PAPER ZO-101: BIOSYSTEMATICS AND BIODIVERSITY

100 (10+10+20+60) Marks

UNIT-I
Definition and basic concepts of biosystematics and taxonomy; Stages and importance of taxonomy; Newer trends in taxonomy (Morphological, Embryological, Ecological, Behavioural, Cytological Biochemical approaches).

UNIT-II
Concept of species (Typological, Nominalistic, Biological, Evolutionary, Recognition species concepts) and its criticism; Species and kinds of species, Subspecies; Nomenclature and types: Basic idea about the international Code of Zoological Nomenclature (ICZN).

UNIT-III
Zoological classification: Kinds of classification (Phonetic, Natural, Phylogenetic, Evolutionary, Omnispective). Future of classification.Components of classification, Classification of nonchordates and chordates.

UNIT-IV
Concept of biodiversity, Biodiversity hot spots, Biogeography: Concept of biogeography, Zoogeographical Realms of the World (Palaearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian).

UNIT-V
Protected areas: National Park and Sanctuary; Important National Parks of India; Wildlife diversity in National Park & Sanctuaries of Odisha. Evolution of biodiversity indices (Shannon-Weiner Index, Dominance Index, Similarity and dissimilarity indices, Association index).

Course Outcomes

1. Understanding the need for classifying animals and the approaches followed for classification.
2. Interpreting the concepts of species, biodiversity, and biogeography.

Recommended Books

1. Kato, M.The Biology of Biodiversity. Springer.
2. Avise, J.C.Molecular Markers, Natural History, and Evolution. Chapman & Hall, New York.
3. Wilson, E.O.Biodiversity. Academic Press, Washington.
4. Simpson, G.G.Principles of Animal Taxonomy. Oxford & IBH Publishing Co.
5. Mayr, E.Elements of Taxonomy.
6. Wilson, E.O.The Diversity of Life (The College Edition). W.W. Norton & Co.
7. Tikader, B.K.Threatened Animals of India. Zoological Survey of India (ZSI) Publication, Calcutta.
8. Kapoor, V.C.Theory and Practices of Animal Taxonomy. Oxford & IBH Publishing Co.
9. Cox, C.B., & Moore, P.D.Biogeography: An Ecological and Evolutionary Approach. John Wiley & Sons.

PAPER ZO-102: STRUCTURE AND FUNCTION IN NONCHORDATES

100 (10+10+20+60) Marks

UNIT-I

Body organization: Origin of body plan; Body cavity: Acoelom, Pseudocoelom, Coelom (schizo- and enterocoelous); Fate of Blastopore: Protostome, Deuterostome;Classification and general characteristic features of Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata

UNIT-II

Hydrostatic movement in Coelenterata, Annelida and Echinodermata; Patterns of feeding and digestion in lower metazoan (Porifera, Coelenterata and Helminthes), filter feeding in Polychaeta, Mollusca and Echinodermata.

UNIT-III

Organs of respiration in non-chordates: Gill, Book lungs, Trachea and mechanism of respiration; Nephridia, Malpighian tubules as organs of excretion, mechanisms of excretion, osmoregulation.

UNIT-IV

Primitive nervous system in Coelenterate and Echinodermata; Advanced nervous system in Annelida, Arthropoda and Mollusca; Trends in neural evolution.

UNIT V

Minor phyla and their significance. Organization and general characters of Ctenophora, Sipuncula and Rotifera; Strategies and evolutionary significance of larval forms of crustaceans and Helminthes.

Course Outcome

1. Understanding the importance of body forms in classifying non-chordates.
2. Comprehending the diversity of organs of respiration, excretion, and nervous systems in non-chordates.
3. Knowing the diversity of major and minor phyla of non-chordates.
4. Deciphering the significance of non-chordate larval forms.

Recommended Books

1. Brusca and Brusca. Invertebrates, Sinauer Associates Inc, 3rd edition
2. Hyman, L.H.Invertebrates (Volumes I to VIII). McGraw-Hill Co., New York.
3. Barrington, E.J.W.Invertebrate Structure and Function. Thomas Nelson and Sons Ltd., London.
4. Barnes, R.D.Invertebrates. 3rd Edition, W.B. Saunders Co., Philadelphia.
5. Sedgwick, A.Student Textbook of Zoology (Vol. I and Vol. II). Central Book Depot, Allahabad.

PAPER ZO-103: PHYSIOLOGY AND ENDOCRINOLOGY

100 (10+10+20+60) Marks

UNIT-I

Physiology of digestion and mechanism of absorption of digested materials; Mechanism of breathing and gaseous exchange, Transport of respiratory gases, Bohr's effect, Chloride shift, Root's effect, Respiratory pigments in animals.

UNIT-II

Haemopoiesis, Blood clotting, Blood volume, blood volume regulation, Haemodynamics, Cardiac cycle and its regulation; Mechanism of urine formation, counter current multiplier mechanism and osmoregulation in mammals; Mechanism of thermoregulation in vertebrates; Stress and adaptation.

UNIT-III

Contractile elements and muscle contraction; Neurophysiology; Action potential, synaptic transmission and maintenance of nerve function, Neuroanatomy of the brain,and spinal cord, central and peripheral nervous system; Electric organ; Bioluminescence.

UNIT-IV

Structural organization and functional aspects of endocrine glands (Pituitary, Pancreas, Adrenal, Thyroid); Hormones of Gastro-intestinal tract; Neuroendocrine system and Neurosecretion; Hormones and behaviour: Effect of hormones on growth and development; Hormones and reproduction (Hormones of menstrual and estrous cycles, pregnancy, parturition and lactation).

UNIT-V

Biosynthesis and secretion of hormones: Biosynthesis of steroid, amino acid derived and simple peptide hormones; General characters of hormones; Mechanism of hormone action: Nature of hormone action, hormone receptors; Feedback regulation of hormonal secretion; Hormones and homeostasis; Hormonal regulation of carbohydrate, protein and lipid metabolism.

Course Outcomes

1. Understanding the basic mechanisms of digestion, respiration, excretion, muscle contraction, and nerve conduction.
2. Comprehending the organization of endocrine glands in the body and the neuroendocrine system.
3. Interpreting the involvement of hormones in body physiology and the mechanisms of their action.

Recommended books

1. Schmidt-Nielsen, K. Animal Physiology: Adaptation and Environment. Cambridge University Press.
2. Dejours, P., Bolis, L., Taylor, C.R., & Weibel, E.R. (Eds.) Comparative Physiology: Life in Water and on Land. Liviana Press, Padova, Italy.
3. Guyton, A.C. Textbook of Medical Physiology.
4. Best, C.H., & Taylor, N.B. The Human Body.
5. Samson,W.E.,& Wright, S. Applied Physiology.

PAPER ZO-104: CELL BIOLOGY AND GENETICS

100 (10+10+20+60) Marks

UNIT-I

Structure and functions of Plasma membrane: Chemical composition of membrane, structure and function, functions of membrane proteins and lipids; Membrane fluidity: Dynamic nature of the plasma membrane, movement of substances across the cell membrane. Cytoskeleton and intracellular protein traffic: Microtubules and microfilaments-structure and dynamics, Role of kinesin and dynein in intracellular and axonal transport

UNIT-II

Cell signaling: Signal molecules (hydrophobic and hydrophilic), Receptors (cell surface and intracellular), Cell surface receptors (ion linked receptors, G-protein linked receptors and enzyme linked receptors), Types of intercellular signaling (membrane contact, paracrine, endocrine, synaptic and autocrine), Signaling from plasma membrane to nucleus, Second messenger, Receptor Tyrosine kinases, MAP kinase pathway, Convergence, Divergence and crosstalk among signaling pathways, Cell adhesion molecules (selectin, intergrin and cadherin).

UNIT-III

Cell cycle and genomic organization: Cyclins and cyclin dependent kinases, Regulation of CDK-cyclin activity, Hierarchy in chromosomal and gene organization, Chromosomal organization of genes and non-coding DNA, DNA packaging in Eukaryotes.

UNIT-IV

Mendel's Study of Heredity, Applications of Mendel's Principles, Mendelian Principles in Human Genetics, Concept of gene: Allele, multiple alleles, pseudo allele, complementation tests, Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

UNIT-V

Pedigree analysis, lod score for linkage testing, karyotypes, Polygenic inheritance, Structural and numerical alterations of chromosomes**:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.Inheritance of Mitochondrial genes, maternal inheritance.

Course Outcome

1. Understanding the structure and function of the cell membrane and cytoskeleton.
2. Understanding the various signalling pathways necessary for gene expression.
3. Concepts of Mendelism, genes, and maternal inheritance.
4. Concepts of karyotyping, mutations, and their genetic implications.

Recommended Books

1. Darnell, J., Lodish, H., & Baltimore, D. Molecular Cell Biology. Scientific American Books, Inc., USA.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., & Watson, J.D.Molecular Biology of the Cell. Garland Publishing Inc., New York.
3. Lewin, B.Genes VII. Oxford University Press, Oxford.
4. Glick, B.R., & Pasternak, J.J.Molecular Biology.
5. Gupta, P.K.Cell and Molecular Biology (Latest Edition). Rastogi Publications.
6. Purohit, S.S.Biotechnology: Fundamentals and Applications (Latest Edition).
7. Dabre, P.D.Introduction to Practical Molecular Biology. John Wiley & Sons Inc., New York.
8. Sambrook, J., Fritsch, E.F., & Maniatis, T.Molecular Cloning: A Laboratory Manual.
9. Meyers, R.A. (Ed.)Molecular Biology and Biotechnology: A Comprehensive Desk Reference. VCH Publishers, Inc., New York.
10. Old, R.W., & Primrose, S.B**.**Principles of Gene Manipulation: An Introduction to Genetic Engineering.

PAPER ZO-105: PRACTICAL

100 (30+70) Marks

Course Outcomes

1. Gaining practical knowledge of identifying non-chordates.
2. Comprehending the basic structure of endocrine glands through slides.
3. Attaining practical knowledge of blood physiology, karyotyping, Mendelian principles, mitosis, and meiosis.

Experiments

1. Taxonomic study of museum specimens on non-chordates.
2. Histological slides on endocrine glands.
3. Total count of RBC and WBC in human blood.
4. Differential count of WBC in human blood.
5. Estimation of haemoglobin in human blood.
6. Blood group determination: Demonstration of antigen-antibody interaction by a suitable method.
7. Demonstration of Barr bodies in human buccal mucosa cells.
8. Temporary aceto-carmine squash preparation of chromosomes of grasshopper/onion root tip.
9. Permanent slides of different phases of cell division.
10. Verification of Mendel's laws using suitable models.
11. Preparation of a karyotype.
12. Problems related to genetics.

Sessional preparation

Seminar presentation report/ Study tour report/Practical record

PAPER ZO-106: INDIAN KNOWLEDGE SYSTEM

50 (20+30) Marks

Unit I: Foundation of Indian Knowledge System

- Definition and scope of Indian Knowledge System (IKS).
- Relevance of IKS in modern academia.
- Sources of IKS: Veda, Upanishads, Mahabharata, Ramayana.
- Bharatdarshan: Natural resources of India (Rivers, Vegetation, Animals, Mineral wealth).
- India's contribution to Science and Technology.

Unit II: IKS in Animal Science

- Traditional knowledge methods of breeding livestock and native animal breeds.
- Importance of genetic diversity and resilience in indigenous breeds.
- Concepts of disease prevention, diagnosis, and treatment as described in ancient texts like Charaka Samhita and Sushruta Samhita.
- Use of medicinal herbs, natural remedies, and holistic health management for animals.

Unit III: IKS in Health Sciences

- Core principles of Ayurveda: Tridosha (Vata, Pitta, Kapha).
- Historical evolution of medicinal practices in ancient India.
- Preventive health and wellness through diet, lifestyle, and seasonal routines.
- Role of yoga in physical fitness.
- Meditation and pranayama for stress management.

Unit IV: IKS in Indian Civilization, Agriculture, and Literature

- Architecture, agriculture trade, and water management during the Harappan Civilization.
- Indian traditional knowledge on environmental conservation.
- Contributions of spiritual leaders: Buddha, Mahavir, Guru Nanak, Sankaracharya, and Vivekananda.
- Indigenous agriculture and biotechnology.

Unit V: Integration of IKS in Modern Context

- Application of IKS in contemporary environmental and sustainability practices.
- Role of IKS in modern health systems and practices.
- Educational value and integration of IKS in today's curriculum.
- Revival and promotion of IKS in modern scientific and technological research.

Course Outcome

1. Understand the relevance of Indian Knowledge Systems in modern zoology and life sciences.
2. Analyze traditional methods of animal breeding and disease prevention.
3. Apply Ayurvedic principles for health and wellness.
4. Explore ancient agricultural practices and environmental conservation methods.

Recommended Books

1. Science and Technology in Ancient India, by B.V. Subbarayappa.

2. Ayurveda and the Mind: The Healing of Consciousness, by Dr. David Frawley.

3. Indigenous Knowledge and Modern Science in India, edited by Anil K. Gupta.

4. Charaka Samhita, translated by P.V. Sharma.

5. Harappan Civilization and Its Writing: A Model for the Decipherment of the Indus Script, by Walter Ashlin Fairservis.

LIFE SKILLS COURSE (30 HOURS)

The Life Skills course is a compulsory course for P.G. students of the MSCB University, Baripada.

Course Objective:

To provide students with a foundational understanding of yoga practices and their application to improve physical health, mental well-being, emotional balance, and overall life skills.

Program Structure:

This is a 30-hours program to be introduced in a semester pattern as a 3-credit course which included two sections like Theory & Practical:

- 10-hours Phase -I (Theory) program spread over 5 consecutive days, 2 hours each day in the first month where the main modules will be covered.
- 20-hours Phase -II (Practical) program spread over 10 consecutive days, 2 hours each day in the 2nd, 3rd & 4th month which will include follow-up sessions spread over next 3 months.

Module 1: Introduction to Yoga (4 hours)

- History & Philosophy of Yoga (1 hour)
  - Origins of Yoga
  - Key yoga texts (Yoga Sutras, Bhagavad Gita, Hatha Yoga Pradipika)
  - Different types and schools of Yoga
- Yoga as a Life Skill (1 hour)
  - Yoga in daily life
  - Yoga for mental clarity, emotional balance, and stress management
- Fundamental Principles (1 hour)
  - The Eight Limbs of Yoga (Ashtanga Yoga)
  - Yamas and Niyamas (Ethical guidelines)
- Setting Intentions (1 hour)
  - The role of intention (Sankalpa) in practice and life
  - Personal goal setting for the course

Module 2: Physical Practice (Asana) (10 hours)

- Foundational Postures (4 hours)
  - Standing postures (Mountain, Warrior series)
  - Seated postures (Easy Pose, Seated Forward Bend)
  - Balancing postures (Tree Pose, Dancer Pose)
  - Backbends (Cobra, Bridge Pose)
- Alignment and Safety (2 hours)
  - Understanding body alignment in postures
  - Injury prevention techniques
- Yoga for Flexibility & Strength (2 hours)
  - Poses to improve flexibility
  - Strength-building sequences
- Yoga for Relaxation and Restoration(2 hours)
  - Gentle and restorative postures
  - Introduction to Restorative Yoga and its benefits

Module 3: Breathwork (Pranayama) (4 hours)

- Introduction to Pranayama (1 hour)
  - What is Pranayama?
  - Importance of breath control
- Basic Pranayama Techniques (2 hours)
  - Nadi Shodhana (Alternate Nostril Breathing)
  - Ujjayi Breathing
  - Kapalabhati (Skull Shining Breath)

- Breathwork for Stress Management (1 hour)
  - How to use breathing techniques to manage stress, anxiety, and emotions

Module 4: Meditation and Mindfulness (6 hours)

- Introduction to Meditation (1 hour)
  - What is Meditation?
  - Benefits of meditation for mental and emotional well-being
- Mindfulness Practices (2 hours)
  - Body scan meditation
  - Mindful breathing
  - Mindful movement
- Guided Meditation Techniques (2 hours)
  - Visualization practices
  - Mantra Meditation
  - Loving-kindness meditation
- Creating a Home Meditation Practice (1 hour)
  - Setting up a regular meditation routine
  - Overcoming obstacles to consistent practice

Module 5: Yogic Lifestyle and Nutrition (2 hours)

- Yogic Diet and Nutrition (1 hour)
  - Basics of a sattvic diet (yoga-inspired nutrition)
  - The role of food in physical and mental health
- Integrating Yoga into Daily Life (1 hour)
  - Developing healthy habits and routines
  - Yoga beyond the mat: applying mindfulness in daily activities

Module 6: Emotional Balance & Stress Management (2 hours)

- Understanding the Mind-Body Connection (1 hour)
  - Emotional regulation through yoga
  - Yoga for managing anxiety, depression, and stress
- Practical Techniques for Emotional Health (1 hour)
  - Journaling, affirmations, and self-reflection practices
  - Using asanas, pranayama, and meditation for emotional balance

Module 7: Reflection, Integration, and Closing (2 hours)

- Personal Reflection and Journaling (1 hour)
  - Reflecting on personal growth and the impact of yoga on life skills
  - Sharing experiences and insights with peers
- Course Wrap-up and Future Planning(1 hour)
  - Review of key concepts
  - How to continue yoga practice beyond the course

Assessment & Evaluation

- Attendance and Participation: 50%
- Personal Yoga Practice and Reflection: 30%
- Final Presentation or Essay on Yoga Life Skills Application: 20%

This syllabus provides a balanced approach between theory, practice, and reflection. It focuses not only on yoga as physical exercise but also as a holistic practice to enhance life skills and well-being.

Recommended Books:

- Patanjali Yogasutra by Swami Vivekananda
- Light on Yoga by B K S Iyenger
- Hatha Yoga by Swami Sivananda
- APMB by Swami Satyananda Saraswati
- Light on pranayama by B K S I yenger
- Srimad Bhagavad Gita by Gitapress, Gorakhapur

Semester II

PAPER ZO-201: APPLIED ZOOLOGY

100 (10+10+20+60) Marks

UNIT-I

Lac Culture:Lac insect and its life history, Host plant management, Strains of lac insects; Propagation of lac insects; Lac crop management; Natural enemies of lac insects and their management; Economic importance of lac.

UNIT-II

Apiculture:Classification and biology of honeybees; Social organization of bee colony; Artificial bee keeping (Apiary), Beehives: Newton and Langstroth; Bee pasturage; Selection of bee species for apiculture; Bee Keeping equipment; Methods of extraction of Honey (Indigenous and Modern); Bee keeping industry: Recent efforts.

UNIT-III

Sericulture:Types of silk and silk moth: Mulberry silk and non-mulberry silk; Their host plants; Pruning and thinning; Life history of silkworms; Moulting; Voltinism; Rearing of silkworm: Grainage management- Seed (egg) production (Disease Free Egg Laying-DFL), Hatching and rearing of larva, Mounting methods of mulberry silkworm; Harvesting of cocoon; Artificial diet of silkworm; Post-cocoon processing; Pest, predators and diseases of silkworm and diseases of host plant.

UNIT-IV

Pisciculture:Site selection and construction of ponds: Pre-stocking and post-stocking management of nursery, rearing and stocking ponds;Breeding of fishes; New generation drugs in induced breeding; Brief study of freshwater aquaculture system: Polyculture, Cage culture, Sewage fed fish culture, Integrated fish farming; Fish products and byproducts; Fish preservation.

UNIT-V

Prawn, Pearl and Vermiculture: Seed production of commercially important prawns and shrimps; Seed resources: Site selection and techniques of collection; Identification and segregation of seed. Extensive, semi-intensive and intensive shrimp farming practices; important species of pearl oysters and method of artificial pearl production;Earthworm farming (Vermiculture): Extraction (harvest), Vermicomposting harvest and processing.

Course Outcomes

1. Understand the importance of commercially important animals, such as the lac insect, silk moth, honeybees, fishes, prawn, pearl oysters, and earthworms in human life.

2. Gain knowledge of various methods to rear animals for commercial purposes, such as lac, honey, and silk production, as well as food and compost preparation.

Recommended Books

1. FAO Manual.
2. Shukla, R., & Upadhyaya, R. Economic Zoology.
3. Ganga, G., & Chetty, M. Sericulture.
4. Dey, D.G., Mohanty, N., Guru, B.C., & Nayak, B.K. Tasar Silk Moth of Similipal.

PAPER ZO-202: DEVELOPMENTAL BIOLOGY

100 (10+10+20+60) Marks

UNIT-I

Four principles of Karl Ernst von Baer; Gametogenesis (Spermatogenesis and Oogenesis); Ultrastructure of sperm and ovum; Cleavage and Blastulation (Chemical changes, rate, planes, patterns, principles, and products).

UNIT-II

Fertilization (Types, mechanism and significance); Fate map (Amphibia and Chick embryo);Gastrulation (Chick and Amphibia);Axes and pattern formation in *Drosophila* and Amphibia.

UNIT-III

Embryonic Induction & its type, Epithelial- mesenchymal interactions, Regional specificity and genetic specificity of induction, embryonic induction in vertebrates (Induction of vertebral lens, limb development).

UNIT-IV

Metamorphosis: Types, Metamorphosis in Chordates, Hormonal control of amphibian metamorphosis; Insect metamorphosis and its hormonal control. Regeneration in Vertebrates and Invertebrates, mechanism of regeneration in coelenterates and amphibia.

UNIT-V

Parthenogenesis: Artificial and natural; Haploid & diploid; Significance; Extra-embryonic membranes in chick and rabbit; Placenta and placentation in mammals (types and physiology); Teratogenesis

Course Outcomes

1. Understanding the key concepts in the development of animals.
2. Comprehending the development of *Drosophila*, Amphibia, and parthenogenetic animals.
3. Interpretation of regeneration in vertebrates and invertebrates, and teratogenesis in animals.

RecommendedBooks

1. Gilbert, S.F.Developmental Biology. Sinauer Associates Inc., Massachusetts
2. Auster, C.R., & Short, A.V.Reproduction in Animals.
3. Longo, F.T.Fertilisation. Chapman and Hall.
4. Berrill, N.J.Developmental Biology. Tata McGraw-Hill.
5. Ballinsky, B.I.An Introduction to Embryology.

PAPER ZO-203: BIOSTATISTICS, TECHNIQUES AND TOOLS IN BIOLOGY

100 (10+10+20+60) Marks

UNIT-I

Resolution, visibility and principle: Light microscopy, Phase contrast microscopy, Fluorescent microscopy, Electron microscopy; Histology and Immunocytochemistry; Detection of molecule in living cells.

UNIT-II

Principle and function: Spectrophotometer; Fluorescent spectroscopy; Chromatography (paper, thin layer, column, gel exclusion, gas, high pressure liquid); Centrifugation; Electrophoresis: Principle and procedure for SDS-PAGE and Agarose; Atomic absorption spectrophotometer: Principle and application.

UNIT-III

Definition and scope of biostatistics; Concept of population and sample; Census vs Sampling techniques; Frequency distribution; Measures of central tendency (Mean, Median, Mode); Measures of dispersion: Range, Mean Deviation, Standard Deviation, Variance and Coefficient of variation; Skewness and Kurtosis.

UNIT-IV

Correlation (Definition, Types, Methods of studying scatter diagram and Karl Pearson's Coefficient); Regression (Definition, concept of linear and non-linear regression, Derivations of regression lines); Elementary idea about probability; Theoretical distribution: Binomial, Poisson and Normal; Sampling distribution and Standard error; Test of Hypothesis: Chi-square, t-, F- tests and analysis of variance.

UNIT-V

RS and GIS: Fundamental principle of remote sensing (RS) and geographical information system (GIS); Stages in RS process; Satellite and Sensors: Platforms, Satellites (LANDSAT, SPOT, IRS, INSAT); Concept of GIS, GPS; Application of RS & GIS.

Course Outcomes

1. Understand the tools and techniques necessary to carryout various biological experiments.
2. Understand and use statistics in biology.

Recommended Books

1. Brown, R. Introduction to Instrumental Analysis. McGraw Hill International Editions.
2. Wilson, K., & Goulding, K.H. (Eds.) A Biologist's Guide to Principles and Techniques of Practical Biochemistry. ELBS.
3. Hochachka, P.W., & Somero, G.N. Biochemical Adaptation. Princeton, New Jersey.
4. Pummer, L. Practical Biochemistry. Tata McGraw Hill.
5. Wilson, K., & Walker, J. Practical Biochemistry.
6. Chainy, G.B.N., Mishra, S., & Mohanty, B.P. Basic Biostatistics. Kalyani Publishers, Ludhiana.
7. Batschelet, E. Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.
8. Snedecor, G.W., & Cochran, W.G. Statistical Methods. Affiliated East-West Press, New Delhi (Indian Edition).
9. Green, R.H. Sampling Design and Statistical Methods for Environmental Biologists. John Wiley & Sons, New York.
10. Murray, J.D. Mathematical Biology. Springer-Verlag, Berlin.

PAPER ZO-204: MICROBIOLOGY, IMMUNOLOGY AND TOXICOLOGY

100 (10+10+20+60) Marks

UNIT-I

Concept of Microbiology: General characteristics of microorganisms; ecological groups of microorganisms; culture media including natural and synthetic types; pure culture methods such as pour plate, streak plate, and spread plate; microbial fermentation and the production of small and macro molecules; Genomic organization of Lambda phage and Life cycle of Bacteriophage (Lytic and Lysogenic phase).

UNIT-II

Infection and Diseases: Host-parasite relationship; types of diseases such as airborne, foodborne, waterborne, and soilborne; human diseases caused by viruses including HIV, HPV, and Influenza; control of microorganisms using physical, chemical, and chemotherapeutic agents.Microbial Genetics: Methods of genetic transfer including transformation, conjugation, and transduction.

UNIT-III

Cells and Organs of the Immune System: Haematopoiesis, cells of the immune system, and organs of the immune system.Innate Immunity: Anatomical barriers, the connection between innate and adaptive immunity, Toll-like receptors, inflammation, and phagocytosis.Antigen and Antibody: Immunogenicity vs. antigenicity; epitope; basic structure of an antibody; antibody binding site; antibody classes and biological activity; antigenic determinants on immunoglobulin (Isotype, Allotype, Idiotype).Complement System: Classical, alternative, and lectin pathways.

UNIT-IV

Antigen-Antibody Interaction: Strength of antigen-antibody interactions, cross-reactivity, precipitation reactions, and agglutination reactions; ELISA (indirect, sandwich, competitive) and ELISPOT assay; Western blotting.Major Histocompatibility Complex (MHC) Role in antigen presentation.B-cell and T-cell Immunity: B-cell maturation, activation, and differentiation; T-cell maturation, activation, and differentiation; cell-mediated cytotoxic responses.Hypersensitivity reactions (Type I, II, III, and IV); cytokines; and vaccines.

UNIT-V

Environmental Pollution Monitoring and Management: Biological indicators of pollution; monitoring of aquatic pollution; global warming and its impact; bioremediation; tolerance limits (LD50, LC50) and dose-response relationships; xenobiotics metabolism and biotransformation of toxicants.

Course Outcomes

1. Understand microorganisms, their ecological roles, and fermentation processes.
2. Learn host-parasite interactions, microbial diseases, and control methods.
3. Grasp immunity basics, antigen-antibody interactions, and immune responses.
4. Explore pollution monitoring, bioremediation, and environmental management.

Recommended Books

1. Microbiology by Prescott.
2. A Textbook of Microbiology by Black.
3. Brock: Biology of Microorganisms by Madigan et al.
4. Immunology by Kuby, W.H. Freeman, USA.
5. Fundamentals of Immunology by W. Paul.
6. Essential Immunology by L.M. Roitt, ELBS Edition.
7. Physical Biochemistry by D. Freifelder, W.H. Freeman and Company.
8. Essentials of Molecular Biology by D. Freifelder.
9. Pesticides in Indian Environment by Gupta, Interprint.
10. Air Pollution by Speding, Clarendon, Oxford.
11. Water Pollution by Speding, Clarendon, Oxford.
12. Ecology and Pollution of Indian Rivers by Trivedy, Ashish.

PAPER ZO-206: FUNDAMENTALS OF CELLBIOLOGY

100 (10+10+20+60) Marks

UNIT-I

Cell organization and structure of organelles: Cell membrane structure and its functions, extracellular matrix, cytoskeleton, cellular motility, and cell junctions.

UNIT-II

Membrane trafficking and cellular organelles: Nucleus, Mitochondria, Endoplasmic Reticulum and Golgi complex

UNIT-III

Structure and function of Chloroplasts, flagella, lysosomes, and peroxisomes; an introduction to stem cells and their significance.

UNIT-IV

Nucleus and chromatin: Chromosome architecture, cell cycle regulation, and mechanisms of cell senescence.

UNIT-V

Programmed cell death and its regulation: Apoptosis, its pathways, and implications in cellular health and disease.

Course Outcomes

1. To provide knowledge on cell structure and its function.
2. Understanding the structure and function of different organelles and functions.
3. To understand cell dynamics

Recommended Books

1.Molecular Cell Biology, by J. Darnell, H. Lodish, and D. Baltimore, Scientific American Book, Inc., USA.

2.Molecular Biology of the Cell, by B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, Garland Publishing Inc., New York.

3.Cell and Molecular Biology, by P. K. Gupta (Latest Edition), Rastogi Publication.

PAPER ZO-205: PRACTICAL

100 (30+70) marks

Course Outcomes:

1. Gaining practical knowledge on various commercially useful animals.
2. Understanding frog and chick development through slides.
3. Training to use various instruments for biological experiments.
4. Performing experiments to evaluate various ecological parameters.

Experiments:

1. Calculation of mean, median, mode, and variance of given data.
2. Test of significance using Student's t-test.
3. Study of different larval stages of frog/toad.
4. Histological slides related to frog/toad and chick embryology.
5. Window preparation of chick embryo at 48/72 hours of incubation.
6. Validation of Beer-Lambert's law by UV-visible spectrophotometer.
7. Absorption maxima of bromophenol blue solution.
8. Separation of amino acids by paper chromatography.
9. Determination of dissolved oxygen content of water samples.
10. Estimation of pH of different water/soil by pH meter.
11. Analysis of zooplankton from different water samples.
12. Calculation of Biodiversity Indices (Shannon-Weiner, Dominance, Association, and Similarity-dissimilarity indices).
13. Preparation of bed for vermiculture.
14. Study of economically important animals (Silkworm, Honeybee, Fish, Prawn).
15. Seminar Presentation.

Sessional preparation

Seminar presentation report/ Study tour report/Practical record

Semester III

PAPER ZO-301: ENVIRONMENTAL BIOLOGY AND NATURAL RESOURCE MANAGEMENT
100 (10+10+20+60) Marks

UNIT-I
Ecosystem: Structural and functional components of ecosystem, Ecological energetics and energy flow models in ecosystem; Biogeochemical cycles (CNP); Productivity of ecosystems: Aquatic and terrestrial (GPP, NPP), Methods of measuring productivity; Biotic and abiotic interactions.

UNIT-II
Population Ecology: Population growth curves, Population regulation, Life history strategies (r- and k-selection), Concept of metapopulation, Demes and dispersal, Age structure of populations; Concept of habitat and niche: Niche width and overlap, Fundamental and realized niche, Resource partitioning; Character displacement.

UNIT-III
Conservation, Preservation, Protection, Extinction of species, Extinct threshold, Causes of extinction and depletion, Categories of wild animals (Endangered, vulnerable, rare, threatened, extinct).

UNIT-IV
Forest and wildlife management: Importance of forests and wildlife; Deforestation (causes and consequences) and Conservation of Forests; Wildlife management: Wildlife values, Aim, Problems, and Basic requirements of wildlife conservation and management.

UNIT-V
Project tiger, Project lion, Project elephant, Crocodile breeding project, CITES, GTF, WWF, IUCN, IBWL, CBSG, SSC. Water resources and management; Wetland conservation.

Course Outcomes
1. Understand the structure and function of ecosystems, and their ecological components.
2. Comprehend the dynamics of population growth, habitat, niche, and life history strategies.
3. Gain knowledge of conservation techniques and the importance of wildlife management and protection.
4. Learn about the significance of natural resources and the roles of global organizations in conservation efforts.

Recommended Books

1. Forests and Forestry by K.P. Sagreiya, National Book Trust.
2. Textbook of Wildlife Management by S.K. Singh, International Book Depot.
3. Fundamentals of Ecology by Odum, Saunders Publications.
4. Fundamentals of Ecology by M.C. Dash.
5. Environmental and Metabolic Animal Physiology by C.L. Prasser, Wiley Liss Inc., New York.
6. The Handbook of Environmental Chemistry, Vol-I, II, III, Ed. Hutzinger.
7. Environmental Chemistry by A.K. Dey, Wiley Estorn.
8. Water Pollution by Speding, Clarendon, Oxford.
9. A Textbook of Microbiology by R.C. Dubey, D.K. Maheswari, S. Chand.
10. Fish and Fisheries by Jhingran.

PAPER ZO-302(A):BIOSYSTEMATICSANDTAXONOMY

100 (10+10+20+60) Marks

UNIT-I

Taxonomic evidence and evolutionary interpretation: Definition and evidence, kinds of evidence, similarity, homology, and homoplasy.

UNIT-II

Taxonomy to classification: Principles, objectives and arbitrariness, monophyly and polyphyly, grades and clades, vertical and horizontal relationships, divergence and diversity, splitting and lumping, relative antiquity, ranks of characters.

UNIT-III

Taxonomic collection: Species registry, collection methods, preservation of collected material (curating preparation, relaxing, mounting, storage, cataloguing, maintaining quality of collection).

UNIT-IV

Identification methods: Literature, keys, pictures, direct comparison, combination of different methods in identification, taxonomic publication, preparation of taxonomic papers (description of keys, classification, synonymies, bibliography, nomenclature, illustrations).

UNIT-V

Reference works in taxonomy: Zoological record, abstracts (biological, dissertation, entomology, helminthology, protozoology), taxonomy on the web.

Course Outcomes

1. Gain knowledge of animal taxonomy and classification.
2. Understand the techniques of cataloguing and preserving taxonomic collections.
3. Learn identification methods using literature, keys, and various taxonomic tools.
4. Explore the use of reference works and publications in taxonomy.

Recommended Books

1. Biological Systematics-The State of Art by A. Minelli, Chapman and Hall, London.
2. Principles of Animal Taxonomyby G.G. Simpson, Columbia University Press, New York.
3. Principles of Systematic Zoology by E. Mayrand P.D. Ashlock, MacGraw-Hill, Inc, New Delhi.
4. The Language of Taxonomy - An Application of Symbolic Logic to the Study of Classificatory Systems by J.R. Gregg, Columbia University Press, New York.
5. Milestones in Systematics by D.M. Williams and P.L. Foley, CRC Press LLC, Boca Raton, Florida, USA.
6. Transformed Cladistics, Taxonomy and Evolution by N.R. Scott-Ram, Cambridge University Press, Cambridge.
7. Foundations of Systematics and Biogeographyby D.M. Williams and M.C. Ebach, Springer Science + Business Media, LLC, New York.
8. Animal Taxonomy by H.E. Goto, Hodder Arnold H&S.
9. Principles and Practices of Animal Taxonomy by V.C. Kapoor, Science Publishers, New Delhi.
10. An Introduction to Taxonomy by T.C. Narendran, Zoological Survey of India, Kolkata.

PAPER ZO-302(B): CELL AND MOLECULAR BIOLOGY

100 (10+10+20+60) Marks

UNIT-I

Cell differentiation: Evidence of genomic equivalence, Cell commitment- Specification, Determination, Differential gene expression: Anatomy of gene, Promoters, Enhancers, Silencers, DNA methylation, Differential RNA processing, Control at level of translation.

UNIT-II

DNA replication, enzymes, and accessory proteins involved in DNA replication in Prokaryotes and Eukaryotes; DNA damage and repair. Polymerase Chain Reaction (Principle, types and application).

UNIT-III

Programmed cell death, aging and senescence. Oncogenes and tumor suppressor genes: Viral and cellular oncogenes from humans, structure, function, and mechanism of action of pRB and p53 tumor suppression genes. Cancer and cell cycle; Therapeutic intervention of uncontrolled growth rate.

UNIT-IV

DNA recombination: Homologous recombination - Holliday junction, Meselson-Radding model, and double-strand break model. Key enzymes of recombination - RecA and other Rec proteins, Cre-LoxP. Non-homologous recombination - Site-specific recombination, transposition, gene disruption, gene targeting.

UNIT-V.

DNA amplification: Genetic Engineering: Restriction enzymes, different methods of construction of recombinant DNA, cell transformation and cloning, transgenic animals, expression of recombinant protein using bacterial/animal vectors, gene knock-out strategies.

Course Outcomes

1. In-depth comprehension of the cell cycle and genomic organization.
2. Understanding of key concepts in cell and molecular biology, including cell differentiation, programmed cell death, cancer, aging, repair, recombination, and DNA replication.

Recommended Books

1. Advances in Cell and Molecular Biology by W.J. Dupraw.
2. Molecular Cell Biology by J. Darnell, H. Lodish, and D. Baltimore, Scientific American Book Inc., USA.
3. Molecular Biology of the Cell by B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson, Garland Publishing Inc., New York.
4. Molecular Biology of Genes by J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz, and A.M. Weiner, The Benjamin/Cummings Publishing Company Inc., Tokyo.
5. Molecular Biology and Biotechnology: A Comprehensive Desk Reference by R.A. Meyers.
6. Molecular Biotechnology by Glick.
7. Genomics by T.S. Brown.
8. Biochemistry by Stryer.
9. Principles of Biochemistry by Lehninger.

PAPER ZO-303: BIOCHEMISTRY

100 (10+10+20+60) Marks

UNIT-I

Structure and function of biomolecules (proteins, lipids, carbohydrates, and nucleic acids). Conformation of proteins: Concept of Ramachandran plot, domains, and motifs. Biologically important carbohydrates and their functions. Lipids of biological importance: Storage, structural, and signaling lipids. Conformation of nucleic acids (helix A, B, Z), t-RNA, micro-RNA. Stability of proteins and nucleic acids.

UNIT-II

Synthesis of purine and pyrimidine nucleotides. Amino acid synthesis (serine, tryptophan, and methionine). Cholesterol biosynthesis. Fatty acid synthesis (saturated). Oxidation of lipids (β-oxidation). Urea cycle. Amino acid catabolism. Nucleic acid catabolism. Metabolism of vitamins.

UNIT-III

Oxidation of carbohydrates: Glycolysis, TCA cycle, electron transport chain, oxidative phosphorylation, HMP pathway. Intermediary metabolism: Glycogenesis and gluconeogenesis.

UNIT-IV

Classification of enzymes (6 major classes). Prosthetic group (coenzyme, cofactor) and holoenzyme. Mechanism of enzyme action (active site, ground state, transition state, activation energy, binding energy). Enzyme kinetics: Vo, Vmax, Km, and Michaelis-Menten and Lineweaver-Burk equations. Enzyme inhibition: Reversible (competitive, uncompetitive, mixed) and irreversible. Regulatory enzymes. Isozymes.

UNIT-V

Enzyme regulation and modulation. Role of coenzymes and cofactors in enzyme activity. Mechanisms of enzyme catalysis. Enzyme-substrate interaction models. Enzyme applications in biotechnology and medicine.

Course Outcomes

1. Understanding the structure and function of biomolecules.
2. Concepts of nucleotide and fatty acid biosynthesis and oxidation of carbohydrates.
3. Understanding enzymes, their action, and kinetics.
4. Understanding the regulation of enzymes and their role in metabolism.

Recommended Books

1. Biochemistry by Berg, Tymoczko, and Stryer, W.H. Freeman, NY.
2. Lehninger Principles of Biochemistry by D.L. Nelson and M.M. Cox, W.H. Freeman, NY.
3. Biochemistry by D. Voet and J.G. Voet, John Wiley and Sons.
4. Physical Biochemistry by D. Freifelder, W.H. Freeman and Company.

PAPER ZO-304: PRACTICAL:

100 (30+70) Marks

Course Outcomes

1. Practical knowledge of performing protein, DNA, and RNA estimation in a given sample spectrophotometrically.
2. Performing enzyme assays and their optimization.
3. Basic understanding of sterilization processes and culture methods.

Experiments

1. Spectrophotometric estimation of protein.
2. Methods of sterilization of glassware and other materials (media and buffers) for microbial culture.
3. Isolation and culture of bacteria by plating methods.
4. Effects of temperature on enzyme activity (any enzyme).
5. Effects of pH on enzyme activity (any enzyme).
6. Effects of substrate concentration on enzyme activity (any enzyme).
7. Estimation of alkaline phosphatase enzyme activity.
8. Preparation of salivary gland chromosomes of *Drosophila*.
9. Spectrophotometric estimation of DNA and RNA.

Sessional preparation

Seminar presentation report/ Study tour report/Practical record

PAPER ZO-305: SWAYAM MOOCS 100 Marks

As per availability (Minimum 3 credits)

SEMESTER- IV

PAPER ZO-401: CHORDATA, COMPARATIVE ANATOMY, EVOLUTION AND ANIMAL BEHAVIOR

100 (10+10+20+60) Marks

UNIT-I:
General characters and classification of Chordata up to orders; Herdmania- a case study; Structural features and affinities of cyclostomes; Structure, distribution, and affinities of Dipnoi and Latimeria. Classification of reptiles based on skull pattern; Flight adaptation in birds; General characters of Prototheria and Metatheria

UNIT-II:
Origin and evolution of chordates; Origin of Amphibia and reptiles; Adaptive radiation in reptiles and mammals; Stages in primate evolution including Homo. Comparative account of the urinogenital and respiratory system, and heart in vertebrates.

UNIT-III:
Speciation; Variation; Isolation; Allopatricity and Sympatricity; Evolutionary time scale, Lamarckism and Darwinism, the evolutionary synthesis.

UNIT- IV

Population genetics: Hardy-Weinberg Law, Convergent evolution; Sexual selection; Co-evolution. adaptation, struggle, fitness, and natural selection; Spontaneity of mutations

UNIT-V:
Concept of learning: Definition, Types – Flexible (habituation, classical conditioning, trial and error, latent learning, discrimination) and Restricted (imprinting, reasoning, and insight).

Course Outcomes
1. Understand the diversity of chordates and their structural features.
2. Comprehend mechanisms of evolution, including the evolutionary history of amphibians, reptiles, mammals, and humans.
3. Gain insights into population genetics, selection, and evolutionary concepts.
4. Understand different types of learning behaviours in animals.

Recommended Books
1. Genetics and Origin of Species by T.H. Dobzhansky, Columbia University Press.
2. Evolutionary Biology by D.J. Futuyama, Sinauer Associates Inc., Publishers, Sunderland.
3. Evolutionary Genetics by J.M. Smith, Oxford University Press, New York.
4. An Introduction to Genetic Analysis by A.J.F. Griffith, J.H. Miller, D.T. Suzuki, R.C. Lewontin, and M.M. Gilbert, W.H. Freeman Company, USA.
5. Principles of Genetics by D.P. Snustad and M.J. Simmons, John Wiley and Sons Inc., NY.
6. Molecular Systematics Edited by David M. Hillis and Craig Moritz, Sinauer Associates, Inc. Publishers, Sunderland, USA.
7. Evolutionary Biology by Strickberger.

PAPERZO-402(A): BIOSYSTEMATICS AND TAXONOMY

100 (10+10+20+60) Marks

UNIT-I

Molecular taxonomy: Population structure, identification of species boundaries, estimation of phylogenies. Collection and storage of tissues: Regulations, removing and preserving tissues in the field (packing, documentation, preservation). Procedures for collection: anesthesia, blood and hemolymph collection, venom collection. Transportation and storage of tissues.

UNIT-II

Barcoding: An initiative to inventorize species. Human resources involved in barcoding, institutions (national and international) associated with taxonomic studies. Rules of zoological nomenclature.

UNIT-III

Species concept and lower categories: The genetic species, evolutionary species, and other kinds of species (taxonomic species, morphospecies, paleospecies, biospecies, agamospecies). Subspecies and other intraspecific groups, superspecies.

UNIT-IV

Higher categories: Basis for recognition of higher taxa. Definition and characteristics of higher categories. Analysis of phylogenetic patterns, examples of mammalian phylogeny, and evolutionary basis of taxa.

UNIT-V

Application of molecular taxonomy and barcoding in species identification and classification. Taxonomic methods for grouping species, the significance of molecular markers, and their role in advancing systematics. Understanding the role of various institutions and resources in the field of biosystematics and taxonomy.

Course Outcomes

1. To gain knowledge on molecular taxonomy and methods of species identification and their grouping.
2. To understand the application of barcoding in taxonomy.

Recommended Books

1. Biological Systematics: The State of Art by A. Minelli, Chapman and Hall, London.
2. Principles of Animal Taxonomy by G.G. Simpson, Columbia University Press, New York.
3. Principles of Systematic Zoology by E. Mayr and P.D. Ashlock, MacGraw-Hill, Inc, New Delhi.
4. Milestones in Systematics by D.M. Williams and P.L. Foley, CRC Press LLC, Boca Raton, Florida, USA.
5. Transformed Cladistics, Taxonomy, and Evolution by N.R. Scott-Ram, Cambridge University Press, Cambridge.
6. Foundations of Systematics and Biogeography by D.M. Williams and M.C. Ebach, Springer ScienceBusiness Media, LLC, New York.
7. Animal Taxonomy by H.E. Goto, Hodder Arnold H&S.
8. Principles and Practices of Animal Taxonomy by V.C. Kapoor, Science Publishers, New Delhi.
9. Molecular Systematics by David M. Hillis and Craig Mortiz, Sinauer Associates, Inc. Publishers, Sunderland, USA.

PAPER ZO-402(B): CELL AND MOLECULAR BIOLOGY

100 (10+10+20+60) Marks

UNIT-I

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, RNA polymerases, capping, elongation, and termination. RNA processing: RNA editing, splicing, polyadenylation. Isolation and purification of RNA. Antisense and ribozymes

UNIT-II

Protein synthesis and processing: Ribosome structure and function, formation of initiation complex, elongation, and termination. The genetic code. Aminoacylation of tRNA. Post-translational modification of proteins.

UNIT-III

Isolation and purification of proteins. Intracellular trafficking mechanisms, protein synthesis on free and bound polysomes, uptake into the endoplasmic reticulum. Protein sorting and post-translational modification. Protein targeting and localization in the nucleus, mitochondria, chloroplast, and peroxisomes. Protein degrading machinery in the cell. The proteasome: Structure and proteasomal degradation of protein.

UNIT-IV

Molecular mapping: Genetic and physical mapping, physical mapping and map-based cloning. Molecular markers in genome analysis: RFLP, RAPD, and AFLP and their applications.

UNIT-V

DNA and protein sequencing: Methods and techniques involved in sequencing. Applications of sequencing in molecular biology. Interpretation of sequencing data and its implications for research and biotechnology.

Course Outcomes

1. Understanding the isolation and synthesis of RNA and proteins.
2. Deciphering protein sorting mechanisms in cells.
3. Understanding molecular markers for genome analysis.
4. Interpretation of DNA and protein sequencing methods.

Recommended Books

1. Advances in Cell and Molecular Biology by W.J. Dupraw.
2. Molecular Cell Biology by J. Darnell, H. Lodish, and D. Baltimore, Scientific American Books Inc., USA.
3. Molecular Biology of the Cell by B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson, Garland Publishing Inc., New York.
4. Molecular Biology of Genes by J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz, and A.M. Weiner, The Benjamin/Cummings Publishing Company Inc., Tokyo.
5. Molecular Cloning: A Laboratory Manual by J. Sambrook, E.F. Fritsch, and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
6. Molecular Biotechnologyby Glick and Pasternak.
7. Genomeby T.S. Brown.
8. Biochemistry by Berg, Tymoczko, and Stryer, W.H. Freeman, NY.
9. Lehninger Principles of Biochemistry by Nelson and Cox, W.H. Freeman, NY.
10. Biochemistry by D. Voet and J.G. Voet, John Wiley & Sons.

PAPER ZO-403: PRACTICAL

100 (30+70) Marks

Course Outcomes

2. Understanding the classification and evolution of chordates through specimen study.
3. Gaining practical knowledge of molecular techniques to study DNA and protein, such as gel electrophoresis, chromatography, plasmid isolation, and histology.

Experiments

1. Study on the Life History of *Drosophila*
2. Preparation of Permanent Histological Slides
3. Isolation of Plasmid
4. Separation of DNA through Agarose Gel Electrophoresis
5. Extraction and Purification of Protein by Column Chromatography
6. Separation of Protein on SDS-PAGE and Determination of Molecular Weight
7. Restriction Mapping
8. Comparative Osteological Studies of Vertebrates (Amphibia, Reptilia, Aves, and Mammalia)
9. Study of Histological Slides of Chordates
10. Museum Specimens of Chordates

Sessional preparation

Seminar presentation report/ Study tour report/Practical record

PAPER ZO- 404: PROJECT WORK

100 Marks

Course Outcomes

1. To enable students to identify a problem and formulate relevant questions.
2. To enable students to survey relevant literature for a given problem.
3. To prepare students to design an experiment and execute it.

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