SIDDHARTH UNIVERSITY

KAPILVASTU, SIDDHARTH NAGAR (U.P.)

Program Structure and Course Curriculum

B.Sc – Zoology

(4-Year Program)

(According to CBCS & NEP 2020)

Faculty of Science

Siddharth University, Kapilvastu, Siddharth Nagar

Syllabus as per the guidelines of the State Higher Education Council

(Partially modified: Board of Studies meeting on 8th July 2025)

July 2025

SIDDHARTH UNIVERSITY

KAPILVASTU, SIDDHARTH NAGAR (U.P.)

Syllabus Developed/Proposed by				
S.No.	**Name of Expert/BOS Member**	**Designation**	**Department**	**College/ University**
1.	Dr. Ashutosh Srivastava	Chairperson	Department of Zoology	Siddharth University, Kapilvastu, Siddharth Nagar
2.	Dr. Ashish Srivastava	Member	Department of Zoology	Siddharth University, Kapilvastu, Siddharth Nagar
3.	Dr. Vineeta Rawat	Member	Department of Zoology	Siddharth University, Kapilvastu, Siddharth Nagar
4.	Prof. Susmita Srivastav	Member	Department of Zoology	Shiv Harsh Kisan PG College, Basti
5.	Prof. Ashok Kumar	Member	Department of Zoology	M.L.K PG College, Balrampur
6	Dr. Ayushi Mishra	Member	Department of Zoology	Shiv Harsh Kisan PG College, Basti
7	Mr. Harinarayan Chauhan	Member	Department of Zoology	Shiv Harsh Kisan PG College, Basti
8	Prof. Ajay Singh-	External Subject expert	Department of Zoology	DDU Gorakhpur University, Gorakhpur
9	Prof. Veena Batra Kushwaha	External Subject expert	Department of Zoology	DDU Gorakhpur University, Gorakhpur
10	Prof. Arvind Kumar Singh	External Subject expert	Department of Zoology	BHU Varanasi

Siddharth University

Kapilvastu. Siddharth Nagar (U.P.)

B.Sc. Program Structure and Course Curriculum According to CBCS (NEP 2020)

(Partially modified: Board of Studies meeting on 8th July 2025)

Subject: Zoology (UG)

Year	Course Code	Paper Title	Theory/Practical	Credits
First		**Semester-I**		
	B050101T	Cytology, Genetics and Immunology	Theory	04
	B050102P	Cell Biology and Cytogenetics Lab	Practical	02
		Semester-II		
	B050201T	Biochemistry and Physiology	Theory	04
	B050202P	Physiological, Biochemical & Hematology Lab	Practical	02
E		**Exit 1: Certificate in Medical Diagnostics & Public Health**		
Second		**Semester-III**		
	B050301T	Molecular Biology, Bioinstrumentation & Biotechniques	Theory	04
	B050302P	Bioinstrumentation & Molecular Biology Lab	Practical	02
		Semester-IV		
	B050401T	Gene Technology and Human Welfare	Theory	04
	B050402P	Genetic Engineering Lab, Genetic Counselling & Telemedicine	Practical	02
		Exit 2: Diploma in Molecular Diagnostics and Genetic Counselling		
Third		**Semester-V**		
	B050501T	Diversity of Non-Chordates, Parasitology and Economic Zoology	Theory	04
	B050502T	Diversity of Chordates and Comparative Anatomy	Theory	04
	B050503P	Lab on Non-Chordates, Chordates, Anatomy, Economic Zoology, and Virtual Dissection	Practical	02
		Semester-VI		

	B050601T	Evolutionary and Developmental Biology	Theory	04
	B050602T	Ecology, Ethology, Environmental Science and Wildlife	Theory	04
	B050603P	Lab on Evolutionary, Developmental, Environmental, and Wildlife Ecology	Practical	02
	Exit 3: Degree in Bachelor of Science			
Year	**Course Code**	**Paper Title**	**Theory/Practical**	**Credits**
Fourth	**Semester-7 & 8**			
	12 Months Apprenticeship/ Internship through NATS or from equivalent organization/ industry/ institute - (200 Hrs)			40
	Exit 4: Apprenticeship/ Internship embedded B.Sc.			
	Or			
Fourth	**Semester-7**			
	MZOC401	Non Chordata	Theory	04
	MZOC402	Biostatistics and Computational Biology	Theory	04
	MZOC403	Comparative Animal Physiology	Theory	04
	MZOC404	Biochemistry	Theory	04
	MZOL405	Practical (Based on MZOC401; 402,403 and 404)	Practical	04
	Semester-8			
	MZOC411	Chordata	Theory	04
	MZOC412	Development Biology	Theory	04
	MZOC413	Genetics and Cytogenetics	Theory	04
	MZOC414	Ecological principles	Theory	04
	MZOL 415	Practical (Based on MZOC411; 412,413 and 414)	Practical	04
	Exit 4: 4 Year B.Sc (Honours)			
	Or (For students who secure 75% marks in the first 6 semesters)			
	Semester-7			
	MZOC402	Biostatistics and Computational Biology	Theory	04
	MZOC403	Comparative Animal Physiology	Theory	04
	MZOC404	Biochemistry	Theory	04

Fourth	MZOL405	Practical (Based on MZOC 402,403 and 404)	Practical	04
	MZOP 406	Research Project	Project	04
	Semester-8			
	MZOC412	Development Biology	Theory	04
	MZOC413	Genetics and Cytogenetics	Theory	04
	MZOC414	Ecological principles	Theory	04
	MZOL 415	Practical (Based on MZOC 412,413 and 414)	Practical	04
	MZOP 416	Research Project	Project	04
	Exit 4: 4 Year B.Sc. (Honours with Research)			

Subject: Zoology

Subject prerequisite

To study Zoology as an undergraduate, a student must have studied Biology, Biotechnology, or Life Science in Class 12/Senior Secondary or at the +2 level.

Programme Objectives (POs)

1. The programme has been designed in such a way so that the students get the flavor of both classical and modern aspects of Zoology/Animal Sciences. It aims to enable the students to study animal diversity in Indian subcontinent, environmental science and behavioural ecology.
2. The modern areas including cell biology and genetics, molecular biology, biochemistry, physiology followed by biostatistics, Evolutionary biology, bioinformatics and genetic engineering have been included to make the study of animals more interesting and relevant to human studies which is a requirement in recent times.
3. **The lab courses have been designed in such a way that students will be trained to join public or private labs.**

Certificate Course in Medical Diagnostics & Public Health

B.Sc. I Year Programme Specific Outcomes (PSOs)

PSO1	This course introduces Systems Biology and various functional components of an organism. Emphasis will be on the physiological understanding of abnormalities and anomalies associated with white blood cells and red blood cells. The course emphasizes cell identification, cell differentiation and cell morphology evaluation procedures. This will enhance hematology analytical skills along with the skill of using many instruments.
PSO 2	The students will learn the basic principles of genetics and how to prepare karyotypes to study the chromosomes.
PSO 3	How chromosomal aberrations are inherited in humans by pedigree analysis in families.

PSO 4	The students will have hands-on training in techniques like microscopy, centrifugation and chromatography, and various biochemical techniques, which will help them in getting employment in pathology labs and contribute to the health care system.
PSO 5	**The Certificate courses will enable students to apply for technical positions in government and private labs/institutes.**

Diploma in Molecular Diagnostics and Genetic Counselling	
B.Sc. II year	**Programme Specific Outcomes (PSOs)**
PSO1	The student at the completion of the course will be able to have a detailed and conceptual understanding of molecular processes *viz.* DNA to trait. The differential regulation of genes in prokaryotes and eukaryotes leads to the development of an organism from an embryo.
PSO 2	The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
PSO 3	The principles of genetic engineering, gene cloning and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their start-ups as well.
PSO 4	The basic tools of bioinformatics will enable students to analyze a large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics to existing software effectively to extract information from large databases and to use this information in computer modeling.
PSO 5	**The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned labs in the country and abroad.**

Degree in Bachelor of Science	
B.Sc III year Programme Specific Outcomes (PSOs)	
PSO1	This programme aims to introduce students to the animal diversity of invertebrates and vertebrates. The students will be taught about invertebrates and vertebrates using observational strategies, museum specimens, permanent stained slides, and field reports.
PSO 2	A variety of interacting processes generate an organism's heterogeneous shapes, size, and structural features.
PSO 3	Inclusion of ecology and environmental sciences will enrich students with our world which is crucial for human wellbeing and prosperity. This section will provide new knowledge of the interdependence between people and nature that is vital for food production, maintaining clean air and water, and sustaining biodiversity in a changing climate.
PSO 4	Students will also come to know about the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
PSO 5	The basic concepts of biosystematics, evolutionary biology and biodiversity will enable students to solve the biological problems related to the environment.
PSO 6	At the end of the course the students will be capable enough to comprehend the reason behind such a huge diversity of animals and reasoning out why two animals are grouped or remain separate due to similarities and differences that exist at many levels along with ecological, environmental and cellular inputs.
PSO 7	**The Degree courses will enable students to go for higher studies like Master's (2-year program) in Zoology and Allied subjects.**

Degree in Bachelor of Science (Apprenticeship/ internship embedded)	
B.Sc IV year Programme Specific Outcomes (PSOs)	
PSO1	The Degree courses will enable students to go for on the job training in the chosen area
PSO 2	This program will make the student industry ready and earn while learn.

PSO 3	The degree course will enable students to learn new skill sets from the real world of academia, industry, administration etc.
PSO 4	**This program aims to equip students with soft skills as well as technical skills required in real setup.**
PSO5	**The Degree courses will enable students to go for higher studies like Masters (1 years program) or Ph.D in Zoology and Allied subjects.**

4 Year B.Sc (Honours)	
B.Sc IV year Programme Specific Outcomes (PSOs)	
PSO1	After completing the program, students will be able to understand the origin, diversity and variations in various phyla of the animal kingdom
PSO 2	After completing the program, students will be able to analyze their biological data by choosing appropriate statistical and bioinformatic tools.
PSO 3	After completing the program, students will be able to understand and compare the physiology of the organisms belonging to different phyla of the chordates
PSO 4	After completing the program, students will be able to explain the metabolism of various biomolecules/nutrients in the body
PSO 5	After completing the program, students will be able to understand the basic concepts in developmental biology, genetics, cytogenetics and animal taxonomy.
PSO 6	After completing the program, students will be able to understand environmental science, ecological concepts, importance of wildlife and the economic aspects of animal rearing.
PSO 7	**The Degree courses will enable students to go for higher studies like Masters (1 year program) or a Ph.D. in Zoology and Allied subjects.**

4 Year B.Sc (Honours with Research)	
B.Sc IV year Programme Specific Outcomes (PSOs)	
PSO1	After completing the program, students will be able to understand the process of research, writing of the research plan, experimentation process, and data analysis for their research findings.

PSO 2	After completing the program, students will be able to analyze their biological data by choosing appropriate statistical and bioinformatic tools.
PSO 3	After completing the program, students will be able to understand and compare the physiology of the organisms belonging to different phyla of the chordates
PSO 4	After completing the program, students will be able to explain the metabolism of various biomolecule/nutrients in the body
PSO 5	After completing the program, students will be able to understand the basic concepts in developmental biology, genetics, cytogenetics and animal taxonomy.
PSO 6	After completing the program, students will be able to understand environmental science, ecological concepts, importance of wildlife and the economic aspects of animal rearing.
PSO 7	**The Degree courses will enable students to go for higher studies like Masters (1 year program) or a Ph.D. in Zoology and Allied subjects.**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Cytology, Genetics and Immunology

Course Code: B050101T

Credit Units: 04

Level: **UG- 1st year (Semester 1)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of the structure and functions of cell organelles
- Learn the principles and mechanisms of the cell cycle and cell division
- Understand the basic principles of heredity
- Develop an understanding of the interactions of genes and environment
- Basic understanding of the Immune system and its components.

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Structure and Function of Cell Organelles I • Plasma membrane: chemical structure—lipids and proteins • Cell-cell interaction: cellular junctions • Endomembrane system: endocytosis, exocytosis • Introduction to Sushruta, Charaka, Varahamihira, Vaghata etc as per the Indian Knowledge System	**6**
Module II	
Structure and Function of Cell Organelles II	**6**

• Cytoskeleton: microtubules, microfilaments, intermediate filaments • Mitochondria: Structure and overview of ATP synthesis • Peroxisome and ribosome: structure and function	
Module III	
Nucleus and Chromatin Structure • Structure and function of the nucleus in eukaryotes • Types of DNA and RNA • Chromatin organization and structure of chromosome	**8**
Module IV	
Cell Cycle and Cell Division • Cell division: mitosis and meiosis • Cell cycle and its regulation	**8**
Module V	
Mendelism and Sex Determination • Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses • Complete and Incomplete Dominance • Sex-Determining Systems, Environmental Sex Determination, Sex Determination in Humans • Sex-linked characteristics	**8**
Module VI	
Extensions of Mendelism, Genes and Environment • Extensions of Mendelism: Multiple Alleles • Cytoplasmic Inheritance, Genetic Maternal Effects • Interaction Between Genes and Environment: Environmental Effects on Gene Expression	**8**
Module VII	
Human Chromosomes and Patterns of Inheritance • Basics of human karyotype • Chromosomal numerical aberrations with examples	**8**

• Pedigree analysis • Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant	
Module VIII	
Immune System and its Components • Structure and functions of different classes of immunoglobulins, Hypersensitivity • Immune system: innate and adaptive immunity, clonal selection • Humoral immunity and cell-mediated immunity	**8**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Describe the structure and function of all the cell organelles.

CO2: Describe the chromatin structure and its location.

CO3: Discuss the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.

CO4: Explain how one cell communicates with its neighbouring cells?

CO5: Describe the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another.

CO6: Explain Mendel's laws and the deviations from conventional patterns of inheritance.

CO7: Discuss how the environment plays an important role by interacting with genetic factors.

CO8: Illustrate, how to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families.

CO9: State Immune System & its mechanisms.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Molecular Cell Biology (9th Edition) by Harvey Lodish, ISBN13: 9781319365486, Freeman & Co, USA (2021).
2. Molecular Biology of the Cell (7th edition), by Alberts et. al., ISBN: 978-0-393-42708-0 (2022).
3. The Cell: A Molecular Approach (9th edition) by Cooper and Adams ISBN13: 978-0197583722 (2022).
4. Karp's Cell and Molecular Biology (9th Edition), ISBN: 978-1-119-59816-9 (2019)
5. Genetics: A Conceptual Approach (7th Edition) by B. Pierce, ISBN:9781319337780 (2024).
6. Lewin's Genes XII, by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick (2017). ISBN no. 978-1284104493
7. Molecular Biology of the GENE (8th Edition) by James D. Watson, ISBN no: 9788176711340 (2024).
8. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W H Freeman (2007).
9. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
10. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Cell Biology & Cytogenetics Lab

Course Code: B050102P

Credit Units: 02

Level: **UG- 1st year (Semester 1)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- To provide hands-on training in using a microscope
- To provide practical knowledge on stating and slide preparations.
- To provide hands-on training for basic blood related pathological testing
- To provide practical knowledge on karyotyping and family pedigrees.

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
1. To study buccal epithelial cells using Methylene blue. 2. To study the different stages of Mitosis in the root tip of onion. 3. To study the different stages of Meiosis in the grasshopper testis. 4. To prepare molecular models of nucleotides, amino acids, dipeptides using the bead and stick method. 5. To check the permeability of cells using salt solutions of different concentrations.	**15**
Module II	
1. To study different mammalian blood cell types using Leishman	**15**

stain. 2. Determination of ABO Blood Group 3. Enumeration of red blood cells and white blood cells using a hemocytometer	
Module III	
1. Study of polytene chromosomes. 2. Study of sex chromatin (Barr bodies) in hair bud cells (Human). 3. Preparation of human karyotype and study chromosomal aberrations concerning number, translocation, deletion, etc. from the pictures provided. 4. To prepare family pedigrees.	**15**
Module IV	
Virtual Labs https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Use simple and compound microscopes.

CO2: Prepare slides and stain them to see the cell organelles.

CO3: Illustrate chromosomal aberrations by preparing karyotypes.

CO4: Choose various virtual labs for their online learning.

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Molecular Cell Biology (9th Edition) by Harvey Lodish, ISBN13: 9781319365486, Freeman & Co, USA (2021).
2. Molecular Biology of the Cell (7th edition), by Alberts et. al., ISBN: 978-0-393-42708-0 (2022).
3. The Cell: A Molecular Approach (9th edition) by Cooper and Adams ISBN13: 978-0197583722 (2022).
4. Karp's Cell and Molecular Biology (9th Edition), ISBN: 978-1-119-59816-9 (2019)
5. Genetics: A Conceptual Approach (7th Edition) by B. Pierce, ISBN:9781319337780 (2024).
6. Lewin's Genes XII, by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick (2017). ISBN no. 978-1284104493
7. Molecular Biology of the GENE (8th Edition) by James D. Watson, ISBN no: 9788176711340 (2024).
8. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W H Freeman (2007).
9. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
10. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005).
11. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Biochemistry and Physiology

Course Code: B050201T

Credit Units: 04

Level: **UG- 1st year (Semester 2)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop understanding about Biomolecules
- To provide basic knowledge of enzymes and their kinetics
- To develop a fundamental understanding of metabolism in humans
- To develop a fundamental understanding of the physiological process in humans

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
structure and Function of Biomolecules • Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, and Polysaccharides) • Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids) • Proteins: Structure and classification of α-amino acids; Levels of organization in proteins	**8**
Module II	
Enzyme Action and Regulation	**8**

• Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action • Isozymes and Allozymes • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition. • Allosteric enzymes	
Module III	
Metabolism of Carbohydrates and Lipids • Metabolism of Carbohydrates: glycolysis, Pyruvate carboxylation, Citric acid cycle • Lipid metabolism: β-oxidation of fatty acid	**8**
Module IV	
Metabolism of Proteins and Nucleotides • Catabolism of amino acids: Transamination, Deamination, Urea cycle • Nucleotide metabolism	**6**
Module V	
Digestion and Respiration • Structural organization and functions of the gastrointestinal tract and associated glands • Mechanical and chemical digestion of food; Absorption of carbohydrates, lipids, proteins, • Structure of trachea and lung • Mechanism of respiration, Pulmonary ventilation; Transport of oxygen and carbon dioxide through hemoglobin and plasma	**8**
Module VI	
Circulation and Excretion • Components of blood and their functions • Haemostasis: Blood clotting system, Blood groups: Rh	**8**

factor, ABO and MN • Structure of the mammalian heart • Cardiac cycle; Electrocardiogram, Blood pressure and its regulation • Structure of the kidney and its functional unit; Urine formation	
Module VII	
Nervous System and Endocrinology • Structure of neuron and nerve conduction • Synaptic transmission • Location of Endocrine glands and their hormones • Classification of hormones and their action	**8**
Module VIII	
Muscular System • Types of muscle; Ultrastructure of skeletal muscle • Molecular and chemical basis of muscle contraction	**6**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Develop a deep understanding of the structure of biomolecules like proteins, lipids and carbohydrates

CO2: Describe the various types of enzymes and thermodynamics of enzyme-catalysed reactions.

CO3: Discuss mechanisms of energy production at cellular and molecular levels.

CO4: Explain, metabolism of proteins and nucleotides

CO5: Describe the structural organization and functioning of the digestive and respiratory system

CO6: Explain the structural organization and functioning of the circulation and excretion system

CO7: Discuss physiology of neuroendocrine system

CO8: Describe types of muscles and their physiology

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Nelson & Cox: Lehninger's Principles of Biochemistry (9th edition) ISBN-13978-1319228002 (2021)
2. Zubay *et al:* Principles of Biochemistry (5th edition): ISBN13: 978-9384007492 (2020)
3. Destin Heilman, Stephen Woski, Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry, 6th Edition ISBN: 978-1-119-90348-2 (2024)
4. Donald Voet, Judith G. Voet. Biochemistry, International Adaptation, 4th Edition ISBN: 978-1-119-77065-7 92021).
5. Kennelly et al., Harper's Illustrated Biochemistry Thirty Second Edition ISBN: 978-1260469943 (2022)
6. Biochemistry and molecular biology 94th Edition by William H. Elliott and Daphne C. Elliott. ISBN No: ISBN: 9780199226719 92009).
7. Guyton and Hall Textbook of Medical Physiology, 15th Edition (2025)
8. Principles of Anatomy and Physiology, 16th Edition by J. Tortora, Bryan H. Derrickson ISBN: 978-1-119-66268-6 (2020).
9. Principles of Animal Physiology, 3rd edition by Christopher D. Moyes and Patricia M. Schulte ISBN-13: 9780137335435 (2021).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<15%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Physiological, Biochemical & Hematology Lab

Course Code: B050202P

Credit Units: 02

Level: **UG – 1st year (Semester 2)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of bioanalytical techniques used in pathology
- Learn the principles and working mechanisms of techniques.
- Perform laboratory procedures as per standard protocols in the areas of their specialization

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
1. Estimation of haemoglobin using Sahil's haemoglobinometer 2. Preparation of haemin and and haemochromogen crystals 3. Recording of blood pressure using a sphygmomanometer 4. Recording of blood glucose level by using a glucometer 5. Preparation of molecular models of amino acids, dipeptides etc.	**15**
Module II	
1. Study of permanent slides of Mammalian skin, Cartilage,	**15**

Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 2. Recording of simple muscle twitch with electrical stimulation (or Virtual) 3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee-jerk reflex)	
Module III	
1. Ninhydrin test for α-amino acids. 2. Benedict's test for reducing sugar and iodine test for starch. 3. Test for sugar and acetone in urine. 4. Paper chromatography of amino acids. 5. Action of salivary amylase under optimum conditions.	**15**
Module IV	
1. https://www.vlab.co.in 2. https://zoologysan.blogspot.com 3. www.vlab.iitb.ac.in/vlab 4. www.onlinelabs.in 5. www.powershow.com 6. https://vlab.amrita.edu 7. https://sites.dartmouth.edu	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Demonstrate basic hematological laboratory testing like blood glucose, blood pressure and haemoglobin estimation.

CO2: Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.

CO3: Understand the structure of biomolecules like proteins, lipids and carbohydrates

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals, discussions and virtual labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Nelson & Cox: Lehninger's Principles of Biochemistry (9th edition) ISBN-13978-1319228002 (2021)
2. Zubay *et al:* Principles of Biochemistry (5th edition): ISBN13: 978-9384007492 (2020)
3. Destin Heilman, Stephen Woski, Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry, 6th Edition ISBN: 978-1-119-90348-2 (2024)
4. Kennelly et al., Harper's Illustrated Biochemistry Thirty Second Edition ISBN: 978-1260469943 (2022)
5. Biochemistry and molecular biology 94th Edition by William H. Elliott and Daphne C. Elliott. ISBN No: ISBN: 9780199226719 92009).
6. Guyton and Hall Textbook of Medical Physiology, 15th Edition (2025)
7. Principles of Anatomy and Physiology, 16th Edition by J. Tortora, Bryan H. Derrickson ISBN: 978-1-119-66268-6 (2020).
8. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition.Lippincott W. & Wilkins.
9. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
10. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Molecular Biology, Bioinstrumentation & Biotechniques

Course Code: B050301T

Credit Units: 04

Level: **UG - 2nd year (Semester 3)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To introduce concepts of molecular biology to the students
- To introduce basic instruments used in science for research.
- To provide basic knowledge for the various techniques used in modern day research.

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Process of Transcription • Fine structure of gene • RNA polymerases • Transcription factors • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes	**7**
Module II	
Process of Translation • Factors involved in translation	**7**

• Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes	
Module III	
Regulation of Gene Expression I • Regulation of gene expression in prokaryotes: *lac* and *trp* operons in *E. coli* • Regulation of gene expression in eukaryotes: Role of chromatin in gene expression • Regulation at transcriptional level, Post-transcriptional modifications: Capping, Splicing, Polyadenylation	**8**
Module IV	
Regulation of Gene Expression II • Regulation of gene expression in eukaryotes: • Regulation at translational level, post-translational modifications: protein folding etc. • Intracellular protein degradation • Introduction to Si RNA and Mi RNA	**8**
Module V	
Principles and Types of Microscopes • Principle of Microscopy and its applications • Types of Microscopes: light microscopy, phase- contrast microscopy • Electron microscopy	**6**
Module VI	
Centrifugation and Chromatography • Principle of Centrifugation	**8**

• Types of Centrifuges: high speed and ultracentrifuge • Principle and Types of Chromatography: paper and thin layer	
Module VII	
Spectrophotometry and Biochemical Techniques • Spectrophotometry: Beer-Lambert law, absorption spectrum • Biochemical techniques: Measurement of pH, Preparation of buffers and solutions	**8**
Module VIII	
Molecular Techniques • Nucleic acid fractionation, detection by electrophoresis, Polymerase Chain Reaction (PCR), DNA fingerprinting • PAGE, ELISA, Western blotting • Hybridoma technology	**6**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: State a detailed and conceptual understanding of molecular processes viz. DNA to trait.

CO2: Recall a clear understanding of the processes of the central dogma viz. transcription, translation etc. underlying survival and propagation of life at the molecular level.

CO3: Describe, how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms

CO4: Discuss, how four sequences (3-letter codons) generate the transcripts of life and determine the phenotypes of organisms.

CO5: Discuss, how genes are regulated differently at different time and place in prokaryotes and eukaryotes.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions, and visits to research labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon, Molecular Cell Biology (9th edition), ISBN13: 978-1319208523 Freeman & Co, USA (2021).
2. Molecular Biology of the Cell (7th edition), by Alberts et. al., ISBN: 978-0-393-42708-0 (2022).
3. The Cell: A Molecular Approach (9th edition) by Cooper and Adams ISBN13: 978-0197583722 (2022).
4. Karp's Cell and Molecular Biology (9th Edition), ISBN: 978-1-119-59816-9 (2019)
5. Molecular Biology of the GENE (8th Edition) by James D. Watson, ISBN no: 9788176711340 (2024).
6. Lewin's Genes XII, by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick (2017). ISBN no. 978-1284104493
7. Genetics: A Conceptual Approach (7th Edition) by B. Pierce, ISBN:9781319337780 (2024).
8. Molecular Cloning: A Laboratory Manual 4th Edition by Michael R. Green, Joseph Sambrook. ISBN-10: 1936113422 Cold Spring Harbor Laboratory Press (2013).
9. Molecular Biotechnology (2nd Edn) by Primrose S B, ISBN : 9788186535217 (2001).
10. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<12%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Bioinstrumentation & Molecular Biology Lab

Course Code: B050302P

Credit Units: 02

Level: **UG- 2nd year (Semester 3)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of bioanalytical techniques used in research
- Learn the principles and working mechanisms of techniques.
- Perform laboratory procedures as per standard protocols in the areas of their specialization

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
. 1. To study the working principle and Simple, Compound and Binocular microscopes. 2. To study the working principle of various lab equipment such as pH Meter, Electronic balance, vortex mixer, use of glass and micropipettes, Laminar flow, Incubator shaker, Water bath, Centrifuge, Chromatography apparatus, etc	**15**
Module II	
1. To prepare solutions and buffers. 2. To learn the working of the Spectrophotometer.	**15**

3. Demonstration of differential centrifugation to fractionate different components in a mixture.	
Module III	
1. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry. 2. To identify different amino acids in a mixture using paper chromatography. 3. Demonstration of DNA extraction from blood or tissue samples. 4. To estimate amount of DNA using a spectro-photometer.	**15**
Module IV	
www.labinapp.com www.uwlax.edu www.labster.com www.onlinelabs.in www.powershow.in https://vlab.amrita.edu info@premiereducationaltechnologyies.com https://li.wsu.edu	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: State the basic principles of microscopy, the working of different types of microscopes

CO2: Select the basic techniques of centrifugation and chromatography for studying cells and the separation of biomolecules

CO3: Explain the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry.

CO4: Discuss about some of the commonly used advanced DNA testing methods.

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals, discussions and virtual labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Molecular Cloning: A Laboratory Manual 4th Edition by Michael R. Green, Joseph Sambrook. ISBN-10: 1936113422 Cold Spring Harbor Laboratory Press (2013).
2. Molecular Biotechnology (2nd Edn) by Primrose S B, ISBN : 9788186535217 (2001).
3. Clark & Switzer. Experimental Biochemistry. Freeman (2000).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Gene Technology and Human Welfare

Course Code: B050401T

Credit Units: 04

Level: **UG- 2nd year (Semester 4)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To introduce concepts of gene technology
- To introduce applications of generic engineering
- To provide basic knowledge about computers and bioinformatics

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Principles of Gene Manipulation • Recombinant DNA Technology • Restriction Enzymes, Cloning Vectors, Ligation • Gene transfer and Gene therapy	**10**
Module II	
Applications of Genetic Engineering • Single cell proteins • Livestock improvement, development of transgenic animals • Development of DNA drugs and vaccines	**8**
Module III	
Enzyme Technology	**6**

• Microbial culture • Methods of enzyme production • Immobilization of enzymes	
Module IV	
DNA Diagnostics • Genetic analysis of human diseases, detection of known and unknown mutations • Application of DNA fingerprinting • Concept of pharmacogenomics and pharmacogenetics	**6**
Module V	
Biostatistics I • Calculations of mean, median, mode • Variance, Standard Deviation • Concepts of Coefficient of variation	**8**
Module VI	
Biostatistics II • Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram • Test of significance: t-test and Chi-square test	**7**
Module VII	
Basics of Computers • Basics (CPU, I/O units) and operating systems • Concept of homepages and websites, World Wide Web, URLs, Use of different • Introduction to disruptive technologies (AI and ML)	**7**
Module VIII	
Bioinformatics • Databases: nucleic acids, genomes, protein sequences and structures, Bibliography • Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW	**8**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Explain the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.

CO2: Discuss the applications of biotechnology in various fields like agriculture, industry and human health.

CO3: Describe the basics of industrial biotechnology

CO4: Discuss DNA testing and the utility of genetic engineering in forensic sciences.

CO5: Use computers and select bioinformatics tools for the research

CO6: Use their skills to get employment in pathology/Hospital.

CO7: Take up research in biological sciences.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and visits to research labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Principles of Gene Manipulation and Genomics, 7th Edition by Sandy B. Primrose, Richard Twyman, ISBN: 978-1-118-65388-3 (2013)
2. Gene Cloning and DNA Analysis: An Introduction, 9th Edition by T. A. Brown, ISBN: 978-1-394-29256-1 (2025).
3. Genetics: Analysis of Genes & Genomes (9^{th} edition) by Hartl and Cochrane (2019).
4. Molecular Cloning: A Laboratory Manual 4th Edition by Michael R. Green, Joseph Sambrook. ISBN-10: 1936113422 Cold Spring Harbor Laboratory Press (2013).
5. Molecular Biotechnology (2nd Edn) by Primrose S B, ISBN : 9788186535217 (2001).
6. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
7. Human molecular genetics by P. Sudbery. Prentice-Hall (2002)

8. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
9. Pasternak. An Introduction to Molecular Human Genetics. Fritzgerald (2000).
10. Biostatistical Analysis (Sixth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi. ISBN no: 978-0134684963 (2019).
11. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell (1991).
12. Biostatistics (11th Edition) by W.W. Daniel and C. L. Cross, Wiley ISBN: 978-1-119-49657-1 (2018).
13. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners. ISBN 13: 9781478638186 (2019).
14. Westhead *et al* Bioinformatics: Instant Notes. Viva Books (2003).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Genetic Engineering Lab, Genetic Counselling & Telemedicine

Course Code: B050402P

Credit Units: 02

Level: **UG- 2nd year (Semester 4)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of bioanalytical techniques and statistical tools used in research
- Learn the principles and working mechanisms of techniques.
- Perform laboratory procedures as per standard protocols in the areas of their specialization

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
1. Measure the pre- and post-clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc. 2. Measure the height and weight of all students in the class and apply statistical measures.	**10**
Module II	
1. To perform bacterial culture and calculate the generation time of bacteria. 2. To study Restriction enzyme digestion using teaching kits.	**20**

3. To study Polymerase Chain Reaction (PCR) using teaching kits. 4. Demonstration of agarose gel electrophoresis for the detection of DNA. 5. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for the detection of proteins. 6. To calculate the molecular weight of unknown DNA and protein fragments from gel pictures.	
Module III	
1. To learn the basics of computer applications 2. To learn sequence analysis using BLAST 3. To learn Multiple sequence alignment using CLUSTALW 4. To learn about Phylogenetic analysis using the programme PHYLIP.	**15**
Module IV	
Virtual Labs 1. Gel Documentation System- https://youtu.be/WPpt3-FanNE 2. Colorimeter- https://youtu.be/v4aK6G0bGuU 3. PCR Part 1- https://youtu.be/CpGX1UFSl4A 4. PCR Part 2- https://youtu.be/6IcHAYPTAEw 5. DNA isolation Part 1- https://youtu.be/QE7Ul0JnY9A 6. DNA isolation part 2- https://youtu.be/- efr_HFeHxM 7. DNA curve- https://youtu.be/ubL8QxTeuG4 8. Spectrophotometer- https://youtu.be/ubL8QxTeuG4 9. Agarose Part 1- https://youtu.be/7gvHPFww--g 10. Agarose part 2- https://youtu.be/j_bOZCHNsSg	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Discuss the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like COVID-19.

CO2: Demonstrate DNA testing and the utility of genetic engineering in forensic sciences.

CO3: Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics to existing software effectively to extract information from large databases and to use this information in computer modelling

CO4: Use bioinformatics tools to find out the evolutionary/phylogenetic relationship of organisms using gene sequences.

CO5: Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders.

CO6: Employ knowledge to take up research in biological sciences

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals, discussions and virtual labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Molecular Biotechnology (2nd Edn) by Primrose S B, ISBN : 9788186535217 (2001).
2. Molecular Cloning: A Laboratory Manual 4th Edition by Michael R. Green, Joseph Sambrook. ISBN-10: 1936113422 Cold Spring Harbor Laboratory Press (2013).
3. Principles of Gene Manipulation and Genomics, 7th Edition by Sandy B. Primrose, Richard Twyman, ISBN: 978-1-118-65388-3 (2013)
4. Genetics: Analsysis of Genes & Genomes (9th edition) by Hartl and Cochrane (2019).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Diversity of Non-Chordates and Economic Zoology

Course Code: B050501T

Credit Units: 04

Level: **UG- 3rd year (Semester 5)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To introduce morphology, anatomy, life cycle and physiology of non-chordates
- To introduce the structure, life cycle, pathogenicity, causes, symptoms and control of certain parasites, vectors and pests
- To provide basic knowledge of apiculture, sericulture, aquaculture, poultry, lac culture and vermiculture.

Pre-requisites: Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Protozoa to Coelenterate • Protozoa – Euglena – Nutrition • Paramecium - Morphology and Reproduction • Porifera – Sycon - Canal System • Coelenterata – Obelia - Morphology and Life cycle	**7**
Module II	
Ctenophora to Nemathelminthes • Ctenophora - Salient features • Platyhelminthes - Fasciola (Liver fluke) – Morphology and Life cycle	**7**

• Nemathelminthes – Ancylostoma (Hook worm) - Morphology	
Module III	
Annelida to Arthropoda • Annelida –Nereis - Morphology and Reproductive System • Hirudinaria (Leech)- Morphology and Haemocoelomic system **Arthropoda** • Arthropoda – Palaemon (Prawn) – Morphology and Appendages	**8**
Module IV	
Mollusca to Echinodermata **Mollusca** • *Pila* - Morphology and Nervous System • *Unio* – Morphology and Life Cycle **Echinodermata** • *Pentaceros* - Morphology and Water Vascular System	**8**
Module V	
Parasitology Structure, life cycle, pathogenicity including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: Trypanosoma, Giardia and Wuchereria	**8**
Module VI	
Vectors and pests Life cycle and their control of the following pests: Gundhi bug, Sugarcane leafhopper, Rodent (rat). Termites, Mosquitoes and their control	**8**
Module VII	
Economic Zoology-1 Animal breeding and culture: Aquaculture (Pisciculture), Poultry	**7**

Module VIII	
Economic Zoology- 2 Economic importance of Sericulture, Apiculture, Lac-culture, and Vermiculture	7

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Demonstrate comprehensive identification abilities of non-chordate diversity

CO2: Explain the structural and functional diversity of non-chordate

CO3: Explain the evolutionary relationship amongst non-chordate groups

CO4: Get employment in different applied sectors

CO5: Start their own business i.e. self-employment.

CO6: Use their learnings to take up research in Biological Science

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and visits to research labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Barnes et al (2009). The Invertebrates: A synthesis (3rd edition). Wiley Backwell, ISBN: 978-1-444-31233-1
2. Moore: An Introduction to the Invertebrates (2006), Cambridge University Press, ISBN no: 978-0521674065
3. Richard C. Brusca, Gonzalo Giribet, and Wendy Moore (2022) Invertebrates (4th Edition). ISBN: 9780197554418
4. Jan Pechenik (2015). Biology of the invertebrates (7th edition). McGraw Hill ISBN13: 9780073524184
5. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. ISBN 978-0-19-960602-3
6. Chatterjee KD (2025). Parasitology Protozoology And Helminthology 13Ed, ISBN

no: 978-8123918105**.**

7. Chakraborty P (2016). Textbook of Medical Parasitology 3rd Edition ISBN : 9789352550418.
8. Thomos C. Chung (2006). General Parasitology (2nd Edition). ISBN: 9781262402269
9. Larry Roberts, John Janovy Jr., Steve Nadler (2012). Foundations of Parasitology (9th Edition). McGraw Hill, ISBN no: 978-0073524191
10. Atuar Rahman (2024). Textbook on Apiculture, ICAR publication. ISBN no 978-8171642809
11. Kamal Jaiswal (2014). Economic Zoology Apiculture, Sericulture and Aquaculture. ISBN no: 978-9382471417
12. Jhingran. V.G (1997). Fish and fisheries in India 3rd Edition. ISBN no: 9788170750178
13. Khanna. S.S, (2019). An introduction to fishes. ISBN: 9788122907353
14. Boyd. C.E. &Tucker.C.S,(2012). Pond aquaculture water quality management. ISBN no: 978-1461374695
15. Biswas.K.P, (2007). Prevention and Control of Fish and prawn diseases. ISBN no: 8185375593
16. Larry P. Pedigo, Marlin E. Rice, Rayda K. Krell (2021). Entomology and Pest Management 7th Edition.
17. C. Edwards (2004), Earthworm Ecology 2nd edition. CRC press
18. Clive A. Edwards , Norman Q. Arancon (2022). Biology and Ecology of Earthworms. ISBN no: 978-0-387-74942-6
19. C. L. Metcalf (2018). Destructive and Useful Insects. ISBN no: 9383285842
20. S. Susikaran, B. Karthick Mani Bharathi, M. Mithilasri, M. Sabarish and R. Kalpana (2024). Recent Innovations and Current Advancements in Sericulture (Volume - 1) ISBN no: 978-93-6233-416-9
21. G. Ganga et al. (2017). Introduction To Sericulture, 2/E.ISBN no**: 978-8120411791**

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<15%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Diversity of Chordates and Comparative Anatomy

Course Code: B050502T

Credit Units: 04

Level: **UG- 3rd year (Semester 5)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To provide basic knowledge of origin of chordates and hemichordates
- To introduce classification and general characteristics of vertebrates
- To introduce comparative anatomy and physiology of vertebrates

.

Pre-requisites: Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Origin of Chordates & Hemichordata Origin of Chordates, Classification of Phylum Chordata up to the class. Hemichordata: General characteristics, classification and detailed study of *Balanoglossus* (Habit and Habitat, Morphology, Salient features and affinities)	**6**
Module II	
Cephalochordata and Urochordata **Cephalochordata** : General characteristics, classification and detailed study of *Branchiostoma* (*Amphioxus*) (Habit and Habitat, Morphology, Anatomy and Physiology of Digestive system).	**6**

Urochordata : General characteristics, classification and detailed study of *Herdmania* (Habit and Habitat, Morphology, Anatomy and Physiology of Excretory system).	
Module III	
Classification and General Characteristics of Vertebrates General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. Poisonous and Non-Poisonous Snakes and Biting Mechanisms Neoteny and Paedogenesis Migration in birds	**8**
Module IV	
Comparative Anatomy and Physiology of Vertebrates Integumentary System Structure, functions and derivatives of integument **Skeletal System** Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	**10**
Module V	
Digestive System Alimentary canal and associated glands, dentition	**6**
Module VI	
Respiratory System Skin, gills, lungs and air sacs; Accessory respiratory organs	**8**
Module VII	
Circulatory System General plan of circulation, evolution of heart and aortic arches **Urinogenital System** Succession of the kidney, Evolution of urinogenital ducts, Types of mammalian uteri	**8**

Module VIII	
Nervous System : Comparative account of Brain, Spinal cord, and Cranial nerves in mammals **Sense Organs** Classification of receptors, Brief account of visual and auditory receptors in man	**8**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Demonstrate comprehensive identification abilities of chordate diversity

CO2: Explain the structural and functional diversity of chordates

CO3: Explain the evolutionary relationship among chordates

CO4: Take up research in biological sciences.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and visits to the Museum.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Harvey Pough, William E. Bemis, Betty Anne McGuire, and Christine M. Janis (2022). Vertebrate Life 11th edition. ISBN: 9780197558621
2. Edwin H. Colbert, Michael Morales, Eli C. Minkoff (2011). Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, 5ed. ISBN no: 978-8126533183
3. Hildebrand (2001) Analysis of Vertebrate Structure (5th ed, John Wiley) ISBN: 9780471295051
4. Kenneth Kardong (2019). Vertebrates: Comparative Anatomy, Function, Evolution (8th Edition). ISBN: 9781259700910
5. Parker and Haswell Textbook of ZOOLOGY - Vertebrates - Volume II (8th

edition, edited by Veer Bala Rastogi) (2021). ISBN: 9789389393460

6. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
7. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
8. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Lab on Non-Chordates, Chordates, Anatomy, Economic Zoology, and Virtual Dissection

Course Code: B050503P

Credit Units: 02

Level: **UG- 3rd year (Semester 5)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of anatomical features of non-chordates and chordates
- Learn the life history of the silkworm and honey bee
- Learn the identification of the various pests.

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
1. To study the Museum specimens of various non-chordates (Protozoa Echinodermata). 2. To study the prepared permanent slides of:- • Protozoa- Euglena, Amoeba, Trypanosoma, Paramecium (Binary fission and Conjugation). • Porifera- Sycon L.S. and T.S., Spicules of sponges. • Coelenterata- Obelia medusa and Obelia colony.	**15**

• Platyhelminthes- Fasciola hepatica (Entire) and its larval stages. • Nemathelminthes- Ancylostoma. • Annelida- Nereis, Heteronereis T.S. through parapodium and Trochophore larva of Nereis. • Hirudinaria- T.S of buccal cavity • Arthropoda- Culex and Anopheles: Male and Female Mouth parts. • Mollusca- Pila - L.S. of Osphradium and Pila-Radula, Unio- T.S. of gill lamina and Glochidium larva. • Echinodermata- T.S. of Starfish arm and Bipinnaria larva. 3. Preparation of a permanent stained slide of Gemmule or Sertularia.	
Module II	
1. To study the museum specimens of various chordates. 2. To study permanent stained slides of fish scales (Placoid, Cycloid, Ctenoid and Rhomboid), Frog- Striated or Unstriated muscle fibres, Lizard skin, Pigeon- Pecten and Filoplume, T.S. liver and kidney of mammals. 3. Preparation of a permanent stained slide of chromatophore. 4. Comparative study of Pectoral Girdle, Pelvic Girdle, Forelimb bones and Hind limb bones of chordates.	**15**
Module III	
1. Identification of pests. 1. Life history of silkworm or honeybee. 2. Any five edible fishes of India. 3. Wallago- Cranial nerve dissection through multimedia / Models.	**15**
Module IV	
Virtual Labs : https://vlab.amrita.edu/ https://www.biointeractive.org/ https://www.visiblebody.com/	**15**

https://www.vlab.co.in/ https://zoologysan.blogspot.com/ https://onlinelabs.in/ https://www.virtualmicroscope.org/ https://anatomyzone.com/ https://www.anatomyarcade.com/ https://www.merlot.org/ https://www.biologycorner.com/ https://animaldiversity.org/	

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Demonstrate the ability to identify and classify non-chordate and chordate specimens

CO2: Explain the structural, functional, and evolutionary diversity among major animal groups.

CO3: Apply knowledge in identifying pests and economically important animals.

CO4: Generate self-employment

CO5: Utilize virtual lab tools to supplement practical skills.

CO6: Enable students to take up research in biological sciences.

Pedagogy for Course Delivery:

The course will be delivered in the form of practicals, discussions and virtual labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. **Barnes, R.D. et al. (2009).** *The Invertebrates: A Synthesis*. Wiley-Blackwell.
2. **Brusca, R.C. & Brusca, G.J. (2016).** *Invertebrates*. Sinauer Associates.
3. **Pechenik, J.A. (2014).** *Biology of the Invertebrates*. McGraw-Hill.
4. **Kardong, K.V. (2015).** *Vertebrates: Comparative Anatomy, Function, Evolution*. McGraw-Hill.

5. **Harvey, P.H. et al. (2006).** *The Vertebrate Life*
6. **Young, J.Z. (2006).** *The Life of Vertebrates* (3rd ed.). Oxford University Press.
7. **Colbert, E.H. et al. (2002).** *Colbert's Evolution of the Vertebrates*. Wiley-Liss.
8. **Moore, J. (2001).** *An Introduction to the Invertebrates*. Cambridge University Press.
9. **Parker, T.J. & Haswell, W.A. (1978).** *Textbook of Zoology, Vol. I & II*. ELBS.
10. **Marshall, A.J. (1972).** *Parker & Haswell's Textbook of Zoology, Vol. I*. Macmillan.
11. **Boradale, L.A. & Potts, E.A. (1961).** *Invertebrates: A Manual for Students*. Asia Publishing House.
12. **Hildebrand, M. (1995).** *Analysis of Vertebrate Structure*. John Wiley.
13. **McFarland, W.N. et al. (1979).** *Vertebrate Life*. Macmillan Publishing.
14. **Romer, A.S. & Parsons, T.S. (1986).** *The Vertebrate Body* (6th ed.). CBS Publishing Japan.
15. **Smith, R.L. (1980).** *Ecology and Field Biology*. Harper and Row.
16. **Pedigo, L.P. (2002).** *Entomology and Pest Management*. Prentice Hall.
17. **Ranganathan, L.S.** *Vermicomposting Technology: Soil Health to Human Health*.
18. **Prost, P.J. (1962).** *Apiculture*. Oxford and IBH Publishing, New Delhi.
19. **Bisht, D.S.** *Apiculture*. ICAR Publication.
20. **Singh, S.** *Beekeeping in India*. Indian Council of Agricultural Research, New Delhi.
21. **Ullal, S.R. & Narasimhanna, M.N. (1987).** *Handbook of Practical Sericulture*. Central Silk Board, Bangalore.
22. **Jolly, M.S.** *Appropriate Sericultural Techniques*. CSR & TI, Mysore.
23. **Handbook of Silkworm Rearing.** *Agriculture and Technical Manual-1*. Fuzi Publishing Co.
24. **Santhanam, B. et al.** *A Manual of Freshwater Aquaculture*.
25. **Boyd, C.E. & Tucker, C.S.** *Pond Aquaculture Water Quality Management*.

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<20%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Evolutionary and Developmental Biology

Course Code: B050601T

Credit Units: 04

Level: **UG- 3rd year (Semester 6)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To provide basic knowledge about theories of evolution
- To introduce the concept of population genetics
- To introduce fundamentals of developmental biology

Pre-requisites: Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Theories of Evolution • Origin of Life • Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, and Artificial selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)	**8**
Module II	
Population Genetics • Microevolution and Macroevolution: Hardy-Weinberg equilibrium • Forces of evolution: mutation, selection	**8**

Module III	
Direct Evidence of Evolution • Types of fossils • Dating of fossils, Phylogeny of horses	**7**
Module IV	
Species Concept and Extinction • Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) • Mass extinction (Causes, Names of five major extinctions	**7**
Module V	
Gamete Fertilization and Early Development • Gametogenesis, Fertilization • Cleavage pattern • Gastrulation, fate maps	**6**
Module VI	
Developmental Genes • Genes and development • Molecular basis of development	**8**
Module VII	
Early Vertebrate Development • Early development of mammals • Metamorphosis, regeneration and stem cells	**8**
Module VIII	
Late Developmental Processes • Development of the eye and limb • Metamorphosis in amphibians, insects • Regeneration: salamander limbs, Hydra	**8**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Understand that by biological evolution, we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.

CO2: Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change

CO3: Understand how the single cell formed at fertilization forms an embryo and then a full adult organism.

CO4: Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.

CO5: Understand a variety of interacting processes, that generate an organism's heterogeneous shapes, size, and structural features.

CO6: Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and visits to the Museum.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Ridley, M. (2003). Evolution. III Edition. Blackwell Publishing. ISBN: 978-1-405-10345-9
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press. ISBN 978-087969684-9
3. Hall, B. K. and Hallgrimsson, B. (2014). Evolution. V Edition. Jones and Bartlett Publishers. ISBN:9781449691929
4. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings. ISBN no: 1256632791
5. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates. ISBN no: 978-0878931897

6. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi (2013).
7. Essential Developmental Biology: Jonathan M. W. Slack, (3rd ed.), Wiley-Blackwell. (2012).
8. Developmental Biology: From a Cell to an Organism (Genetics & Evolution) eBook: Russ Hodge, Infobase Publishing. (2009).
9. Current Topics in Developmental Biology: Roger A. Pedersen, Gerald P. Schatten, Elsevier. (1998).
10. Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
11. Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences. (2018).
12. Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Ecology, Ethology, Environmental Science and Wildlife

Course Code: B050602T

Credit Units: 04

Level: **UG 3rd year (Semester 6)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To provide basic knowledge about Ecology and ecosystems
- To introduce concepts of community ecology, behaviour ecology and chronobiology
- To provide basic knowledge about climate change causes and its effects.
- To introduce the fundamentals of wildlife and its conservation

Pre-requisites: Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Introduction to Ecology • Levels of organization, Laws of limiting factors, Study of physical factors	**4**
Module II	
Organization of Ecosystem • Population: Density, natality, mortality, life tables, survivorship curves, age ratio, sex ratio, Exponential and logistic growth • Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem • Ecological pyramids and Ecological efficiencies, Nutrient and	**12**

biogeochemical cycle of Carbon	
Module III	
Community Ecology • Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example	**7**
Module IV	
Environmental Hazards • Sources of Environmental Hazards • Climate changes • Greenhouse gases and global warming • Acid rain, Ozone layer destruction	**7**
Module V	
Effects of Climate Change • Effect of climate change on public health • Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal • Nuclear waste handling and disposal, Waste from thermal power plants	**6**
Module VI	
Behavioural Ecology and Chronobiology • Origin and history of Ethology • Instinct vs. Learnt Behaviour • Associative learning, classical and operant conditioning, Habituation, Imprinting • Circadian rhythms • Chronomedicine	**8**
Module VII	
Introduction to Wildlife • Values of wildlife - positive and negative; Conservation ethics;	**8**

Importance of conservation; Causes of depletion; World conservation strategies	
Module VIII	
Protected areas • National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve	**8**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Explain the complexities and interconnectedness of various environmental levels and their functioning.

CO2: Discuss global environmental issues, their causes, consequences and amelioration.

CO3 Understand and identify behaviors in a variety of taxa.

CO4: Explain the proximate and ultimate causes of various behaviors.

CO5: Discuss about the molecules, cells, and systems of biological timing systems.

CO6: Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons.

CO7: Interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing.

CO8: Understand the importance of wildlife conservation.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and visits to the Museum.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Ecology: Theories & Applications. Peter D. Stiling, 2001, Prentice Hall

2. Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell
3. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc
4. Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc
5. Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor & Francis. London
6. Environment. Raven, Berg, Johnson, 1993, Saunders College Publishing
7. Essentials of Ecology. G.T. Miller, Jr. & Scott. E. Spoolman, 2014, Brooks/Cole, Cengage Learning
8. Freshwater Ecology: A Scientific Introduction. 2004. Closs, G., Downes, B. and Boulton, A. Wiley-Blackwell publisher, Oxford
9. Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. OxfordUniversity Press, UK
10. Fundamentals of Ecology. E.P. Odum & Gray. W. Barrett, 1971, Saunder
11. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science
12. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University
13. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition.The Wildlife Society, Allen Press. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. BlackwellSciences
14. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Lab on Evolutionary, Developmental, Environmental, and Wildlife Ecology

Course Code: B050603P

Credit Units: 02

Level: **UG - 3rd year (Semester 6)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	4

Course Objectives:

The Learning Objectives of this course are as follows:

- Develop a fundamental understanding of developmental biology
- Learn the skills for report writing
- Learn the skills to use various instruments for wild life study

Pre-requisites:

Basic knowledge of Biology

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
1. To study the different types of fossils 2. Study of different types of eggs based on the distribution of yolk. 3. To study the cleavage pattern through a chart 4. To study the metamorphosis in frog 5. To study the regeneration in Hydra/Salamander	**15**
Module II	
1. Study of population dynamics through numerical problems. 2. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary. 3. Study of circadian functions in humans (daily eating, sleep and	**15**

temperature patterns)	
Module III	
1.Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses) 2.Familiarization and study of animal evidence in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nests, antlers etc. 3.Demonstration of different field techniques for flora and fauna	**15**
Module IV	
Virtual Labs: https://vlab.co.in https://www.biointeractive.org/ https://learn.genetics.utah.edu/ https://vlab.amrita.edu https://animaldiversity.org/ https://www.labster.com/	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Understand the basic concepts, importance, and status of evolution, development, and interactions between organisms and the environment.

CO2: Identify fossils, egg types, cleavage patterns, metamorphosis, and regeneration in animals.

CO3: Analyse population dynamics and circadian rhythms using practical approaches.

CO4: Develop field skills in using wildlife equipment and identifying animals through signs and traces.

CO5: Gain hands-on experience through field visits and virtual labs, preparing for research and careers in wildlife services, sanctuaries, and conservatories.

Pedagogy for Course Delivery:

The course will be delivered in the form of practicals, discussions, filed visits and virtual labs.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu , Siddharth Nagar

Text Books/ Reference Books:

1. Verma, P. S., & Agarwal, V. K. (2023). Cell biology, genetics, molecular biology, evolution and ecology (Revised ed.). S. Chand Publishing.
2. Hickman, C. P., Jr., Keen, S. L., Eisenhour, D. J., Larson, A., & I'Anson, H. (2023). Integrated principles of zoology (19th ed., Int'l Student ed.). McGraw-Hill Education.
3. Futuyma, D. J. (2023). Evolution (5th ed.). Sinauer Associates.
4. Gilbert, S. F. (2022). Developmental biology (12th ed.). Sinauer Associates.
5. Strickberger, M. W. (2021). Evolution (6th ed.). Jones & Bartlett Learning.
6. Hickman, C. P., Roberts, L. S., & Larson, A. (2023). Integrated principles of zoology lab manual (19th ed.). McGraw-Hill.
7. Krebs, C. J. (2009). Ecology: The experimental analysis of distribution and abundance (6th ed.). Benjamin Cummings.
8. Odum, E. P., & Barrett, G. W. (2020). Fundamentals of ecology (6th ed.). Cengage Learning.
9. Pianka, E. R., & Scott, J. H. (2022). Evolutionary ecology (8th ed.). Pearson.
10. Sinha, R. K. (2019). Wildlife ecology and management (2nd ed.). Anmol Publications.
11. Kaul, R. N. (1993). Forest ecology. Scientific Publishers.
12. Saharia, V. B. (1982). Wildlife in India. Nataraj Publishers.
13. Negi, S. S. (1993). Biodiversity and its conservation in India. Indus Publishing.
14. Rajagopalan, R. (2011). Environmental studies: From crisis to cure (2nd ed.). Oxford University Press.
15. Chapman, J. L., & Reiss, M. J. (2013). Ecology: Principles and applications (3rd ed.). Cambridge University Press.
16. Molles, M. C. (2019). Ecology: Concepts and applications (8th ed.). McGraw-Hill.
17. Singh, J. S., & Singh, S. P. (2015). Ecology, environment and resource conservation (2nd ed.). Anamaya Publishers.
18. Ghosh, S. (2010). Developmental biology (Hindi ed.). Hindi Granth Karyalay.
19. Saxena, R. K. (2012). Paryavaran adhyayan (Hindi ed.). Sahitya Bhawan Publications.
20. Singh, H. S. (2001). Bhartiya vanya jeev (Hindi ed.). Vishwavidyalaya Prakashan.
21. Sharma, P. D. (2010). Paryavaran adhyayan (Hindi ed.). Rastogi Publications.
22. UGC e Pathshala. (n.d.). E content modules. Retrieved from https://epgp.inflibnet.ac.in/

23. Journal of Wildlife Research. (Ongoing). Journal of wildlife research [Journal]. Retrieved from https://www.wildliferesearch.org/

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**13th July 2023**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<20%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Non-Chordata

Course Code: MZOC 401

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To create in the student an appreciation of non-chordate diversity
- To develop in the student an understanding of structural and functional diversity
- To develop in the student the understanding of the evolutionary relationship among the non-chordate groups

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters (Only for B.Sc. Zoology (Honors degree Program)

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
• **Protozoa**: Organization, osmoregulation, locomotion, nutrition and reproduction • **Porifera** - Organization and affinities • **Cnidaria** - Origin of metazoa, polymorphism, coral reefs	**15**
Module II	
Helminthes • General organization and larval forms of trematodes and cestodes, parasitic adaptation • **Annelida** -Adaptive radiation in polychaeta, segmental organs	**15**

Module III	
• **Arthropoda** -Larval forms in Crustacea, respiratory organs in Arthropods, mouthparts and modes of feeding in insects, economic importance of arthopods	**15**
Module IV	
• **Mollusca**-Modifications in the foot, nervous system and torsion in gastropods • **Echinodermata** -Water vascular system, larval forms and their affinities • **Minor Phyla** - Organization and affinities of Rotifera, Ctenophora and Sipunculoidea	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Discuss the structural and functional diversity of non-chordate.

CO2: Explain the evolutionary relationship and larval forms amongst non-chordate groups

CO3 Describe the economic importance of arthopods

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and field visits

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Jordan E.L., Verma P.S. (2009), Invertebrate Zoology 11th Edition ISBN : 9788121903677
2. Bernd Schierwater, Rob DeSalle (2021). Invertebrate Zoology: A Tree of Life Approach. ISBN 9780367685676
3. Robert D. Barnes (2006). INVERTEBRATE ZOOLOGY: A FUNCTIONAL EVOLUTIONARY APPROACH. 7th Edition. ISBN no: 978-8131501047
4. INVERTEBRATE ZOOLOGY [7 TH EDITION] A FUNCTIONAL EVOLUTIONARY APPROACH BY EDWARD E. RUPPERT & RICHARD S. FOX (2024).

5. R. S. K. Barnes , Peter P. Calow, P. J. W. Olive, D. W. Golding , J. I. Spicer (2012). The Invertebrates - A synthesis, 3rd edition, Blackwell, ISBN no: 978-8126537853
6. Kotpal, R.L. (2019). Modern Text Book of Zoology Invertebrates 12th edition. ISBN no: 978-8193887554
7. PARKER AND HASWELL TEXTBOOK OF ZOOLOGY VERTIBRATES & INVERTIBRATES VOL 2, 8TH EDITION edited by Veer Bala Rastogi (2021). ISBN no: 978-9389393460
5. J. Moore (2012). An Introduction to the Invertebrates (2nd Edition). Cambridge University Press, ISBN no: 9780511754760

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: BIOSTATISTICS AND COMPUTATIONAL BIOLOGY

Course Code: MZOC 402

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To teach the representation of data in the form of a table and graph
- To provide basic concepts of Statistical Analysis
- To provide knowledge on basics of computers and bioinformatics

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Tabulation and graphical representation of the data: frequency distribution, tabulation, bar diagram, histogram, pie diagram and their significance, measures of central tendency and variation in data, principle of probability, Probit log analysis	**15**
Module II	
Test of Significance: t-test, analysis of variance, f-test, null hypothesis and chi-square test; distribution. normal, binomial and poison, correlation and regression, ANOVA	**15**
Module III	
Basic components of computer-Hardware and software (operating	**15**

system); MS Excel: use of worksheet to enter, edit, copy, move data, Use of input statistical function for computation of mean, S.D., Correlation, Regression coefficient and graphical presentation	
Module IV	
Introduction to bioinformatics: Database: Nucleotide sequence database (Gene Bank, UCSC, EMBL, DDBJ) and protein sequence database (Swiss-Prot, PDB, Blast, Psi-Blast), FASTA, sequence alignment: pairwise and multiple sequence alignment. Application of computational biology in today's world	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Illustrate basic components of computers, Software (operating systems) and application software used in biological and statistical studies

CO2: Sketch overview of databank search, data mining, data management and interpretation.

CO3: Discuss an introduction and learning of Probit Log Analysis for the interpretation of data.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions and by online tools

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. PN Arora and P.K Malhan. Biostatics, Himalaya publishing house
2. Pagano M. Gauvreau, K (2000). Principles of Biostatistics, Duxbury press, USA
3. I A Khan and A Khanam, Fundamental of Biostatics, Ukaaz publication, Hyderabad
4. Batschelet, E., Introduction to mathematics for life scientists. Springer-Verlag, Berling.
5. Jorgensen, S.E., Fundamentals of ecological modeling, Elsevier, New York.
6. Swartzman, G.L., and S.P.O. Kaluzny, Ecological simulation primer, Mac millan, New York.
7. Lendren, D., Modelling in behavioral ecology, Chapman & Hal, London, U.K.

8. Sokal, R.R. and F.J. Rohlf, Biometry, Freeman, San Francisco.
9. Snedecor, G. W. and W.G. Cochran, Statistical methods, Affilited East-West Press, New Delhi (Indian ed).
10. Green, R.H., Sampling design and statistical methods for environmental biologists, John Wiley & Sons, New York.
11. Murray, J.D., Mathematical biology, Springer-Verlag, Berlin.

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Comparative Animal Physiology

Course Code: MZOC 403

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop understanding of the functioning of organism's body
- To develop understanding of the various homeostatic systems of the body
- To develop understanding of the regulation of function in the body

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Digestion: Digestion and absorption of carbohydrates, proteins, lipids and nucleic acids **Excretion**: Structure of nephron, urine formation and its regulation, Acid-base balance and homeostasis Thermoregulatory mechanism	**15**
Module II	
Respiration: Gaseous exchange through the respiratory membrane, respiratory pigments, respiratory adaptation to low oxygen tension, mechanism and regulation of respiration	**15**

Circulation: Blood, haemopoiesis, lymph composition. haemodynamics, regulation of circulation: cardiac cycle	
Module III	
Muscular System: Types and ultrastructure of muscle fibres, mechanism of muscular contraction, muscle twitch, summation, tetanus and fatigue	**15**
Module IV	
Nervous System: Structure and Functions of neurons, mechanism of conduction and transmission of nerve impulses, mechanism of synaptic transmission **Endocrine System:** Major endocrine glands their secretion and functions (pituitary, thyroid. parathyroid, adrenal)	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Discuss various functional components of an organism's body

CO2: Describe the complexities and interconnectedness of these functional components

CO3: Explain the mechanism underlying the maintenance of homeostasis of the body

CO4: Understand the regulatory mechanisms for maintenance of function in the body

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Chatterjce C.C. (2016) Human Physiology Volume 1 & 2. 11th edition. CBS Publishers

2. Christopher D. Moyes, Patricia M. Schulte 2016 Principles of Animal Physiology. 3rd Edition, Pearson Education 4. Hill, Richard W, et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, 2004.
3. Ganong Review of Medical Physiology (21st Ed.), Lang Medical Publications, 2003
4. Guyton, A.C. & Hall, JE. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company
5. Keel et al: Samson Wright's Applied Physiology (13th Ed.), Oxford Press, 1989
6. Murray et al: Harper's Illustrated Biochemistry (26th Ed.), Appleton & Lange, 2003
7. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & Sons
8. West: Best and Taylor's Physiological Basis of Medical Practice (11th Ed.), Williams and Wilkins, 1981.
9. C. Ladd Procsser. Comparative animal physiology. Wiley Publication
10. William Stewart Hoar. General and Comparative Physiology. Prentice Hall

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Biochemistry

Course Code: MZOC 404

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding of the biochemical basis of life
- To develop an understanding of the role of stabilizing interaction and biomolecular complexity
- To develop an understanding of the biochemical processes as the foundation of all physiological events occurring in animals

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Thermodynamics - Elementary thermodynamic system, second law and its applications, concept and calculation of free energy change during biological redox reactions **Electrolytes -** Concepts of Buffers, Henderson-Hasselbach Equation	**15**
Module II	
Carbohydrates: Glycolysis, Krebs cycle, oxidative phosphorylation, gluconeogenesis, glycogenesis, glycogenolysis, hexose monophosphate pathway	**15**
Module III	
Amino Acids: Biosynthesis of amino acids (Phenylalanine,	**15**

tryptophan, aspartate, and proline) **Proteins**: Organization and structure of proteins (a-helix, ß-sheet, motifs, folds, domains), Ramachandran plot	
Module IV	
Lipid: Structure, classification and beta oxidation **Nucleic Acids**: Structure, types and biosynthesis of nucleotides **Enzymes:** Kinetics; inhibition; mechanism of action; Michaelis and Menton Equation; Isozyme: allosteric enzymes, ribozymes **Vitamins and coenzymes:** Structure and functions	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates and how simple molecules together form complex macromolecules.

CO2: Explain the thermodynamics of enzyme-catalysed reactions and mechanisms of energy production at the cellular and molecular levels

CO3: Appraise the application of biochemistry in understanding disease and medicine

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Jeremy Berg, Gatto Jr. Gregory, Hines Justin, Tymoczko John, Stryer Lubert (2023). Biochemistry 10th Edition. ISBN no: 978-1319498504
2. David L.. Nelson and Michael M. Cox (2021). Lehninger Principles of Biochemistry (8rd Ed.), W.H. Freeman & Co Ltd; ISBN No: 978-1319228002
3. Christopher K. Mathews, K. E. Van Holde, Dean R. Appling , Spencer J. Anthony-cahill (2012). Biochemistry (4th Edition). ISBN No: 978-0138004644

4. Destin Heilman, Stephen Woski, Donald Voet, Judith G. Voet, Charlotte W. Pratt (2024). Fundamentals of Biochemistry, 6th Edition. ISBN: 978-1-119-90348-2
5. Peter J. Kennelly, Kathleen M. Botham, Owen P. McGuinness, Victor W. Rodwell, P. Anthony Weil (2022). Harper's Illustrated Biochemistry, 32nd Edition. ISBN No: 978-1260469943.
6. Veer Bala Rastogi K. R. Aneja (2020). Zubay's Principles Of Biochemistry - 5th Edition. ISBN no: 978-9384007492

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Practical

Course Code: **MZOL 405**

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	8

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop understanding of the morphology and anatomy of the non-chordates
- To provide hands on training on slide preparations.
- To develop practical understanding of the biochemical processes as the foundation of all physiological events occurring in animals

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (120)**
Module I	
Non-chordata General characters and classification of the non-chordates phyla (Protozoa to Echinodermata) with the help of museum specimens and slides. **Protozoa** Vital staining and staining preparation of *Paramecium*; Study of cyclosis and trichocysts in *Paramecium*; Permanent preparation of *Ceratium, Noctiluca, Paramecium, Vorticella.* **Study of prepared slides:** *Balantidium, Nyctotherus. Opalina Parameciu*m-conjugation/binary fission. *Entamoeba histolytica, Entamoeba coli, Entamoeba gingivalis, Monocystis, Giardia, Trypanosoma, Leishmania, Trichomonas, Trichonympha, Plasmodium.*	**48**

Porifera: Permanent preparation of gemmules and different kinds of spicules **Study of museum specimens/models;** *Lecuosolenia, Sycon, Grantia, Euplectella, Hyalonema, Oscarella, Chondrilla, Chliona, Chalina, Spongilla, Spongia, Hippospongia.* **Cnidaria and Ctenophora:** Study of nematocysts of *Hydra*, Permanent preparation of *Hydra; Obelia* and other hydrozoan colonies and *Obelia medusa* **Study of museum specimens' models**: *Tubularia, Bougainvillia, Pennaria, Hydractinia, Sertularia, Campanularia, Millepora, Stylaster, Physalia, Porpita, Valella, Aurelia, Rhizostoma. Tubipora, Alcyonium, Gorgonia, Corallium, Pennatula, Zoanthus, Metridium, Adamsia, Cerianthus, Fungia, Madrepora, Cestum.* **Helminths**. Permanent preparation of selected soil and plant nematodes, cestode and trematode parasites of cattle and poultry and different larval stages of liver fluke **Study of museum specimens' whole mounts***: Dugesia, Polystoma, Bipalium, Fasciola, Echinococcus, Paramphistomum, Schistosoma, Taenia solium, Taenia saginata, Moniezia, Trichuris, Trichinella, Heterodera, Enterobius, Ascaris, Ancylostoma, Dracunculus, Wuchereria* **Study of prepared slides***: S*colex of tape worm, mature and gravid proglottid of tape worm; Study of cysticercus larva, hydatid cyst, larval stage of *Fasciola* **Annelida:** Study of museum specimens/models: *Aphrodite, Tomopteris, Glycera, Chaetopterus, Arenicola, Sabella, Amphitrite, Serpula, Tubifex, Branchiobdella, Eisenia, Metaphire, Placobdella, pontobdella Branchellion, Polygordius,* **Study of prepared slides:** T.S. of body of leech passing through various portions of its body. **Arthropoda.** Study of museum specimens*: Limulus, Palamnaeus, Lycosa, Apus, Argulus, Balanus. Sacculina, Mysis, Gmmarus, Squilla, Prawn,*	

Lobster, true crab, hermit crab, Julus, Scolopendra, Scutigerella, Lepisma, Mantis, stick insect, grass hopper, termites, Forficula,, Pediculus, Ranatra, Dysdercus, Musca, Lady bird beetle, butterfly, wasp, Xenopsylla, life history of honey bee, lac insect and silk moth, spider **Study of prepared slides:** Mouth parts of male and female *Anopheles* and *Culex,* house fly, honeybee, butterfly, *Cimex, Daphnia, Cypris, Cyclops, Pediculus,* **Mollusca: Study of museum specimens/models:** *Chiton, Dentaliun, Pila, Aplysia, Baccinum, Doris, Lymnaea, Mytilus, Patella, Pecten, Limax, pearl oyster, Teredo, Nautilus, Loligo, Sepia, Octopus.* **Study of prepared slide:** Radula, T.S of shell of *Unio,* T.S of gill lamina of *Unio,* T.S of body of *Unio* passing through middle region; Larvae of molluscs. **Echinodermata:** Study of museums specimens/ models: *Astropecten, Asterias, Ophiothrix, Opiura, Echinus, Clypeaster, Echinocardium, Thyone, Holothuria, Antedon;* **Study of prepared slides**. Larvae of echinoderms: Aristotle's lantern **Minor phyla** Representative specimens of Sipunculida *(Sipunculus)*	
Module II	
Biostatistics and Computational Biology • Numerical Based on: Matrices. Mean, median and mode. Mean deviation, variance, standard deviation and standard error. • Representation of data: Bar diagrams, π-diagrams, Histograms, Frequency polygons • t-test • F-test • Chi square test • ANOVA • Demonstration of PubMed in searching scientific literature	**24**

using the author's name, fields, limits etc. • Demonstration of BLAST in comparing Protein Sequences. • Use of Sigma Stat/Prism Software for Statistical analysis. • Use of Search engines and online resources.	
Module III	
Physiology • Determination of the rate of Oxygen consumption of the Albino rat • Study of the total count of erythrocytes and leukocytes of rats • Study of different leukocyte count in rats • Determination of Rh factor in human blood • Colorimetric estimation of hemoglobin content of the blood, colour index and mean corpuscular volume in rats. • Determination of respiratory rate of rats concerning size and sex; Respiration rate in fish at different temperatures.	**24**
Module IV	
Biochemistry • Isolation and colorimetric determination of glycogen content of rat liver • Demonstration of the effect of epinephrine on the glycogen yield from the liver • Estimation of protein content liver of fish and rats • Quantitative estimation of total free amino acids in tissues of cockroach and paper chromatographic separation of these amino acids • Kinetic essay of salivary amylase and study of effects of time temperature and pH • Estimation of total lipid in the fat body of cockroach and liver of fish, and rat.	**24**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Identify various non-chordate species through morphology and anatomy

CO2: Employ an appropriate method for statistical analysis into the research data

CO3: Perform various biochemical and physiological analysis

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals, discussions, and virtual labs.

Assessment/ Examination Scheme:

Distribution of Marks: Exercise		**Time: 6 hours** Marks
Physiology Exercise		20
Biochemistry Exercise		20
Biostatistics and Computational Exercise		10
Slide preparation		06
Spotting (12 spots)		24
Viva voce		10
Class record		10
	Total Marks	100

Text Books/ Reference Books:

1. S.S. Lal (2019). Practical Zoology Invertebrate (12th Edition). ISBN No: 9789350781616
2. Pandey and Shukla (2017). Non-Chordate (Invertebrate) Zoology Practical. ISBN No: 978-8184884661
3. Pamela Jha. (2024). Practical Biochemistry. ISBN: 978-981-5165-86-9
4. G K Pal and Pravati Pal (2020). Textbook of Practical Physiology, Fifth Edition. ISBN no 978-9389211641
5. KV Sastry (2017). Animal Physiology and Biochemistry 3rd edition. ISBN no: 978-9350781630

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Research Project

Course Code: MZOP406

Credit Units: 04

Level: **UG 4th Year (Semester 7)**

Course Code: MZOP 406	**Credit: 4**	**Project**
	Course Title: Research Project	
Each student will do a research project under the guidance of a supervisor. Evaluation of the research project will be done after the second semester.		

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: CHORDATA

Course Code: MZOC 411

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop understanding of the of structural and functional diversity
- To develop understanding of the of evolutionary relationship amongst chordate

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Origin of chordates: Pisces - ostracoderm, placoderms and Devonian fishes: general organization and affinities of holocephali, crossopterygii, and dipnoi	**15**
Module II	
Origin of tetrapoda: general organization of anura, peculiarities of urodela and apoda, neoteny in amphibia	**15**
Module III	
Origin and evolution of Reptilia: General organization of Chelonia, Rhynchocephalia, Squamata and Crocodilia	**15**
Module IV	
Origin and Evolution of Birds: Aerodynamics in Birds: Flight Adaptations,	**15**

Origin and Evolution of Mammals: Characteristic Features of Monotremes, Marsupials and Placentals	

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Demonstrate comprehensive identification abilities of chordate diversity

CO2: Explain the structural and functional diversity of chordates

CO3: Explain the evolutionary relationship among chordates

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ References Books:

Books Recommended

1. VK Agarwal (2024). Diversity of Chordates. ISBN : 9789358705812
2. Harvey Pough, Author William E. Bemis, Betty Anne McGuire, and Christine M. Janis (2022). Vertebrate Life, 11th edition. ISBN: 9780197558621
3. Colbert, E H., Morales, M. and Minkoff, E. C. (2011). Colbert's Evolution of the Vertebrates. A history of the backboned animals through time, 5th edition, John Wiley-Liss, Inc., New York, ISBN No: 978-8126533183
4. Hildebrand, M. and Goslow G. (2015). Analysis of Vertebrate Structure, 5th edition, John Wiley & Sons, Inc., New York, ISBN: 9780471295051
5. Jordan, E. L. and Verma, P. S., (2014). Chordate Zoology. 15th Edition S. Chand & Company Ltd,
6. Kenneth V Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
7. Kotpal, R. L The Birds, 4th edition, Rastogi Publications, Shivaji Road, Meerut, 1999
8. Boolootian, R. A and Stiles, K. A., (1981).College Zoology, 10th edition, Macmillan Publishing Co., Inc. New York.

9. Farner, D. S. and King, J. R., Avian Biology (in several volumes), Academic Press, New York, 1971. 4. Goodrich, E. S, Studies on Structure and Development of Vertebrates, Dover Publication, New York, 1958.

10. Marshall, A. J., Biology and Comparative Physiology of Birds, Volume I & II, 1960.

11. McFarland, W. N., Pough, F. H., Cade, T. J. and Heiser, J. B., Vertebrate Life, Macmillan Publishing Co., Inc, New York, 1979.

12. Moore, J. A, Biology of Amphibia, Academic Press, 1964.

13. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford

14. Parker, T. S. and Haswell, W. A., TextBook of Zoology, Vol. II, ELBS, 1978.

15. Romer, A. S. and Parsons, T. S., The vertebrate body, 6th edition, CBS Publishing Japan Ltd. 1986.

16. Sinha, A. K., Adhikari, S. and Ganguli, B. B.: Biology of Animals, Vol. II, New Central Book Agency, Calcutta, 1988.

17. Young, J. Z. The life of vertebrates, 3rd edition, ELBS with Oxford University Press, 1981

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: DEVELOPMENTAL BIOLOGY

Course Code: MZOC 412

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding, how the single cell formed at fertilization forms an embryo and then a fully formed adult organism.
- To develop an understanding of the Integration of genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development,
- To develop an understanding of the treatment of birth defects and infertility in humans.

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Cellular differentiation, signalling, Potency, Induction, Competence, morphogenetic gradient, cell fate and cell lineages, Stem cells,	**15**
Module II	
Structure and recognition of gametes, Sperm capacitation and acrosomal reaction, Fertilization, Prevention of polyspermy, egg activation Nature of Egg, Cleavage Pattern, Blastula formation, Gastrulation, Formation and fate of the germinal layers, Causes of fetal deformities	**15**
Module III	
Organogenesis of vertebrate eye and heart, Evolution of viviparity in	**15**

mammals, Cellular and Biochemical events in Amphibian and Insect metamorphosis	
Module IV	
Determination of polarity and symmetry, Induction and Organizer concept, Regeneration of salamander limbs, morphallactic regeneration in Hydra, Transgenic animals, Aging and cellular death	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Discuss a variety of interacting processes that generate an organism's heterogeneous shapes, size, and structural features

CO2: Explain how a cell behaves in response to an autonomous determinant or an external signal, and

CO3: Describe the scientific reasoning exhibited in experimental life science

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Cheryll Tickle, Alfonso Martinez Arias, Marysia Placzek, and Lewis Wolpert (2025). Wolpert's Principles of Development (7th edition). ISBN: 9780192896612
2. Michael Barresi and Scott Gilbert (2023). Developmental biology 13th Edition. ISBN: 9780197574591
3. Kalthoff (2001). Analysis of biological development.2nd edition McGraw-Hill, ISBN 0-07-092037-0
4. Current Topics in Developmental Biology (Book Series) 1st Edition, Volume 66 - March 9, 2005 Editor: Gerald P. Schatten, ISBN: 9780124112568
5. Roger A. Pedersen, Gerald P. Schatten. Current Topics in Developmental Biology: 1998
6. Russ Hodge Developmental Biology: From a Cell to an Organism (Genetics & Evolution) eBook: 2009, Infobase Publishing.

7. Michael J. F. Barresi, Scott F. Gilbert. Developmental Biology. 2019, Oxford University Press
8. T. Subramaniam. Developmental Biology. (Reprint) 2013, Narosa Publishing House Pvt. Ltd., New Delhi
9. Werner A Müller.Developmental biology: 2012, Springer Science & Business Media.
10. Jonathan M. W. Slack. Essential Developmental Biology:, (3rd ed.) 2012, Wiley-Blackwell.
11. Bruce M. Carlson. Human Embryology and Developmental Biology E-Book:, 2018, Elsevier Health Sciences
12. B. Balansky. An introduction to embryology by, CBS college publishing

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: GENETICS AND CYTOGENETICS

Course Code: MZOC 413

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding of the structure of gene and learn how the information contained within them gets transferred from one generation to other
- To develop an understanding of the Human genetics which will impart knowledge about the human chromosome constitution that would help in applying basic principles of chromosome behaviour to the disease context.
- To develop an understanding of genetic diseases.

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Mendelian Principles of Inheritance, Current status of Mendelism, Concept of gene, allele, multiple alleles, Pseudoalleles	**15**
Module II	
Chromosomal mapping. Extension of Mendelian principles-codominance, incomplete dominance, gene interactions, pleictropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage	**15**
Module III	
Euchromatin and heterochromatin, chromosomal aberration, DNA	**15**

Replication, transposable elements in prokaryotes and eukaryotes	
Module IV	
Bacterial transformation, transduction, conjugation, mapping of genes interrupted, elements of eugenics , imprinting of genes, gene therapy	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Explain Mendelism, cytoplasmic inheritance. aberration, gene therapy

CO2: Discuss genetic diseases, their types and causes.

CO3: Discuss the principles of inheritance, linkage and crossing over which lead to variations will be made clear as well as the application thereof in gene mapping

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures and discussions.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Brooker (2023). Genetics: Analysis and Principles 8th edition, ISBN No: 978-1266822988
2. D. Peter Snustad, Michael J. Simmons (2015). Principles of Genetics, 7th Edition ISBN: 978-1-119-14228-7
3. Gardner, M. J. Simmons, D. P. Snustad (2008). Principles of Genetics 8th edition, ISBN No 978-81-265-1043-6.
4. Anthony J. F. Griffiths; William M. Gelbart; Richard C. Lewontin; Jeffrey H. Miller (2002). Modern Genetic Analysis: Integrating Genes and Genomes, Second Edition. ISBN no**:** 978-0716747147
5. Hartl, Daniel L (2020). Essential genetics and genomics 7th Edition. ISBN No: 978-128-4152-68-5

6. Lewin's Genes XII, by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick (2017). ISBN no. 978-1284104493
7. Peter J. Russell (2014). iGenetics A Molecular Approach -Third Edition. ISBN 13: 978-1-292-02633-6
8. Gardner, M. J. Simmons, D. P. Snustad (2008). Principles of Genetics 8th edition, ISBN No 978-81-265-1043-6.
9. Molecular Biology of the Cell (7th edition), by Alberts et. al., ISBN: 978-0-393-42708-0 (2022).
10. De Robertis & De Robertis. Cell and Molecular Biology 8th Edition ISBN 9780812110128
11. Karp's Cell and Molecular Biology (9th Edition), ISBN: 978-1-119-59816-9 (2019)
12. Lewin's Genes XII, by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick (2017). ISBN no. 978-1284104493
13. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon, Molecular Cell Biology (9th edition), ISBN13: 978-1319208523 Freeman & Co, USA (2021).

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: ECOLOGICAL PRINCIPLES

Course Code: MZOC 414

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
4	0	0

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding of the ecosystem structure and function
- To develop an understanding of the ecological development
- To develop an understanding of the ecosystem modelling

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (60)**
Module I	
Concept of habitat and niche, ecosystem — structure and functions, concept of limiting factors, Liebig's law of the minimum; Shelford law of tolerance; energy flow, first and second law of thermodynamics, biogeochemical cycles (carbon, nitrogen and phosphorus)	**15**
Module II	
Characteristics of population, population growth curve, life history strategies (r and k selection), nature of community, community structure, edges and ecotones; ecological indicator	**15**
Module III	
Ecological pyramids, ecological succession-types, mechanism; species interaction; tritrophic interaction, concept of homeostasis and	**15**

feedback	
Module IV	
Ecosystem modelling, acclimation and acclimatization; different types of ecosystem -terrestrial and aquatic; conservation of natural resources; wetlands	**15**

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Discuss ecological relationships between organisms and their environment.

CO2: Explain and identify the role of the organism in energy transfers

CO3: Describe the habitat ecology and resource ecology.

Pedagogy for Course Delivery:

The course will be delivered in the form of lectures, discussions, and field trips.

Assessment/ Examination Scheme:

Evaluation scheme and mode will be as per the guidelines notified by the Siddharth University, Kapilvastu, Siddharth Nagar

Text Books/ Reference Books:

1. Clifford B. Knight. Basic concepts of Ecology, The Macmillan Company, New Yok
2. EP. Odum. Fundamental of Ecology, Oxford and IBN Publishing Co., New Delhi
3. Grant, W.E. and Swannack. T.M Ecological Modeling. (2008), Blackwell.
4. Kimon Hadjibros. Ecology and Applied Environmental Science
5. Margaret Brown. Ecology, Apple Academic
6. Gurkirat Kaur Environmental Law, Shree Publishers and Distributors, New Delhi
7. Benton and Werner. Field Biology and Ecology, McGraw-Hill Book Company
8. Conklin A R Jr. Field Sampling: Principles and Practices in Environmental Analysis (2004), CRC Press
9. Wilkinson, D.M. Fundamental processes in Ecology: An Earth system Approach, (2007), Oxford University PRESS , UK,
10. Fahey, T.J. and Knapp, A.K. Principles and standards for Measuring Primary Production, (2007), Oxford University press, UK.

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<5%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Practical

Course Code: **MZOL 415**

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Credit Distribution of the course		
Lecture (L)	Tutorial (T)	Practical (P)
0	0	8

Course Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding of the morphological and anatomical features of the chordates
- To provide hands on training on techniques for developmental biology study
- To develop practical understanding of the ecology, cytogenetics, and genetics

Pre-requisites: Zoology in UG Course as a major subject studied in six Semesters

Course Contents/Syllabus:

Descriptors/Topics	**Total No. of Lectures/Teaching Hours (120)**
Module I	
Chordata **Urochordata:** Study of museum specimens/ whole-mount Oikopleura, Herdmania, Ascidia, Pyrosoma, Dotiolum, Salpa **Cephalochordate**: Study of museum specimen: Branchiostoma. **Cyclostomata:** Study of museum specimens /models: peltromyzon , Myxine; Ammocoete larva. **Pisces**:	**48**

Natural history of cartilaginous fishes (class Chondrichthyes): Scoliodon, Sphyrna (hammer-headed shark), Torpedo (electric rays), Pristis, Rhinobatus, Raja (skate), Trygon (sting rays), Chimaera Natural history of bony fishes (class Osteichthyes) *Polypterus, Acipenser, Pulydon, Amia, Lepidosteus, Salmo, Hilsa, Netopterus, Labeo, Catia, Cyprinus, Curhina, ariys , Heteropneustes, Clarius, Wallago, Mystus, Anguilla, Exocoteus, Hippocampus, Channa, Amphipmous, Anabas, Synaptura, Echeneis, Syngnathus, Pleuronectes, Lophius, Tetradon, Diodon, Ostracion* Lung Fishes: Protopterus, Lepidosiren, Neoceratodus Study of the disarticulated bone of a carp. **Amphibia:** Study of museum specimens/models: *Ichthyophis, Uraeotyphlus, Cryptobrunchus, Ambystoma,* Axolotl larva*, Salamandra, Amphiuma, Triturus, Proteus, Necturus, Siren, Alytes, Bufo, Hyla, Rhacophorus,* Study of the disarticulated bone of a frog **Reptilia:** Study of museum specimens/models: *Testudo, Chelone, Kachuga, Trionyx, Sphenodon, Hemidactylus, Phrynosoma, Calotes, Draco, Lguana, Chamaeleon, Heloderma, Varanus, Ophisaurus, Typhlops. Python, Ptyas, Natrix, Eryx, Dendrophis, Hydrophis, Crotalus, Bungarus, Naja, Russel Viper, Pit Viper, Crocodilus, Alligator, Gavialis,* Study of the disarticulated bones of Varanus **Aves:** Study of museum specimens / models: *Arhaeopteryx, Phoenicopterus* (Flamingo), *Pavo* (Peacock), *Columba* (Pigeon), *Eudynamus* (Koel*), Psittacula* (Parrot), *Bubo* (Owl), *Dendrocopus* (Woodpecker), *Passer domesticus* (House sparrow), *Corvus* (Crow) Study of the disarticulated bones of a fowl	

Mammalians: Study of museum specimens/models: *Ornithorhynchus, Tachyglossus, Erinaceus, Talpa, Sorex, Macropus, Pteropus,* (Bat), *Loris, Funambulus, Rattus, Oryctolagus, Hystrix,* Study of the disarticulated bones of a rabbit	
Module II	
Developmental Biology • Experiments on artificial ovulation, and insemination in the study of the life history stages of frog • Study of hormonal control of amphibian metamorphosis • Incubation and mounting of chick embryos; • Study of prepared slides of the embryology of frog, chick and mammals and mammalian placentation • Application of window techniques for in-situ study of chick embryo with special reference to morphogenetic movement • Determination of the effect of temperature on the embryonic development of the chick; • Study of the development of selective organs through preserved specimens and prepared slides: Experiment on regeneration in earthworms, regeneration of lizards.	**28**
Module III	
Genetics and Cytogenetics • Study of mitosis in onion root tip • Meiosis in the testis of grasshopper with the acetocarmine squash method • Study of the salivary gland chromosomes of Drosophila and Chironomus.	**16**
Module IV	
Ecological Principles • Study of different structural adaptations of animals to ecological conditions	**28**

• Study of micro and macro fauna of soil by the froth floatation method • Comparative estimation of physicochemical eco factors of/ in different localities; Temperature, pH, Carbonate, sulphate, nitrate, and turbidity, in freshwater sample; moisture content of soil sample • Study of seasonal variation in plankton population demonstration of parallax vision and height perception • Analysis of plant community, biodiversity, and biomass • Study of seasonal plankton population both qualitative and quantitative	

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Identify various chordate species through morphology and anatomy

CO2: Employ an appropriate method for the study of developmental biology

CO3: Perform various biological and chemical analysis for ecological studies

Pedagogy for Course Delivery:

The course will be delivered in the form of Practicals, discussions, and virtual labs.

Assessment/ Examination Scheme:

Distribution of Marks: **Exercise**		**Time: 6 hours** **Marks**
Cytogenetics Exercise		10
Ecology Exercise		15
Embryology exercise		15
Preparation		10
Spotting (12 spots)		25
Viva voce		15
Class record		10
	Total Marks	100

Text Books/ References Books:

1. P S Verma (2025). A Manual of Practical Zoology – Chordates (12th edition). ISBN : 9789369587568
2. M.A. Gibbs (2003). Practical Guide to Developmental Biology. ISBN: 9780199249718
3. Beffa and Knight (2011). Key experiment in practical developmental biology. ISBN: 9780521179768.
4. Paramjeet Kaur and A.S.Yadav (2024). A Practical Handbook on Cytogenetics.1st edition. ISBN: 978-81-977835-1-7
5. P.G. Kumar. Practical Zoology VI- Lab on ecology, Environmental science, behavioural ecology and wild life. ISBN: 978-93-5854-749-8
6. Peter A. Henderson (2003). Practical Methods in Ecology. ISBN: 978-1-405-10244-5

Record Matrix	
To be Filled by Institution	
Date of Introduction of the course:	**24th May 2022**
Date of Last Revision:	**Not applicable**
Version*:	**2nd**
Percentage of revision:	**<10%**

SIDDHARTH UNIVERSITY

Kapilvastu, Siddharth Nagar (UP)- 272202

Course Title: Research Project

Course Code: MZOP 417

Credit Units: 04

Level: **UG 4th Year (Semester 8)**

Course Code: MJOP417	**Credit: 4**	**Project**
	Course Title: Research Project	
Each student will do a research project under the guidance of a supervisor. Evaluation of the research project will be done after the second semester.		