Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of two Year PG Programme

Post Graduate Programme of Science and Technology

M.Sc. I in Zoology

Board of Studies

In

Zoology

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

W.e.f. June, 2023

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **M.Sc. in Zoology** Programme to be effective from the **Academic Year 2023-24.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 09/08/2023

Place: Latur

NEP CELL

Rajarshi Shahu Mahavidyalaya, Latur

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CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **M.Sc. in Zoology** Programme to be effective from the **Academic Year 2023-24.**

Date: 14/07/2023

Place: Latur

Dr. D.S. Rathod

Chairperson

Board of Studies in Zoology

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Members of Board of Studies in the Subject Zoology

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Dr. D.S.Rathod** Head, Department of Zoology Rajarshi Shahu Mahavidyalaya (Autonomous), Latur	Chairperson	HoD
2	**Prof. S. P .Chavan** Director, School of Life Science Swami Ramanand Teerth Marathwada University, Nanded	Member	V.C. Nominee
3	**Prof. Ragvender Rao** Walchand Centre for Research in Nanotechnology & Bio-Nanotechnology Walchand College of Arts and Science, Ashok Chowk, Solapur – 413006 Maharashtra, India	Member	Academic Council Nominee
4	**Dr. Mamidala Estari** Head, Department of Zoology, Infectious Diseases & Metabolic Disorders Research Lab, Kakatiya University, Hanumakonda-506 009. Telangana State, India.	Member	Academic Council Nominee
5	**Prof. D. H. Jadhav** Head, Department of Zoology Maharashtra Mahavidyalaya, Nilanga	Member	Expert from outside for Special Course
6	**Mr. Ishrar Deshmukh** Pharma Pune, Maharashtra, India	Member	Expert from Industry
7	**Dr. Vinay Biradar** Department of Zoology, Savitribai Phule University Pune	Member	P.G. Alumni
8	**Dr. K. S. Raut**	Member	Faculty Member
	Mr. Datta Nalle	Member	Faculty Member
	Mrs. Dhanshree Jagtap	Member	Faculty Member
9	**Dr. A. A. Yadav**	Member	Member from same Faculty

From the Desk of the Chairperson…

The Department of Zoology was established in the year 1971. The department has been recognized by our parent University as Research center since 8th May 2003 and now it has been developed into center of teaching and research in Zoology.

To reach the mission of "Pursuit of Excellence" in higher education to make our students globally competent. The departmental staff is committed towards our work with dedication, determination and devotion.

National Education Policy NEP-2020 focuses more on practical rather than theoretical learning. It also focus on developing overall personality of students by incorporating Humanitarian and Constitutional values, creativity and critical thinking, harnessing innovation, use of modern technology and interaction with various stakeholders. It uses the practical based pedagogy to evolve and make education more experiential, holistic, integrated, learner-centric, flexible and developing skill etc. To skilled and trained students can accept the challenge of the future, as we know that the new policy also envisages the refinement and improvement in the Learning Outcome based Curriculum Framework.

The syllabus of B.Sc. I has been designed as per the National Education Policy (NEP), 2020, the present structure comprises Discipline specific courses (DSC), Discipline Specific Electives (DSE), Discipline Specific Minor Course (DSM), Generic/Open Electives (GE/OE), Vocational Specific Course (VSC), Skill Enhancement Course (SEC), Ability Enhancement Course (AEC) etc. The discipline specific courses (DSC) are compulsory and the elective courses can be chosen from the given Basket. Except Ability Enhancement courses, all other courses, comprise theory and practicals.

The project work is specially underlined in this structure. The project will mainly involve experimental work. The students will be asked their choice for project. The Generic Electives will be offered to the students of other departments of the college. The students will have the option to choose one generic elective from the given Basket. The generic elective comprises theory as well as practical. The students will also undertake one Vocational Specific Course (VSC) and one Skill Enhancement Course (SEC) of two credits each. The VSC and SEC also comprise theory and practicals. These courses will be chosen by the students from the concerned basket. One of the DSC is specified for Indian Knowledge Systems (IKS). Indian Knowledge Systems have a strong foundation in Indian Culture, Philosophy and Spirituality and have evolved through thousands of years.

B.Sc. Zoology course will help to understand the behaviour, structure and evolution of animals. Zoologists use a wide range of approaches to do this, from genetics to molecular and cellular biology, as well as physiological processes and anatomy, whole animals, populations, and their ecology. The scope of Zoology as a subject is very broad. The intention is to understand the subject of Zoology in the evolving biological paradigm in modern times; where, living beings need to be understood at the

level of atomic interactions; and comparative systems of organisms need to be studied through the prism of integrated chemical, physical, mathematical and molecular entities to appreciate the inner working of different organisms at morphological, cellular, molecular, interactive and evolutionary levels. The key areas of study within the disciplinary/subject area of Zoology comprise: animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied zoology, behaviour, immunology, reproductive biology, and insect, vectors and diseases. B.Sc. degree programme in Zoology also deals with skill enhancement courses such as apiculture, aquarium fish keeping, medical diagnostics, sericulture etc. The depth and breadth of study of individual topics dealt with would vary with the nature of specific Zoology programmes.

Our institution gives importance in mission to provide value and need based education which can be useful to students to get the skill for entrepreneurship and jobs or self-help for earnings. This institution is connected long back with anti-superstition activity to develop the scientific attitude among students.

As a part of the efforts to enhance the interest and employability of graduates of Zoology programmes, the curricula for these programmes are expected to include learning experiences that offer opportunities for higher studies and research at reputed laboratories.

(**Dr. D. S. Rathod)**
Chairperson
Board of Studies in Zoology

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

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Shiv Chhatrapati Shikshan Sanstha's
Rajarshi Shahu Mahavidyalaya, Latur
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Department of Zoology
PG Skeleton in Accordance with NEP-2020
Illustrative Credit Distribution Structure for Two Year M.Sc. Degree

Year Level	Sem	MMC 24-28 (22-26) per Sem 46-56 for two years		Lab Course	RM	OJT/FP	RP	Cum. Cr	Marks	Degree
		Mandatory	**Elective**		RMC 4Cr	NA	NA	20Cr	Theory: 1Cr=25M Lab Course: 1Cr=50M	**PG Diploma (After 03 Year B.Sc. Degree)**
I 6.0	**I**	MMC I 3Cr MMC II 3Cr MMC III 3Cr	MEC I 3Cr	LC-I 1Cr LC-II 1Cr LC-III 1Cr LC-IV 1Cr						
	II	MMC IV 3Cr MMC V 3Cr MMC VI 3Cr	MEC II 3Cr	LC-V 1Cr LC-VI 1Cr LC-VII 1Cr LC-VIII 1Cr	NA	OJT-I 4Cr /FPI 4Cr	NA	20Cr	OJT/FP: 1Cr=25M	
	Total	**MMC 18Cr**	**MEC 06Cr**	**LC-8Cr**	**RMC 04Cr**	**OJT/FP 04Cr**	**NA**	**40Cr**		
Exit Option: PG Diploma with 40 Credits After 03 Year B.Sc. Degree										
II 6.5	**III**	MMC VII 3Cr MMC VIII 3Cr MMC IX 3Cr	MEC III 3Cr	LC-IX 1Cr LC-X 1Cr LC-XI 1Cr LC-XII 1Cr	NA	NA	RP-I 4Cr	**20Cr**	RPI & RPII: 1Cr=25M	**PG Degree (After 03 Year UG Degree)**
	IV	MMC X 3Cr MMC XI 3Cr MMC XII 3Cr	MEC IV 3Cr	LC-XIII 1Cr LC-XIV 1Cr LC-XV 1Cr LC-XVI 1Cr	NA	NA	RP-II 6Cr	**22Cr**		
	Total	**MMC 18Cr**	**MEC 06Cr**	**LC-8Cr**	**NA**	**NA**	**RP 10 Cr**	**42Cr**		
Cum. Total of I & II Year		**MMC 36Cr**	**MEC 12Cr**	**LC-16Cr**	**RMC 04Cr**	**OJT/FP 04Cr**	**RP 10Cr**	**40+42 =82 Cr**		**82 Credits**
	Exit Option: Two Years 04 Sem. PG Degree with 82 Credits After 03 Year UG Degree									

Abbreviations:

1. **MMC : Major Mandatory Course**
2. **MEC : Major Elective Course**
3. **RMC : Research Methodology Course**
4. **OJT : On Job Training (Internship/Apprenticeship)**
5. **FP : Field Project**
6. **RP : Research Project**
7. **Cum. Cr : Cumulative Credit**

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Department of Zoology

M. Sc. I Zoology

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 6.0	I	601ZOO1101 (MMC I)	Structure and Function In Invertebrates	03	45
			Lab Course-I	01	30
		601ZOO1102 (MMC II)	Animal Cell Biology	03	45
			Lab Course-II	01	30
		601ZOO1103 (MMCIII)	Biochemistry	03	45
			Lab Course-III	01	30
		601ZOO1201 MEC-I (A) Or MEC-I(B)	Tools and Techniques in Biology OR Forensic Biology and Investigation	03	45
			Lab Course-IV	01	30
		601ZOO1301 (RMC)	Research Methodology Course	04	100
	Total Credits			**20**	
	II	601ZOO2101 (MMC IV)	Comparative Anatomy of Vertebrates	03	45
			Lab Course-V	01	30
		601ZOO2102 (MMCV)	Molecular Biology	03	45
			Lab Course-VI	01	30
		601ZOO2103 (MMC VI)	Genetics and r-DNA Technology	03	45
			Lab Course-VII	01	30
		MEC-I (A) Or MEC-I(B)	Biosystematics and Taxonomy OR Animal biotechnology	03	45
			Lab Course-VIII	01	30
		OJT-I/Field Project (FP) 601ZOO2401	OJT/ Field Project	04	120
	Total Credits			**20**	
Total Credits (Semester I & II)				**40**	

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

After the completion of the M.Sc. programme, a student will have obtained:

Programme Outcomes (POs) for M.Sc. Programme	
PO 1	**Disciplinary Masters Knowledge** Comprehensive in-depth relevant scientific knowledge and its execution in the Specific area of study.
PO 2	**Scientific Outlook** The qualities such as observation, precision, analysis, logical thinking, clarity of thought and expression and systematic approach to work on research projects and explain scientific phenomena.
PO 3	Problem Solving Skills Analytical skills to solve problems, evaluate situations and act responsibly to Communicate, cooperate and lead the team.
PO 4	Interpersonal Skills and Ethics Ability to integrate professional ethics and scientific knowledge in life, organization, society and individual to fulfill the needs of mankind in both moral and material aspects.
PO 5	Self-Directed Life-long Learning Ability to prepare for NET, SET, GATE and other national and international Competitive examinations.
PO 6	Professional Competence Ability to apply the knowledge independently for continuous personal and professional development and identify business opportunities and initiate Action to achieve it.
PO 7	**Research and Related Skills** Technical know-how about identification of local issues and develop lab to land solutions for the benefit of society at large.

Programme Specific Outcomes (PSOs) for M.Sc. Zoology	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	The Students are expected to acquire the knowledge of animal Science, natural phenomenon, and manipulation of nature and environment by man.
PSO 2	Understanding the scientific terms, concepts, facts, phenomenon and their interrelationship.
PSO 3	Applications of the knowledge develop skills in practical work, experiments and laboratory materials.
PSO 4	Students followed and understood general laboratory practice guidelines, including safety.
PSO 5	They are able to handle instruments for basic and modern analysis.
PSO 6	To develop scientific attitude which is the major objective this makes the students open minded, critical observations, curiosity, thinking etc.
PSO 7	Abilities to apply scientific methods, collection of scientific data, problem solving.
PSO 8	Students are expected to work.
PSO 9	Utilize the developed expertise in concepts, theories, and emerging methodologies to succeed in tackling real-world issues in aquaculture and aquatic science.
PSO 10	Demonstrate advanced knowledge and competency in taxonomy and natural history of aquatic flora and fauna.
PSO 11	Demonstrate hands-on experience in aquatic sampling inventory and measurement techniques. Become an independent, self-motivated professional with the ability to recognize problems in their field of aquaculture and aquatic science and apply critical thinking and problem-solving skills.

Semester - I

Shiv Chhatrapati Shikshan Sanstha's

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Department of Zoology

Course Type: MMC-I

Course Title: MMC-I : Structure and Function in Invertebrates

Course Code: I601ZOO1101

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand of systematic, taxonomy and structural organization of animals

LO 2.To understands evolutionary history and relationships of different non-chordates through functional and structural affinities.

LO 3. To understand Relationship among these Phylum Onychophora, Arthropod and Mollusca

LO 4.To understand Relationship between these Phylum Echinodermata and Hemichordata

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Develop understanding about the systematic, taxonomy and structural organization of animals.

CO 2. Analyze diversity of non-chordates living in varied habit and habitats.

CO 3. Critical analysis of the organization, complexity and characteristic features of non-chordates.

CO 4. Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.

Unit No.	Title of Unit & Contents	Hrs.
I	**Protista, Parasol, Metazoan and Porifera**	**12 Hrs.**
	General characteristics and Classification up to classes Life cycle and pathogen city of Plasmodium vivax Locomotion and Reproduction in Protista Evolution of symmetry and of Coelom and Metamerism Canal system and Spicules in sponges	
	Unit Outcome: **UO 1.** After completion of the unit the students will develop understanding about the systematic, taxonomy and structural organization of animals.	
II	**Cnideria, Ctenophore and Platyhelminthes**	**11 Hrs.**
	General characteristics and Classification up to classes Life cycle and pathogenicity of Fasciola hepatica , Parasitic adaptations in helminthes,Metagenesis in Obelia	

Unit No.	Title of Unit & Contents	Hrs.
	Polymorphism in Cnideria Corals and coral reefs	
	Unit Outcome: UO 1. Analyze diversity of non-chordates living in varied habit and habitats.	
III	**Nematohelminthes, Annelida, Arthropoda and Onychophora**	**12Hrs.**
	General characteristics and Classification up to classes Life cycle and pathogen city of Ascaris lumbricoides and Excretion in Annelida Vision and Respiration in Arthropoda Metamorphosis in Insects Evolutionary significance of Onychophora	
	Unit Outcome: UO 1. After completion of the unit the students will Critical analysis of the organization, complexity and characteristic features of non-chordates	
IV	**Mollusca and Echinodermata**	**10 Hrs.**
	General characteristics and Classification up to classes Torsion and distortion in Gastropod Water-vascular system in Asteroidea Larval forms in Echinodermata Affinities with Chordates	
	Unit Outcome: UO 1. After completion of the unit the students will Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem	

Learning Resources:

1. Protozoa through Echinodermata, Kotpal Volumes Rastogi Publications
2. Invertebrate Zoology, Jordan & Verma (revised editions) S. Chand and Co. Ltd., New Delhi.
3. Biology of the Invertebrates, Jan Pechenik (2014). McGraw-Hill Science, 2014
4. Non-Chordate Zoology by Dhabi and Dhami Pradeep Publication, Opposite Sitla Mandir, Jalndhar-144008
5. Invertebrate Zoology (Multicolor Edition) By P.S. Verma
6. Textbook of Zoology Invertebrates-I, Parker and Haswell Paperback – 1 January 2021
7. Invertebrate Zoology, Author - E. L. Jorden and P. S. Verma.
8. Morden text book of Zoology Invertebrate, Author –R.L.Kotpal

9. https://www.google.co.in/books/edition/Invertebrate_Zoology_Multicolour_Edition/TAkrDAAAQBAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover
10. Handbook of Invertebrate Zoology for Laboratories and Seaside Work By William Keith Brooks https://www.google.co.in/books/edition/Handbook_of_Invertebrate_Zoology/pkUAAAAAQAAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover

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Rajarshi Shahu Mahavidyalaya, Latur

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Department of Zoology

Course Type: MMC-I

Course Title: MMC-I Lab Course –I (Based on MMC-I)

Course Code: 601ZOO1104

Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To understand practical approach of Life and Diversity of Non-chordate

LO 2. To understand Identification, Classification of different invertebrates specimens

LO 3. To learn dissection skill by demonstration /Software/ Charts etc

LO 4. To learn the mounting techniques of different invertebrates

Course outcomes

After completion of course the student will be able to-

CO 1.Analyze Identification, Classification of different invertebrate's specimens.

CO 2.Comprehend the dissection of earthworm's skill by demonstration Software /Charts

CO 3. Learn dissection skill by demonstration /Software/ Charts etc

CO 4. Learn the mounting techniques of different invertebrates

Practical No.	Unit
1	Theoretical and practical knowledge of simple and compound microscope.
	Identification, Classification and comments on the slides/specimens of:
3	Protozoa: Amoeba, Euglena, Plasmodium, Paramecium, Trypanosoma, Elphidium, Vorticella,
4	Porifera: Sycon, Hyalonema, and Euplectella
5	Cnideria: Hydra, Obelia, Physalia, Aurelia, Tubipora
6	Aschelminthes: Ascaris, Ancylostoma, Wuchereria,
7	Platyhelminthes: Fasciola, Taenia and their larvae,
8	Arthropoda: Palaemon (Prawn), Crab, Palamnaeus
9	Annelida: Pheretima, Hirudinaria (Leech), Nereis, (Scorpion)
10	Mollusca: Pila (Apple snail), Lamellidens (Unio), Sepia, Octopus
11	Echinodermata: Asterias (Sea Star), Echinus (Sea urchin)
12	Hemichordata: Balanoglossus
13	Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium

14	Examination of pond water collected from different places for diversity in Protista/Planktons
15	Demonstration of earthworm Nerve ring and Ovaries;
16	Demonstration of digestive, Nervous, Reproductive, Tracheal, system and Malpighian tubules of cockroach
17	To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Department of Zoology

Course Type: MMC-I I

Course Title: MMC-II: Animal Cell Biology

Course Code: 601ZOO1102

Credits: 03 **Max. Marks: 75** **Lectures: 45Hrs.**

Learning Objectives:

LO1-To understand types of cells, cell membrane and membrane transportation structural organization of cell.

LO 2-To understand intracellular compartment and protein sorting.

LO 3-To understand cell signaling, cell interactions and cytoskeleton.

LO 4-To understand cell cycle, apoptosis and cancer

Course Outcomes:

After completion of course the student will be able to-

CO1. Understand how the cell functions as a unit of life and Membrane Transport of cell..

CO2. Appreciate the importance of various cell function and structures in the evolution of multicellular organisms.

CO3. The studies will make the students reveal elegance, dynamics and economy in the living cell and a gratifying unity in the principles by which a cell functions.

CO4. The students will know about the basic cellular and molecular approaches for cancer development and treatment

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Cell biology and Bio membranes.**	**12 Hrs.**
	Discovery of cell, cell theory, **Structural organization:** of virus, bacteria and eukaryotic cell- ultra structure of animal cell. **Bio membranes:** Models of membranes (fluid mosaic) and its chemical composition **Membrane Transport:** Passive Transport (Diffusion) and Active transport , Carrier proteins (uni, sym and antiporters), Channel proteins (voltage and ligand gated). Bulk transport-Pinocytosis Phagocytosis and exocytosis, Receptor mediated endocytosis.	
	Unit Outcome: **UO 1** - After completion of course the student will be able to	

Unit No.	Title of Unit & Contents	Hrs.
	understand how the cell functions as a unit of life and Membrane Transport of cell.	
II	**Intracellular Compartments and Protein sorting**	**11 Hrs.**
	Structure and Function of Nucleus and Chromosome, Organization of chromatin- nucleosomes, export and import of proteins Mitochondria structure and functions, Endoplasmic reticulum (types): signal peptide hypothesis, insertion of membrane proteins and glycosylation, Golgi (cis and Trans): secretory and lysosomal proteins. Glycosylation of proteins. **Synthesis of proteins:** free and bound ribosomes, signals for protein sorting.	
	Unit Outcome: **UO 1.**After completion of course the student will be able to appreciate the importance of various cell function and structures in the evolution of multicellular organisms.	
III	**Cell Signaling, and Cell interactions**	**11Hrs.**
	Cell surface receptors: G-protein linked receptors, signal transduction, second messengers, receptor tyrosine kinases and intracellular receptors. **Cell junctions**: tight junction, desmosome, hemi desmosome and gap junctions. **Cell adhesion molecules**: cadherin, Immunoglobulin like molecules, integrin and selectins.	
	Unit Outcome: **UO 1-** After completion of course the student will be able to understand the detail aspects of Cell Signaling, Cell interactions and Cytoskeleton	
IV	**Cell cycle, Apoptosis and Cancer**	**11 Hrs.**
	Phases of cell cycle. Regulation of cell cycle: Discovery of MPF, cyclins and cyclin dependent kinases, Check points- role of Rb and p53. **Cancer**. Types and stages. Tumor suppressor genes and proto-oncogenes. Molecular basis of cancer. **Apoptosis:** Neurotropic factors, caspases, Pathways of apoptosis. Cell senescence, telomerase	
	Unit Outcome: **UO 1-** After completion of course the student will be able to	

Unit No.	Title of Unit & Contents	Hrs.
	understand the detail aspects of Cell cycle, Apoptosis and Cancer	

Learning Resources:

1. Molecular all biology: Lodish, etal.
2. Molecular all biology: Bruce Alberts, etal
3. Cell Biology: De Roberts.
4. Cell and molecular biology: Gerald karp
5. Molecular cell biology: David Baltimore.
6. Cell Biology : Rastogi
7. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
8. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
9. Cell and molecular biology Phillip Sheeler, Donald E .Bianchi Wiley, 1987
10. Life :The Science of Biology by David Sativa
11. Cell and Molecular Biology by De Robertis

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Rajarshi Shahu Mahavidyalaya, Latur

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Department of Zoology

Course Type: MMC-II

Course Title: MMC-II Lab Course –II (Based on MMC-II)

Course Code: 601ZOO1104

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO.1 To study the Light microscope, Phase contrast microscope and Electron microscope.

LO.2 To understand the staining, mounting and micro techniques like blood smear. Squash preparation.

LO 3. To understand mitosis and the effect of colchicine on mitosis

LO 4. To understand cytochemical staining and preparation of permanent slide**.**

Learning Outcomes:

After completion of the course the students will able to-

CO 1. Learn Light microscope, Phase contrast microscope and Electron microscope.

CO 2. Learn the staining, mounting and micro techniques like blood smear, Squash preparation.

CO 3. Understand mitosis and the effect of colchicine on mitosis

CO 4. Understand cytochemical staining and preparation of permanent slide

Sr.No.	Practical
1	Principle of Light microscope, Phase contrast microscope and Electron microscope and principle of cell fixation, staining and fractionation.
2	Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
3	Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
4	Study of various stages of meiosis.
5	Preparation of temporary stained mount to show the presence of Barr body in human female blood cells/ cheek cells.
6	Preparation of blood smears to observe the blood cells.
7	Study of permanent slides of various stages of mitosis and meiosis.
8	Temporary preparation of mitotic cells from onion root tips.
9	Study of Cell organelles (any three) by using microphotographs.
10	Study of types of cells. (Permanent slide) any three.
11	Determination of Percent Hemolysis and the Osmotic Fragility of Erythrocytes. (1P)
12	Study of Phagocytosis / Pinocytosis. (1P)

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

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Department of Zoology

Course Type: MMC-III

Course Title: MMC-III: Biochemistry

Course Code: 601ZOO1103

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1-To understand the classification, Properties and significance of Biomolecues

LO 2-To understand Biochemical reaction of carbohydrates.

LO 3-To understand Biochemical reaction of lipid

LO 4-To understand nucleic acid metabolism and enzymes and coenzymes

Course Outcomes:

After completion of course the student will able to-

CO1.Understand the classification, Properties and significance of Biomolecues

CO2. Understand Biochemical reaction of carbohydrates.

CO3. Understand Biochemical reaction of lipid

CO4.Understand nucleic acid metabolism and enzymes and coenzymes

Unit No.	Title of Unit & Contents	Hrs.
I	**Classification and Biological Significance of Biomolecues**	**12 Hrs.**
	Carbohydrates: Monosaccharide's, Oligosaccharides and Polysaccharides, **Lipids**: Simple lipid, Complex lipid and Derived lipid. **Protein:** Primary, Secondary, tertiary structure, quaternary structure and Functional diversity of proteins. Ramachandran plot, α helix, β sheet. Structure of collagen, **Amino acid (Structure and properties)** .	
	Unit Outcome: **UO 1**- After completion of this unit the student will understand the classification, Properties and significance of Biomolecues	
II	**Carbohydrate metabolism**	**11 Hrs.**
	Glycolysis, glycogenolysis, gluconeogenesis, pentose phosphate pathway, glucoronic acid pathway (emphasis on regulation)	

Unit No.	Title of Unit & Contents	Hrs.
	Citric acid cycle: Cyclic overview and reactions. Metabolic sources of acetyl CoA. Regulation and amphibolic nature of the cycle. Glyoxylate cycle **Dark reactions of Photosynthesis:** CO2 fixation: C3, C4 and CAM pathways	
	Unit Outcome: **UO 1.**After completion of this unit the student will understand Biochemical reaction of carbohydrates.	
III	**Lipid Metabolism**	**11Hrs.**
	Lipid Metabolism: β oxidation of unsaturated and saturated fatty acid and its regulation. Propoinyl CoA metabolism, significance of ketone bodies, Biosynthesis of palmitate and its regulation. **Amino acid metabolism**: Transamination, deamination, Fate of amino acid skeleton, urea cycle, precursors for compounds other than proteins, Genetic diseases.	
	Unit Outcome: **UO 1.** After completion of this unit the student will understand Biochemical reaction of lipid	
IV	**Nucleotide Metabolism and Enzymes**	**11 Hrs.**
	Nucleotide Metabolism: Salvage and de novo pathways of purine and pyrimidine, nucleotide biosynthesis. Formation of deoxyribonucleotides, origin of thymine. **Enzymes and Coenzymes**: Classification, Enzyme Kinetics, Effect of pH, Inhibitor, Activator. Regulation of enzyme activities.	
	Unit Outcome: **UO 1.** After completion of this unit the student will Understand nucleic acid metabolism and enzymes and coenzymes	

Learning Resources:

1. Garret, R. H., & Grisham, C. M. (1995). *Biochemistry*. (5 thedn).CBS publishers & distributors,Delhi
2. Hames, D., & Hooper, N., (2005). Instant notes in Biochemistry (3rd.ed). Taylor & Francis, London.
3. Horton, H. R., Morson, L. A., Scrimgeour, K. G., Perry, M. D., & Rawn, J. D. (2006). *Principles of biochemistry*. Pearson *educations, international, NewDelhi*.

4. Murray, R. K., & Granner, D. K., Mayes & P.A., Rodwell, V.W. (2012). Harpers. *Biochemistry* (29th Ed). Lange Medical Books/McGraw-Hill.ISBN: 978-0-07-176-576-3.
5. Nicholls, D. G., & Ferguson, S. J. (1992). *Bioenergetics*. Academic Press.
6. Tymoczko, J. L., & Stryer, L. (2011). *Biochemistry* (7th.ed). W. H. Freeman and Company· New York.
7. Voet, D., & Voet, J. G. (2011). *Biochemistry (4th ed)*. John Wiley & Sons.
8. Zubay, G. (2017). *Biochemistry* (4th Ed). McGraw-Hill.
9. Biochemistry, 3rd Ed. (2005), Voet Donald and Voet Judith G. John, Publisher: Wiley & sons, New York. 2. Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, Stryer Lubert, Publisher: W. H. Freeman, New York.
10. Lehninger's Principles of Biochemistry, 4th edition, (2005) Nelson D. L. and Cox M. M. W. H. Freeman & Co. NY.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-III

Course Title: MMC-III Lab Course –II (Based on MMC-III)

Course Code: 601ZOO1106

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives:

LO 1.To understands the preparation of acid and alkali solution, and measuring pH.

LO 2.To understands the concepts of preparation of buffers.

LO 3.Determine presence of macromolecules likes carbohydrates, proteins, lipids, etc. in known

LO 4.To estimate Micromolecules such as glucose, Amino acids, Nitrogenous bases from unknown samples.

Learning Outcomes:

After completion of this course students should be able to-

CO1. Prepare acid, alkali solution of different normality, Molarity, and concentration.

CO2. Prepare different types of buffer solution.

CO3. Analysis different macromolecules and Micromolecules

CO 4.Estimate Micromolecules such as glucose, Amino acids, Nitrogenous bases from unknown samples.

Sr. No.	Unit
Basic and standardization Methods. (3P)	
1	Preparation of Acid and Alkali solutions and acid-base titration. Problems and concepts related to mole, Molarity, normality, buffers
2	Concept of pH. Measuring pH of different solutions
3	Preparation of buffers: Acetate, Phosphate and Tris-buffers
Estimation of Micromolecules. (4P)	
4	Estimation of amount of Protein by Biuret method/Bradford method/Lawry
5	Estimation of amount of carbohydrate from given sample by Anthrone reagent
6	Estimation of amount of lipid from given sample by Chloroform methanol mixture
7	Estimation Of DNA By Diphenylamine Reaction
8	estimation of RNA by Orcinol method

Separation of Micromolecules by paper / Thin layer chromatography (3P)	
9	Sugars, Amino acids and Nitrogenous Bases
10	Effect of temperature on enzyme action
11	Effect of pH on enzyme action
12	Effect of temperature on enzyme action
13	Effect of temperature on enzyme action

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-I

Course Title: MEC-I: Tools and Techniques in Biology

Course Code: 601ZOO1201

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1- To understand the fundamentals of optical microscopy and handling of different types of Microscope.

LO 2- To understand various analytical techniques of different chromatography,

LO 3. To understand various analytical techniques like, Radioisotopes technique and spectroscopy

LO 4. To understand various analytical techniques like, Electrophoresis, Centrifugation, Microtomy and Cry technique

Course Outcomes:

After completion of course the student will be able to-

CO 1. Understand the fundamentals of optical microscopy and handling of different types of Microscope.

CO 2- Understand various analytical techniques of different chromatography,

CO 3. Understand various analytical techniques like, Radioisotopes technique and spectroscopy

CO 4. Understand various analytical techniques like, Electrophoresis, Centrifugation, Microtomy and Cry technique

Unit No.	Title of Unit & Contents	Hrs.
I	**Microscopes and Microscopic Techniques**	**12 Hrs.**
	Fundamentals of optical microscopy: Introduction to optics scales of magnification and limits of resolution, Microscope designs and types, imaging components and image formation Abbe's theory of microscopic resolution. **Contrast in Microscopy:** Fundamentals of contrast modulation in bright-field and dark-field, Concept of phase differences, Phase contrast microscopy, Applications **Light Microscope :**Compound and Inverted microscope, Florescence microscopy in brief **Electron Microscopy:** SEM, and TEM Microscopic image documentation in brief.	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcome: **UO 1-**After completion of course the student will be able to Understand the fundamentals of optical microscopy and handling of different types of Microscope.	
II	**Chromatography**	**11 Hrs.**
	Adsorption chromatography Partition chromatography Ion-exchange chromatography Affinity chromatography Molecular exclusion chromatography Thin layer chromatography HPLC, FPLC, selection of chromatographic system	
	Unit Outcome: **UO 1-** After completion of course the student will be able to understand various analytical techniques of different chromatography,	
III	**Spectrophotometry**	**11Hrs.**
	UV-visible light spectroscopy Spectro flourimetry Infrared and Raman spectroscopy Nuclear magnetic resonance spectroscopy Applications in biology **Radioisotopes Technique:** Nature of radioactivity, detection and measurement of radioactivity, counting radioactivity, applications of radioisotopes in biology	
	Unit Outcome: **UO 1-** After completion of course the student will be able to understand various analytical techniques like, Radioisotopes technique and spectroscopy	
IV	**Electrophoresis , Centrifugation, Microtomy and Cry technique**	**11 Hrs.**
	General principles, Support media, electrophoresis of proteins and nucleic acids, Capillary electrophoresis. **Centrifugation:** Basic principles of sedimentation, Types of centrifuges, Analytical Centrifugation, Preparative centrifugation. **Microtome:** Types and applications. Collection & preservation of animal tissue – fixation, embedding, Sectioning, Staining, Identification of deferent components. Tissue preparation for light microscopy. Cry techniques: History and applications of Cry techniques, Cryoultramicrotomy.	
	Unit Outcome:	

Unit No.	Title of Unit & Contents	Hrs.
	UO 1-After completion of course the student will be able to understand various analytical techniques like, Electrophoresis,Centrifugation, Microtomy and Cry technique	

Learning Resources:

1. Principles and Techniques in biochemistry and molecular biology Wilson & Walker
2. Sharma V.K. (1991), Techniques in microscopy and cell Virology, Tata-Mc Craw Hill.
3. Robert Braun Introduction to instrumental analysis Mc.Crew.Hill
4. Bisen & Mathew. Tools and Techniques in Life Sciences, CBS Publishers & distributors.
5. Modern Tools and Techniques to Understand Microbes by Ajit Varma and Arun Kumar Sharma , Springer Publication. https://www.google.co.in/books/edition/Modern_Tools_and_Techniques_to_Understan/jVG5DgAAQBAJ?hl=en&gbpv=1&dq=Tools+and+Techniques+in+Biology&printsec=frontcover
6. Biochemical analysis Tools (Methods For Biochemical studies) by Oana Maria Bouldura Dr. Cornel Balta and Naser Sayad https://www.google.co.in/books/edition/Biochemical_Analysis_Tools/0Er9DwAAQBAJ?hl=en&gbpv=1&dq=Tools+and+Techniques+in+Biology&printsec=frontcover
7. Tools and Techniques in Bimolecular Science by Aysha Divan and Janice Royds https://www.google.co.in/books/edition/Tools_and_Techniques_in_Biomolecular_Sci/0NwDmnKTnQ4C?hl=en&gbpv=1&dq=Tools+and+Techniques+in+Biology&printsec=frontcover

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-II: Forensic Biology and Investigation (B)

Course Code: 601ZOO1202

Credits: 03 **Max. Marks: 75** **Lectures: 45Hrs.**

Learning Objectives:

LO 1 -To understand the fundamental principles and functions of forensic science. The significance of forensic science to human society.

LO 2 -To understand the working of the forensic establishments in India and abroad.

LO 3 -Beginning to apply knowledge from all scientific disciplines to the study of crime.

LO 4 -Apply forensic science research to the development of highly discriminating, accurate, reliable, cost-effective, rapid methods for the identification, analysis and interpretation of physical evidence.

Course Outcomes:

After completion of course the student will be able to-

CO 1-To define forensic science and describe various areas related them to modern day practice.

CO2-To emphasize the importance of scientific methods in crime detection.

CO3 -To get the information on careers in forensic science.

CO4-To recognize, identify, examine and testify any and every kind of physical evidence mostly found in crime scenes.

CO5-To provide a platform for students and forensic scientists to exchange views, collaborative programs and work in a holistic manner for the advancement of forensic science.

Unit No.	Title of Unit & Contents	Hrs.
I	**History & Development of Forensic Science**	**12 Hrs.**
	.Definition, History & Development, Scope, Ethics in Forensic Science Nature, Types, Search methods, Collection, Preservation, Packing &Forwarding of Physical & Trace evidence for forensic analyses, Custody. Crime Scene: Unnatural deaths, Criminal assaults, Sexual offences, Poisoning, Vehicular accidents Courts: Types, powers and jurisdiction, Admissibility of evidence. Organization of Forensic Science Laboratories of Centre and State, NCRB and NICFS Fundamental Rights: Right of Equality (Articles 14 to 18) and Right of	

	Freedom (Articles 19 to 22) as per Constitution of India. Criminal Profiling: Profile of victim and culprit, its role in crime investigation, Lie detection (Polygraphy), Brain mapping,	
	Unit Outcome: **UO 1**-This Unit will provide students to understand History & Development in Forensic Science	
II	**Tools and Techniques in Forensic Science**	**11 Hrs.**
	Microscopy, Stereoscopic, Fluorescent &Electron Microscopes. Spectrophotometry: UV, Visible, IR, Atomic absorption, X – rays, XRD, Spectroscopy. Chromatographic Techniques: GLC, HPLC, HPTLC, GC-MS, LC-MS, IR-MS and ICP-MS. Electrophoresis: Immunoassays: Principle, Types, Techniques and applications	
	Unit Outcome: **UO 1**-This unit will provide students to understand tools and techniques used in forensic science	
III	**Sample Analysis in Forensic Science**	**11Hrs.**
	Detection and Identification of Blood stains. Blood Group Systems. Detection of Seminal and other body. Fluids and their Blood. Disputed Paternity & Maternity...DNA: Structure, DNA as genetic marker, DNA Extraction and Profiling Techniques and RNA Profiling & their applications. Analysis of Ethyl alcohol in beverages, liquors, biological fluids, liquors. Analysis of Chemicals in Trap Cases. Insecticides & Pesticides & Sedatives, Narcotics, Drugs of abuse and their Toxicity Plant poisons.	
	Unit Outcome: UO 1-This unit will provide students to understand Sample Analysis in Forensic Science.	
IV	**Forensic Investigation**	**11 Hrs.**
	Fire and Arson: Analyses of Petroleum Products and other incendiary materials. Explosives: Definition, Types and Analyses. Bombs: Country made bombs, Improvised Explosive Devices (IEDs) and their examination. Investigation in Explosion and Arson related cases. Photography: Types, application in criminal investigation& Forensic evidence examination.	

	Hair& Fibers: Nature, Types, Structure and Examination. Pollens and Diatoms: application in Forensic investigation. Dust & Soil: Nature, Types, Forensic Examination. Paint, Lacquer & Varnishes: Nature, composition and forensic examination. Glass: Composition, Types, Fractures, Examination. Cement, Mortar and Concrete: General Composition, Forensic Analysis. Computer Forensics: Introduction, Types of Computer crimes, Digital evidence- Seizure, Acquisition and Forensic examination. Mobile Phone Forensics.	
	Unit Outcome: **UO 1**-This unit will provide students to understand various forensic investigation	

Learning Resources:

1. Dahiya, M. S. (2015). Principles and practices in contemporary forensic sciences, shanty Prakashan.
2. James, S. H., &Nordby, J. J. (2005). Forensic science: An introduction to scientific and investigative techniques (2nd ed). CRC Press.
3. Krishnamachari, V. (2017). Law of evidence (7th ed), S. Gogia, & Company.
4. Maloney, M. S. (2014). Crime Scene Investigation: Procedural Guide, CRC Press.
5. Robert, C. (2011). Shaler, crime scene forensics: A scientific method approach. CRC Press.
6. Tilstone, W. J., Hastrup, M. L., &Hald, C. (2013). Fisher's techniques of crime scene investigation. CRC Press Press.
7. Vij, K. (2014). Textbook of forensic medicine and toxicology: Principles and practice— E-book. Elsevier India. ISBN: 8131237850, 9788131237854.
8. **Essential Forensic Biology by Alan Gunn**
   https://www.google.co.in/books/edition/Essential_Forensic_Biology/3gCCDwAAQBAJ?hl=en&gbpv=1&dq=Forensic+Biology+and+Investigation&printsec=frontcover
9. **Forensic Biology by Max M. Houck**
   https://www.google.co.in/books/edition/Forensic_Biology/3t6cBAAAQBAJ?hl=en&gbpv=1&dq=Forensic+Biology+and+Investigation&printsec=frontcover
10. **Molecular Forensic by Ralph Rapley and Devid Whitehouse**
    https://www.google.co.in/books/edition/Molecular_Forensics/fgL0Lt_1-EUC?hl=en&gbpv=1&dq=Forensic+Biology+and+Investigation&printsec=frontcover
11. **Crime and Circumstances by Suzanne Bell**
    https://www.google.co.in/books/edition/Crime_and_Circumstance/HoDDEAAAQBAJ?hl=en&gbpv=1&dq=Forensic+Biology+and+Investigation&printsec=frontcover

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-I

Course Title: MEC Lab Course –IV (Based on MEC- I (A)

Course Code: 601ZOO1203

Credits: 01 **Max. Marks: 50** **Hours: 30 Hrs**

Leaning Objectives

LO 1. To understand practical approach of Life and Diversity of Non-chordate

LO 2. To understand Identification, Classification of different invertebrates specimens

LO 3. To learn dissection of earthworms skill by demonstration /Software/ Charts etc

Course outcomes

After completion of course the student will be able to-

CO 1. Understand practical approach of Life and Diversity of Non-chordate

CO 2. Analyze Identification, Classification of different invertebrate's specimens.

CO 2. Comprehend the dissection of earthworm's skill by demonstration Software /Charts

Practical No.	Unit
1	Components of light microscopy, upright and inverted microscopes, episcopic and Diascopic microscopic alignment. Different types of lenses, Numerical apertures
2	Handling and adjustment of microscopic components, Method of Koehler illumination, Interpupillary and diopter adjustment. Microscopic image documentation techniques. Other techniques related practical
3	Study of pH of a solution/sample by using pH meter
4	Gel filtration
5	Ion exchange chromatography
6	Density gradient centrifugation
7	Thin layer chromatography
8	Radioactivity based problems
9	Separation and analysis of DNA by using agarose gel electrophoresis
10	Separation of protein by electrophoresis (native and SDS page)
11	Spectroscopy based practicals about study of biomolecules Colorimeter, UV-Visible spectrophotometer, FTIR
12	Study of histology of animal tissues by using microtome techniques.

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-II Lab Course –IV (Based on MEC- II (B)

Course Code: 601ZOO1203

Credits: 01 **Max. Marks: 50** **Hours: 30 Hrs**

Leaning Objectives

LO 1-To understand and Gain knowledge about crime and its elements.

LO 2-To demonstrate skill in handling clinical equipment

LO 3 -To explain the characteristics of clinical samples analysis.

Course outcomes

Upon Completion of this Course students will able to -

CO 1- learn the general technique for fingerprint rolling

CO 2- Explain the role of glass analysis in forensics • Identify fracture and impact patterns using the 3R rule

CO 3- will perform the basic steps of an autopsy on a grass frog to practice the steps a forensic pathologist or medical examiner uses to determine cause of death.

CO 4-Anthropometry to estimate the height of an individual when only partial skeletal remains are discovered.

Practical No.	Unit
1.	Finger rolling technique and minutiae identification
2.	lifting fingerprints
3.	DNA extraction from sample
4.	Gel Electrophoresis
5.	Bloodstain Analysis - Height And Volume
6.	Bloodstain Analysis - Angle Of Impact
7.	Fiber Analysis of Forensic Sample
8.	Tire Track Analysis of Forensic Sample
9.	Fracture Analysis
10.	Grass Frog Autopsy
11.	Using Anthropometry To Estimate Height

N.B.: Any Ten Practicals from above

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: RMC

Course Title: RMC-II: Research Methodology

Course Code: 601ZOO1201

Credits: 03 **Max. Marks: 75** **Lectures: 45Hrs.**

Learning Objectives:

LO 1.To understands and work methods and concepts related Research.

LO 2.To develop research Design and Sampling

LO 3. To develop skills of Data Collection and Data Processing

LO 4. To examine the Report writing evaluations and plagiarism

Course Outcomes:

After completion of course Students are enable to-

CO 1. Understands and work methods and concepts related Research.

CO 2. Develop research Design and Sampling

CO 3. Develop skills of Data Collection and Data Processing

CO 4. Examine the Report writing evaluations and plagiarism

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction and Methods of Research:**	**12 Hrs.**
	Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods, Research processes, Criteria for good research Research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining a problem	
	Unit Outcome: **UO 1**-This Unit will provide students to Understands and work methods and concepts related Research.	
II	**Research Design and Sampling:**	**11 Hrs.**
	Meaning and need for research design, features of a good design. Important concepts relating to research design: Dependent and independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis –Testing research, Experimental and control group	

	Different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis- testing research studies, basic principles of experimental designs, Important Experimental Designs Sampling Design, steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design	
	Unit Outcome: **UO 1**-This unit will provide students to develop research Design and Sampling	
III	**Data Collection and Data Processing:**	**11Hrs.**
	Measurements in Research, Measurement Scales, Sources of errors in measurement. Collection of primary data: Observation Method, Interview Method, through questionnaires, through schedules, difference between questionnaire and schedule Collection of secondary data, Selection of appropriate methods for data collection, Case study method Data processing, processing operations: editing, coding, classification, tabulation, Graphical representation, types of analysis, Statistical tools and techniques of data analysis-measures of central tendency, dispersion.	
	Unit Outcome: UO 1-This unit will provide students to understand Develop skills of Data Collection and Data Processing	
IV	**Report writing and evaluations:**	**11 Hrs.**
	Principles of report writing and guide lines according to style manuals. Writing and presentation of preliminary, main body and reference section of report. Evaluation of research report. Methods to search required information effectively, Reference Management Software like Zotero/ Mendeley, Software for paper formatting like LaTeX/ MS Office. Software for detection of Plagiarism.	
	Unit Outcome:	

	UO 1-This unit will provide students to Examine the Report writing evaluations and plagiarism	

Learning Resources:

1. Bajpai S. R. (1975) Methods of Social Survey and Research, Kitabghar, Kanpur.
2. Hans Raj (1988) Theory and Practice in Social Research, Surjeet Publication, Kolhapur.
3. Krishnaswami O. R. (1988) Methodology of Research in Social Science, Himalaya Pub.
4. House.
5. Sadhu, Singh, Research Methodology in Social Science Bhandarkar, Research Methodology
6. Kothari, C. R. (2005) Quantitative Technique, New Delhi, Vikas Publication House.
7. Gautam, N. C. (2004) Development of Research tools, New Delhi, Shree Publishers.
8. Gupta, Santosh (2005) Research Methodology and Statistical Techniques, Deep and Deep
9. Publications.
10. Chandera A. and Sexena T. P. (2000) Style Manual, New Delhi, Metropolitan Book Comp.Ltd.
11. Shukla, J. J. (1999) Theories of Knowledge, Ahmadabad, Karnavati Publication.
12. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.
13. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New
14. York, Routledge Publication.
15. Best J. W. and Khan J. V. (2005) Research in Education New Delhi, Prentice Hall India.

Semester - II

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-IV

Course Title: MMC-IV: Comparative Anatomy of Vertebrates

Course Code: 601ZOO2101

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the diversity and origin of chordates

LO 2. To understand diversity of chordates.

LO 3. To understand comparative functional anatomy from Pisces to mammals

LO 4. To Comparative functional anatomy and adaptation from Pisces to mammals

Course Outcomes:

After completion of course the student will be able to -

CO 1. Understand the diversity and origin of Chordates.

CO 2. Understand diversity of Chordates.

CO3.Explain comparative functional anatomy from Pisces to mammals

CO 4.Describe the comparative functional anatomy and adaptation from Pisces to mammals.

Unit No.	Title of Unit & Contents	Hrs.
I	**Diversity and Origin of Chordates**	**12 Hrs.**
	Protochordata: Urochordata and Cephalochordata. **Amphioxus :** a generalized chordate ,The origin of chordates from filter feeding animals **Cyclostomes:**General characteristics and classification of Cyclostomes **Fishes:** General characteristics and classification of fishes. **Amphibians:**General characteristics and classification of Amphibians.	
	Unit Outcome: UO 1. After completion of course the student will be able to Understand the Diversity and Origin of Chordates.	
II	**Diversity of Chordates**	**11 Hrs.**
	Reptiles: History, General characteristics and classification of Reptiles **Aves:** History, General characteristics and classification of birds. **Mammals:** History, General characteristics and classification of Mammals. Evolution of Mammals	
	Unit Outcome:	

Unit No.	Title of Unit & Contents	Hrs.
	UO 1. After completion of course the student will be able to understand Diversity of Chordates	
III	**Comparative functional anatomy from Pisces to mammals**	**11Hrs.**
	Integumentary system: Integument and its derivatives. Skeletal system **Nervous system:** brain, and spinal cord **Respiratory systems :** Gills, Lungs **Circulatory system:** Heart and aortic arches	
	Unit Outcome: **UO 1.** After completion of course the student will be able to explain comparative functional anatomy from Pisces to mammals	
IV	**Comparative functional anatomy and adaptation from Pisces to mammals**	**11 Hrs.**
	Digestive and excretory system Reproductive system comparison of male and female Special salient features and adaptations in vertebrates Reptilia: Adaptive radiation in reptiles Aves: Flight adaptation and migration Adaptive radiation in mammals	
	Unit Outcome: **UO 1.** After completion of course the student will be able to describe the Comparative functional anatomy and adaptation from Pisces to mammals.	

Learning Resources:

1. Life of vertebrates by J.Z. Young
2. An Introduction to Zoology –Investigating the Animal world by Joseph T. Springer and Dennis Holley
3. A textbook of zoology Vol. IIby Parker and Haswell (revised by Marshall)
4. Comparative vertebrate anatomy by Hyman.
5. Vertebrate structure and function by Waterman.
6. Evolution of vertebrates by E.H. Colbert. Vertebrates –R. L. Kotpal
7. Chordate Zoology E. L. Jordan & P. S. Verma Vertebrate Zoology & Evolution –Yadav B. N. & D. Kumar

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-IV

Course Title: MMC-V Lab Course –V (Based on MMC-IV)

Course Code: 601ZOO2104

Credits: 01 **Max. Marks: 50** **Hours: 30 Hrs**

Learning Objectives

LO 1. To understand practical approach of Life and Diversity of chordate

LO 2 to understand Identification, Classification of different vertebrates specimens

LO 3. To learn mounting skills of different scales of fishes and other material of animals

LO 4. To understand skills of dissection of vertebrates and Osteology

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Analyze Identification, Classification of different vertebrate's specimens.

CO 2. Comprehend the skills of Mounting of different materials of animals

CO 3.Learn mounting skills of different scales of fishes and other material of animals

CO 4.Understand skills of dissection of vertebrates and Osteology

Practical No.	Unit
	Identification, Classification and comments on the slides/specimens of:
1	Protochordates: Balanoglossus, salpa, Doliolum, Herdmania, Amphioxus
2	Pisces: Zygaena, pristis, ophiocephalus, Mastacembalus, Catla-catla,
3	Exocoetus, Hippocampus, Syngnathus, Diodon, Notopterus.
4	Amphibia: Icthyophis, Rhacophorus, Rana, Necturus, Ambystoma.
5	Reptilia Chameleon, phrynosoma, varanus, crocodilus, cobra
6	Aves: Bubo, Duck, Vulture, Psittacula, Pigeon.
7	Mammalia: Loris, Bat, Pangolin, Funambulus, Shrew.
8	Study of whole mount of Cycloid, Ctenoid and Placoid Cells
9	Estimation of age of fishes through Scales
10	Dissection and/ or its demonstration through models/video/CD etc Digestive system, Brain , Afferent and Efferent artery of fish
11	**Osteology:** Skull of fowl, Dog, /Rabbit. Vertebral column: Atlas vertebra, Axis vertebra, Trunk, lumbar, caudal. Pelvic Girdle, Pectoral girdle
12	Visit to Zoo park

N.B.: Any Ten Practicals from above

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-V

Course Title: MMC-V: (Molecular Biology)

Course Code: 601ZOO2102

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the Genome organization and DNA Replication.

LO 2.To understand DNA damage and repair

LO 3.To understand transcription and translation regulations in prokaryotes and eukaryotes.

LO 4.To understand translational regulation

Course Outcomes:

After completion of this course students should be able to:

CO 1. Describe genome organization and DNA Replication

CO 2. Explain the molecular events in DNA damage and repair

CO 3. Explain the Transcription and translation regulations in prokaryotes and eukaryotes.

CO 4. Explain the Translational regulation of eukaryotes.

Unit No.	Title of Unit & Contents	Hrs.
I	**Genome organization and DNA Replication:**	**12 Hrs.**
	C value paradox and genome size, Cot curves, repetitive and non-repetitive DNA sequence Organelle genome- Structure of chromatin, nucleosomes, chromatin organization and remodeling, higher order organization - chromosome, Centromere, telomere Histone and its effect on structure and function of chromatin DNA replication in E. coli, Origin of replication, , types of E. coli DNA polymerases, details of replication process, regulation of replication, connection of replication to cell cycle. Different models of replication for linear and circular DNA, replication features of single stranded phages.	
	Unit Outcome: **UO 1.** After completion of this course students should be able to describe genome organization and DNA Replication	
II	**DNA damage and repair:**	**11 Hrs.**

Unit No.	Title of Unit & Contents	Hrs.
	Eukaryotic DNA replication, multiple replicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex (ORC), regulation of replication Different types in DNA damages, Different DNA repair systems: Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair. Homologous and site specific recombination Transposable DNA elements	
	Unit Outcome: **UO 1.** After completion of this course students should be able to explain the molecular events in DNA damage and repair	
III	**Transcription and translation regulations in prokaryotes and eukaryotes.**	**11Hrs.**
	Activating transcription: Transcription activating factors, Different domains in transcription factors, Mechanism of transcription activation, response elements recognized by activators. **RNA processing Splicing**: Nuclear pre-mRNA splicing - spliceosomes, alternative splicing, trans splicing tRNA splicing, rRNA splicing - autosplicing in group I and group II introns. Editing: types of editing gRNA mediated editing, enzyme mediated editing 3'processing: Polyadenylation, PARP, Poly (A) signal	
	Unit Outcome: UO 1. After completion of this course students should be able to explain the Transcription and translation regulations in prokaryotes and eukaryotes.	
IV	**Translational regulation**	**11 Hrs.**
	mRNA stability, half-life- Polyadenylation, polypore formation mRNA structure-3' and 5' UTRs CAP mRNA stability 5'Processing: Capping, importance of capping, mechanism of capping independent, CAP dependent translation, IRE sites, multiple ORFs, 5' and 3' structures formed, role of initiation and elongation factors Mechanism of global and mRNA specific regulation of translation: Initiation by eIF2, cap binding protein assembly, IRE mediated regulation, morns –as trans regulating proteins, m RNA mediated regulation, mRNA localization and regulation of translation, protein	

Unit No.	Title of Unit & Contents	Hrs.
	degradation and regulation of translation	
	Unit Outcome: **UO 1.** After completion of this course students should be able to explain the Translational regulation eukaryotes.	

Learning Resources:

1. Genes IX, 9th edition (2008), Benjamin Lewin, Publisher - Jones and Barlett Publishers Inc.

2.Molecular Biology of the Gene, 5th Edition (2004), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Publisher - Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.

3. Molecular Biology, 4th Edition (2007), Weaver R., Publisher-McGrew Hill Science.

4. Molecular Biology of the Cell, 4th Edition (2004), Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Publisher: Garland Publishing.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-V

Course Title: MMC-VI Lab Course-VI (Based on MMC-V)

Course Code: 601ZOO2105

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO 1. To understand the Spectrophotometric analysis of nucleic acid and amino acids.

LO 2. To understand the Gel Electrophoretic analysis of nucleic acid and proteins

LO 3. To understand the process of preparation of plasmid isolation and Bacterial cell culture

LO 4. To understand the process of Preparation of Competent cells of E.Coli and its Transformation

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the Spectrophotometric analysis of nucleic acid and amino acids.

CO 2. Understand the Gel Electrophoretic analysis of nucleic acid and proteins

CO 3. Understand the process of preparation of plasmid isolation and Bacterial cell culture

CO 4. Understand the process of Preparation of Competent cells of E.Coli and its Transformation

Practical No.	Unit
1.	Spectrophotometric analysis of nucleotides and amino acids
2.	Agarose Gel Electrophoresis
3.	SDS-Polyacrylamide Gel Electrophoresis
4.	Growth of Bacterial Culture and Preparation of Growth Curve
5.	Isolation of Plasmid DNA from Bacteria
6.	Restriction Digestion of Plasmid DNA
7.	Preparation of Competent cells of E.Coli and its Transformation
8.	. Bacteriophage Titration
9.	Isolation of Bacterial Genomic DNA
10.	Isolation of High Molecular Weight DNA and Analysis.
11.	PCR and Optimization of Factors Affecting PCR
12.	Southern Hybridization
13.	Northern Hybridization
14.	Western Blotting

N.B.: Any Ten Practicals from above

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-VI

Course Title: MMC-VI: Genetics and r-DNA Technology

Course Code: 601ZOO2103

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the Mendel's Laws of inheritance.

LO 2. To understand the function of gene chromosome theory of inheritance

LO 3. To understand sex linked genes and chromosomal mutations.

LO 4. To understand the principles of recombinant DNA technology

Course Outcomes:

After completion of this course students should be able to:-

CO 1. Understand the Mendel's Laws of inheritance.

CO 2. Understand the function of gene chromosome theory of inheritance

CO 3. Understand sex linked genes and chromosomal mutations.

CO 4. Understand the principles of recombinant DNA technology

Unit No.	Title of Unit & Contents	Hrs.
I	**UNIT I: Transmission Genetics**	**12Hrs.**
	History of Genetics, Scope and significance of genetics, Mendel's law of Inheritance **Allelic variation and gene function**-; Incomplete dominance, co-dominance, multiple alleles **Gene action**-from genotype to phenotype. Gene interaction, reentrance, expressivity, Epistasis, pleiotropic, interaction with environment.Genomic imprinting, Continuous variation, Quantitative traits and significance of polygenic control. **Chromosome theory of inheritance** - Experimental evidence, non-disjunction as proof of chromosome theory, genic balance theory. Sex chromosome and sex determination - Human, Drosophila, other animals.	
	Unit Outcome: **UO 1.** After completion of this course students should be able to understand the Mendel's Laws of inheritance.	
II	**Sex linked Genes and Chromosomal Mutations.**	**11Hrs.**

Unit No.	Title of Unit & Contents	Hrs.
	Sex linked genes in humans - Hemophilia, colour blindness. **Dosage compensation of X- linked genes**. Hyper activation of X-linked gene in male drosophila, Inactivation of X-linked gene in female. **Maternal Inheritance**- Mitochondrial- Snail, poky and petite Chloroplast – leaf variegation in Mirabilis Jalapa, Lojap. Morphology of chromosomes, Structural and Numerical Variations Linkage, Recombination, Crossing over, Chromosome mapping (two point and three point test cross). **Mutation:** Mutagens, Spontaneous and induced Mutation, gene mutations-Point Mutations. Microbial Genetics: Conjugation, Transformation and transduction Phenomenon and mapping.	
	Unit Outcome: **UO 1.** After completion of this course students should be able to understand the function of gene chromosome theory of inheritance	
III	**Principles of Gene Manipulation**.	**10Hrs.**
	Basic recombinant DNA techniques, cutting and joining DNA molecules, restriction modification systems, various enzymes used in recombinant DNA technology Restriction maps and mapping techniques; nucleic acid probes, blotting techniques, DNA fingerprinting, foot printing, methyl interference assay. Polymerase chain reaction: methods and applications.	
	Unit Outcome: **UO 1.** After completion of this course students should be able to. Understand sex linked genes and chromosomal mutations.	
IV	**Methods and Applications of rDNA Technology**	**12 Hrs.**
	Basic biology of cloning vectors: plasmids, phages, single stranded DNA vectors, high capacity vectors, retroviral vectors, expression vectors and other advanced vectors in use. **Gene cloning strategies:**methods of transforming E. coli and other cells with rDNA; methods of selection and screening of transformed cells; construction of genomic and cDNA libraries; **Principles of DNA sequencing** – Sanger and Maxmam Gilbert DNA sequencing, automated sequencing methods; synthesis of oligo-nucleotides, primer design;	

Unit No.	Title of Unit & Contents	Hrs.
	Changing genes- gene transfer to animal cells, genetic manipulation of animals, transgenic technology, application of recombinant DNA technology; genetically modified organisms: gene knockouts, mouse disease models, gene silencing , CRISPRCAS- 9 genome editing	
	Unit Outcome: UO 1. After completion of this course students should be able to understand the principles of recombinant DNA technology	

Learning Resources:

1. Principles of Genetics by Robert H. Tamarin. Tata-McGraw Hill, Seventh Edition 2002).

2. Genetics, Principles and Analysis by Daniel Hartl& E.W. Jones. 4th Edition 1998; Jones &Barlett Publication.

3.The science of Genetics by Atherly, A. G. Girton, J. R & MC Donald, J. F. (1999) Saunders College Publications / Harcourt Brace.

4. Genetics – M.W. Strickberger Macmillan Publications New York. •Snustad D P, M J Simmons and J P Jenkins, 1997. Principles of Genetics. John Wiley and Sons, INC.

5.Griffiths A J F, H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart, 2000. An introduction to genetic analysis. W. H. Greeman. New York

6.genetics: A mendelian approach by russel• Concepts of genetics by klug and cummings

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MMC-VI

Course Title: MMC-VII Lab Course –VII (Based on MMC-VI)

Course Code: 601ZOO2106

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO 1. To understand the problems on pattern of inheritance.

LO 2. To understand the problems on pedigree analysis for tracing of ancestral history of organism

LO 3. To understand protocol of blood group analysis and karyotyping.

LO 4. To understand the principles of recombinant DNA technology and process of Preparation of Competent cells of E.Coli and its Transformation

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the problems on pattern of inheritance.

LCO 2. Understand the problems on pedigree analysis for tracing of ancestral history of organism

CO 3. Understand protocol of blood group analysis and karyotyping.

CO 4. Understand the principles of recombinant DNA technology and process of Preparation of Competent cells of E.Coli and its Transformation

Practical No.	Unit
1.	Problems based on monohybrid and dihybrid cross.
2.	Problems based on interaction of genes
3.	Problems based on pedigree analysis.
4.	Problems based on Hardy-Weinberg equilibrium.
5.	To study the human blood group by using given blood sample.
6.	Study of karyotype.
7.	Study of Human traits, Animal traits and plant traits for its diversity in phenotype.
8.	To study the transformation of E.coli. Cells with plasmid DNA.
9.	To study small scale extraction and purification of plasmid DNA.
10.	To set Restriction digestion reaction of pBR322 DNA
11.	Extraction and estimation of mitochondrial DNA and mapping by restriction endonuclease digestion

12.	Isolation, purification and electrophoresis of RNA
13.	To Prepare a passenger DNA by PCR using Taq DNA Polymerase
14.	Linearization of T- vector
15.	Ligation of PCR product into T-vector
16.	Transformation of Ligated T-vector.
17.	Quantitative analysis of gene expression using RT- PCR

N.B.: Any Ten Practicals from above

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-II: Biosystematics and Taxonomy (A)

Course Code: 601ZOO2201

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

CO 1. To understand the biosystematics and types of taxonomy

CO 2. To understand the dimensions of speciation and species concept and taxonomic procedures.

CO 3. To understand classification and nomenclature

CO 4. To understand the molecular taxonomy, Ethics in taxonomy and taxonomic evaluation

Course Outcomes:

After completion of this course students should be able to:

LO 1. Understand the biosystematics and types of taxonomy

CO 2. Understand the dimensions of speciation and species concept and taxonomic procedures.

CO 3. Understand classification and nomenclature

CO 4. Understand the molecular taxonomy, Ethics in taxonomy and taxonomic evaluation

Unit No.	Title of Unit & Contents	Hrs.
I	**Biosystematics, and types of taxonomy**	**12 Hrs.**
	Definition and basic concepts of Biosystematics, , Historical perspectives of Biosystematics and Taxonomy, Stages of taxonomic procedures-alpha taxonomy, Beta taxonomy and Gamma taxonomy, Neotaxonomy, Approaches/Trends in taxonomy-embryological, ecological, ethological, cytological, Biochemical, and numerical approaches in taxonomy Significance/Importance of Taxonomy in – biodiversity and conservation, research, medicine, agriculture and pest management, and fisheries	
	Unit Outcome: **UO 1-**After completion of course the student will be able tounderstand the biosystematics and types of taxonomy	
II	**Dimensions of speciation and species concept and taxonomic procedures.**	**11 Hrs.**

Unit No.	Title of Unit & Contents	Hrs.
	Dimensions of speciation and species concept – Biological species concept, evolutionary species concept, polytypic and monotypic species, subspecies, infraspecific groups, super species etc. Taxonomic Procedures – Methods of collection, Labeling, Preservation and curation of collections, cataloguing collections, Kinds of collections – survey collection, collections for general exhibit, research collections and others. Identification using taxonomic keys – simple dichotomous key, Bracket key, Indented key, serial key, branching key, circular key, box key, multi entry key and computer key. Comparing the identified specimen with previous description, comparing identified specimen with authenticated specimens, requesting help from specialists and Identification through internet.	
	Unit Outcome: **UO 1-** After completion of course the student will be able to understand the dimensions of speciation and species concept and taxonomic procedures.	
III	**Classification and nomenclature**	**11Hrs.**
	Classification – History of Animal classification, Kinds of classification – Natural classification, cladistics or phylogenetic classification, Phenetic classification and evolutionary classification, biological classification, hierarchical classification. Nomenclature – History of nomenclature, the nature of scientific names, Kinds of names descriptive,ecological,geographical,patronymic names. Meaning of authors names in brackets, Six types of zoological nomenclature – holotype,paratype,lectotype,syntype,neotype,allotype, Taxonomical publications – Short research papers, revision, monograph, faunal/floral works,	

Unit No.	Title of Unit & Contents	Hrs.
	synopses and reviews, hanbooks and mannuals, catalouges and checklists, atlases etc.	
	Unit Outcome: **UO 1-** After completion of course the student will be able tounderstand classification and nomenclature	
IV	**Molecular taxonomy, Ethics in taxonomy and taxonomic evaluation**	**11 Hrs.**
	Introduction to molecular taxonomy, DNA barcoding, Molecular Phylogenetics, method in molecular taxonomy and Significance of Molecular taxonomy. Systematics and molecular taxonomy Ethics in taxonomy – credit, lending and borrowing specimens, loan of materials, exchange of materials, collaboration and co-operations of researchers, use of language, ethics in taxonomic publications,correspondence,authorship of taxonomic papers, acknowledgement etc. Taxonomic evaluation - Evaluation of Biodiversity indices with brief reference to Shannon-Weinner index and dominance index.	
	Unit Outcome: **UO 1-**After completion of course the student will be able to understand the molecular taxonomy, Ethics in taxonomy and taxonomic evaluation	

Learning Resources:

Reference books

1. G.G. Simpson, Principle of animal taxonomy. Oxford IBH Publishing Company.
2. E. Mayer. Elements of Taxonomy. Oxford IBH Publishing Company.
3. E.O. Wilson. The diversity of Life (The College edition W.W. Northem & Co.
4. B.K. Tikadar. Threatened Animal of India, ZSI publication Calcutta
5. V.C. Kapoor. Theory and Practice of Animal Taxonomy. Oxford & IBH Publishing Co.
6. J.c. Avise, Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-II: Animal Biotechnology (B)

Course Code: 601ZOO2202

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning objectives:

LO 1. To understand necessary skills for Genetic Engineering and Transgenics:

LO 2. To understand necessary skills of Fish breeding, Androgenesis, Gynogenesis, and Gene bank and Conservation

LO 3. Understand necessary skills of Feed technology, Algal biotechnology and Nanotechnology in aquaculture

LO 4. Understand necessary Health management and Post-harvest biotechnology

Course Outcomes:

After completion of the course, students will be able to-

CO1. Apply necessary skills for Genetic Engineering and Transgenics technology.

CO 2. Understand to use Synthetic hormones for induced breeding, Androgenesis, Gynogenesis, Gene bank and Conservation

CO 3. Understand necessary skills of Feed technology, Algal biotechnology and Nanotechnology in aquaculture.

CO 4. Understand necessary Health management and Post-harvest biotechnology

Unit No.	Title of Unit & Contents	Hrs.
I	**Genetic Engineering and Transgenics:**	**12 Hrs.**
	Biotechnology: Origin, definition and knowledge of different branches. •**Genetic Engineering**: Recombinant DNA technology; Tools of genetic engineering – cloning vectors, restriction endonuclease, DNA lipases, topoisomerases, methylases, nucleases, polymerases, reverse transcriptase and their functions. •**Screening analysis of recombinants**: Colony hybridrization technique, immunological tests. •**Transgenics:** Principles of Transgenic technology and its applications in fisheries..	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcome: **UO 1-**After completion of course the student will be able understand knowledge of different branches of animal biotechnology,Genetic Engineering and Transgenics.	
II	**Fish breeding, Androgenesis, Gynogenesis,and Gene bank and Conservation**	**11 Hrs.**
	•**Fish breeding**: Synthetic hormones for induced breeding – GnRH analogue, structure and function; Selective breeding for improving fish stocks – hybridization in Indian fishes. •Androgenesis, Gynogenesis, Polyploidy and Sex reversal. •**Hormonal regulation**: reproduction and molting in important cultivable crustaceans. •**Gene bank and Conservation**: Cryopreservation of gametes and embryos. Embryo transfer technology	
	Unit Outcome: **UO 1-**After completion of course the student will be able understand concepts of Fish breeding, Androgenesis, Gynogenesis, and Gene bank and Conservation.	
III	**Feed technology, Algal biotechnology and Nanotechnology in aquaculture**	**11Hrs.**
	•**Feed technology**: Micro encapsulated feeds; micro coated feeds; micro particulate feeds and bio-encapsulated feeds; mycotoxins and their effects on feeds. •**Algal biotechnology:** Biotechnological approaches for production of important microalgae; single cell protein from Spirulina; vitamins, minerals and omega3 fatty acids from micro algae; enrichment of micro algae with micronutrients. •**Application of Nanotechnology**: nanotechnology in aquaculture; A general knowledge of tissue culture.	
	Unit Outcome: **UO 1-** After completion of course the student will be able understand concepts of Feed technology, Algal biotechnology and Nanotechnology in aquaculture.	

Unit No.	Title of Unit & Contents	Hrs.
IV	**Health management and Post-harvest biotechnology**	**11 Hrs.**
	Health management: DNA and RNA vaccines; molecular diagnosis of viral diseases; Biofilms and its impact on health management; genetically modified microorganisms as probiotics. •Nitrogen fixation in aquatic environment and Biofertilizers. • Post-harvest biotechnology: Delaying of spoilage; biosensors	
	Unit Outcome: **UO 1-** After completion of course the student will be able understand concepts of DNA and RNA vaccines; molecular diagnosis of viral diseases; Post-harvest biotechnology.	

Learning Resources:

1. Bhattacharya S.1992.Hormones in Pisciculture. Biology Education,Vol. 9 No.1 pp.31- 41.

2. CIFE. 1998. Summer School Manuals, Mumbai.

i). Recent Developments in Biotechnology: Applications to Aquaculture & Fisheries. ii). Genetics and Biotechnolical Tools in Aquaculture and Fisheries.

3. Felix S. 2007. Molecular Diagnostic Biotechnology in Aquaculture. Daya Publ. House.

4. ICAR. 1992. Biotechnology in Aquaculture. Training Manual. C.I.F.A, Kausalyaganga, Bhubaneswar, Orissa.

5. Lakra WS, Abidi SAH, Mukherjee SC & Ayyappan S. 2004. Fisheries Biotechnology. Narendra Publ. House.

6. Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. Biotechnology of Aquatic Animals. Science Publ.

7. Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ.

8. Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ.

9. Ramesh RC. 2007. Microbial Biotechnology in Agriculture and Aquaculture. Vol. II. Science Publ.

10. ReddyPVGK, Ayyappan, ThampyDM & Gopalkrishanan 2005.Text Book of Fish Genetics and Biotechnolical

11. Singh B. 2006. Marine Biotechnology and Aquaculture Development. Daya Publ. House

12. Animal Biotechnology, Models in Discovery and Translation.
https://www.google.co.in/books/edition/Animal_Biotechnology/s6wSXQHMZYIC?hl=en&gbpv=1

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-VIII Lab Course –VIII (Based on MEC- II (A)

Course Code: 601ZOO2203

Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To understand practical approach of Life and Diversity of Non-chordate

LO 2. To understand Identification, Classification of different invertebrates specimens

LO 3. To learn dissection of earthworms skill by demonstration /Software/ Charts etc

Course outcomes

After completion of course the student will be able to-

CO 1. Analyze Identification, Classification of different invertebrate's specimens.

CO 2. Comprehend the dissection of earthworm's skill by demonstration Software /Charts

Practical No.	Unit
1	Study of soil fauna: sampling, extraction / collection, preservation and analysis.
2	Collection, identification and preservation of various insect orders and arthropod groups (including study of permanent specimens)
3	Study of Freshwater planktons, collection, sorting, identification of samples of zooplanktons: protozoans, rotifers, crustaceans. (Including study of permanent specimens)
4	Study of biodiversity sampling using quadrate method: study of community in an ecosystem by determination of frequency density and abundance of different taxonomic groups (fauna only) present in the community.
5	Study of biotic component of a pond ecosystem and grouping on the basis of their trophic position.
6	Study of water quality and dissolved oxygen content in water samples of an ecosystem
7	Museum preservation techniques of selected vertebrates and invertebrates.
8	. Laboratory and field exercises of animal behaviors; Learning, Recognition, Feeding
9	Visit to ZSI Pune and other places.

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Zoology

Course Type: MEC-II

Course Title: MEC-VIII Lab Course –VIII (Based on MEC- II (B)

Course Code: 601ZOO2203

Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To understand basic concept Principles Animal Biotechnology.

LO 2. To understand principal and techniques of Recombinant DNA

LO 3. To understand Construction of Genomic Library. Food preservation. harmone therapy and advancement in animal biotechnology.

Course outcomes

After completion of the course, students will be able to-

CO 1. Understand Utilize the developed expertise in concepts, practical, and emerging methodologies in animal biotechnology.

CO 2. Understand general principal and techniques of Recombinant DNA.

CO 3. Understand Food preservation.harmone therapy and Advancement in animal biotechnology.

Practical No.	Unit
1	Isolation of Genomic DNA from Bacteria
2	isolation and purification of Plasmid DNA
3	Demonstration of Protocol for PCR
4	Demonstration DNA microinjection method
5	Demonstration gene gun method.
6	Demonstration of blotting techniques.
7	Isolation of Lactic Acid Bacteria from Curd
8	Collection and preservation of fish pituitary gland and preparation of pituitary extract for induced breeding
9	Cryopreservation of fish gametes.
10	Cell density of algal culture.
11	Eyes talk ablation procedure in crustaceans.
12	Determination of some stages of the molting cycle of *penaeus duorarum, by microscopic examination*

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

PG First Year

Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken Tutorial Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
Research Methodology	100	10	10	20	10	-	-	40	60	100
DSC/DSE	75	05	10	15	10	-	-	30	45	75
Lab Course	50	-	-	-	-	05	20	-	25	50
Field Project	100	10	10	20	10	-	-	40	60	100

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks.