School of Basic Sciences and Research

Department of Life Sciences

Program Structure: Three Year U.P. HigherEducation for Zoology Discipline

AY: 2021-22 Onwards

1. Standard Structure of the Program at University Level

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Creative Campaign can be TEDs: This is guiding principle for promotion and wide circulation among various stakeholders.

Guidelines: Similar Mnemonics can be designed by schools.

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

Note: Detailed Mission Statements of University can be used for developing Mission Statements of Schools/ Departments.

1.2 Vision and Mission of the School

Vision of the School

Achieving Excellence in the Realm of Basic and Applied Sciences to Address the Global Challenges of Evolving Society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences.**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish centre of excellence for ecologically and socially innovative research.**
4. **To strengthen inter institutional and industrial collaboration for skill development and global employability.**

Core Values

1. Passion
2. Perseverance
3. Scientific nature
4. Yearning for truth

1.2 Vision and Mission of the Department

Vision of the Department

To acquire and impart knowledge of biology and bio-techniques so as to build capacity for addressing current global challenges

Mission of the Department

1. **To train and transform students into thinking researchers/ professionals who are able to integrate theoretical knowledge and analytical skills in diverse areas of Biotechnology.**
2. **To make students and faculties updated with advance techniques and to introduce the students to dynamic environment of bioscience**
3. **To conduct cutting-edge interdisciplinary research.**
4. **To introduce various skill development courses thereby enhancing the employability and providing opportunities for industry-academia collaboration.**

1.3 Programme Educational Objectives (PEO)

1.3.1 Writing Programme Educational Objectives (PEO)

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO1: To create a foundation of various zoology concepts and phenomena in the minds of students through theoretical and practical knowledge.

PEO2: To keep students upgraded with new discoveries in biological world and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.

PEO3: To make the students to tackle detailed problem-solving and analytical tasksassociated with pure and applied zoological questions, in areas that include evolution, ecology and conservation.

PEO4: To make students industry- or academia-ready by developing independent thinking,good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.

PEO5: To make students understand interdisciplinary nature of research in zoology by assigning them different research projects/ case studies/ presentations.

1.3.2 Map PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1:	3	2	-	-
PEO2:	3	2	2	-
PEO3:	3	3	2	1
PEO4:	2	3	2	2
PEO5:	3	2	2	2

Enter correlation levels 1, 2, or 3 as defined below:

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

If there is no correlation, put "-"

1.3.2.1 Map PEOs with Department Mission Statements:

PEO Statements	Department Mission 1	Department Mission 2	Department Mission 3	Department Mission 4
PEO1:	3	1	1	1
PEO2:	3	3	2	2
PEO3:	2	2	2	2
PEO4:	3	-	2	3
PEO5:	3	2	3	2

Enter correlation levels 1, 2, or 3 as defined below:

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

If there is no correlation, put "-"

1.3.3 Program Outcomes (PO's)

PO1: Knowledge: The student will have knowledge of the animals of the Earth and provide valuable insight for wise management of the planet's resources.

PO2: Skill Set Development: The student will be skilled in the observation and study of nature, biological techniques, experimental skills and scientific investigation.

PO3: Oral Communication and Scientific Writing: The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report, assignments and reviews) content.

PO4: Environment and Sustainable Development: The student will be able to recognizing the essential roles of science and biology in the lives of citizens today and tomorrow; and the valuable insight for wise management of the planet's resources.

PO5: Ethics, Independent Thinking and Team Work: The student will be able to focus on "real world" relationships and dependencies among the phenomena and processes will give character to any location or place.

PO6:

PO7:

1.3.4 Mapping of Program Outcome Vs Program Educational Objectives

Mapping	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	2	2	2
PO2	3	2	2	3	2
PO3	1	1	-	3	2
PO4	1	2	3	-	2
PO5	1	2	-	3	2

1. Slight (Low) ***2. Moderate (Medium)*** ***3. Substantial (High)***

B. Program Structure

1. TITLE: Three Year U.P. Higher Education Program Structure for Zoology Discipline

2. DURATION OF THE COURSE: 3 Years

3. YEAR OF IMPLIMENTATION

This syllabus will be implemented for the session academic year 2021-22 onwards.

4. PREAMBLE

Total Credits- 150

Minimum credit required for multiple entry and exit:

Total credit of the 03 year UG Program for year wise multiple entry and exit	01st Year	46
	02nd Year	96
	03rd Year	146

Total Number of Semesters – 06 (Two semesters per year)

Total Number of Theory Papers – 28

Total Number of Practical courses – 20

Total Number of Minor Projects/Dissertations- 02

Number of papers (theory) per semester – 04-05

Number of Laboratory courses per semester – 02-04

Community Connect: 01

Internship: 01

Semester wise subjects							
No.	**Course Name**		**Subject**	**Theory/ Practical**	**Credit**		(Min.-Max.Total Credits) After completion {Minimum Credits} [Max Duration in years]
					Total	Min. - Max. of the semester/ year	
Year 01: Certificate Course in Medical Diagnostics & Public Health							
1.	**Semester1**	Cytology, Genetics and Immunology	Major I	Theory	04	23	(46-50) {46} [4] **Certificate Course in Medical Diagnostics & Public Health**
2.		Cell Biology and Cytogenetics Lab	Major I	Practical	02		
3.		Introduction to Microbiology	Major II	Theory	04		
4.		Microbiology Lab	Major II	Practical	02		
5.		Chemistry – I	Major III	Theory	04		
6.		Chemistry Lab - I	Major III	Practical	02		
7.		Vocational	Vocational	Practical	03		
8.		Food, Nutrition and Hygiene	Co-curricular	Theory	02		
Total credit					**23**		
1.	**Semester2**	Biochemistry and Physiology	Major I	Theory	04	23-27	
2.		Physiological, Biochemical & Hematology Lab	Major I	Practical	02		
3.		Human Physiology and Histology	Major II	Theory	04		
4.		Human Physiology and Histology Lab	Major II	Practical	02		
5.		Chemistry – II	Major III	Theory	04		
6.		Chemistry Lab - II	Major III	Practical	02		
7.		Physics – I	Minor/ Elective	Theory	04		
8.		Vocational Course	Vocational	Practical	03		
9.		Health and Hygiene	Co-curricular	Theory	02		
Total credit					**27**		
Year 02: Diploma in Molecular Diagnostics and Genetic Counselling							

1.	**Semester3**	Molecular Biology, Bioinstrumentation & Bio-techniques	Major I	Theory	04	23	96-100 {96} [7] **Diploma in Molecular Diagnostics and Genetic Counselling**
2.		Bioinstrumentation & Molecular Biology Lab	Major I	Practical	02		
3.		Animal Biotechnology	Major II	Theory	04		
4.		Animal Biotechnology Lab	Major II	Practical	02		
5.		Chemistry – III	Major III	Theory	04		
6.		Chemistry Lab - III	Major III	Practical	02		
8.		Vocational	Vocational	Practical	03		
9.		Physical Education	Co-curricular	Theory	02		
Total credit					**23**		
1.	**Semester4**	Gene Technology and Human Welfare	Major I	Theory	04	27	
2.		Genetic Engineering Lab, Genetic Counselling & Telemedicine	Major I	Practical	02		
3.		Enzymology	Major II	Theory	04		
4.		Enzymology Lab	Major II	Practical	02		
5.		Chemistry – IV	Major III	Theory	04		
6.		Chemistry Lab – IV	Major III	Practical	02		
7.		Physics – II	Minor/ Elective	Theory	04		
8.		Vocational	Vocational	Practical	03		
9.		Human values and Environment Studies	Co-curricular	Theory	02		
Total credit					**27**		
Year 03: Degree in Bachelor of Science							
1.		Diversity of Non-Chordates, Parasitology and Economic Zoology	Major I	Theory	04	25	
2.		Diversity of Chordates and Comparative Anatomy	Major I	Theory	04		
3.		Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	Major I	Practical	02		
4.	**Semester5**	Research Project (will be undertaken as a part of internship after semester 4)	Industrial Training/ Survey/ Project	Project	01		
5.		Nano-biotechnology	Major II	Theory	04		

6.		Medical Zoology	Major II	Theory	04		(146-150) {146) [10] **Degree in Bachelor of Science**
7.		Nano-biotechnology Lab	Major II	Practical	02		
8.		Analytic Ability and Digital Awareness	Co-curricular	Theory	02		
9.		Community connect	Industrial Training/ Survey/ Project	Project	02		
Total credit					25		
1.	**Semester6**	Evolutionary and Developmental Biology	Major I	Theory	04	25	
2.		Ecology, Ethology, Environmental Science and Wildlife	Major I	Theory	04		
3.		Lab on Environmental Science, Behavioral Ecology, Developmental Biology, Wildlife, Ethology	Major I	Practical	02		
4.		Research Project	Industrial Training/ Survey/ Project	Project	03		
5.		Structural Bioinformatics	Major II	Theory	04		
6.		IPR	Major II	Theory	04		
7.		Structural Bioinformatics Lab	Major II	Practical	02		
8.		Communication Skills and Personality Development	Co-curricular	Theory	02		
Total credit					25		
Total credit of the 03 year UG Program: 150			01st Year		46-50		**Minimum credit required:** 146
			02nd Year		96-100		
			03rd Year		146-150		

Three years UG programme structure of Zoology as per UP Higher Education

		Subject I	Subject II	Subject III	Subject IV	Vocational	Co- Curricular	Industrial Training/ Survey/ Project		
		Major (Zoology)	Major (Zoology)	Major (Chemistry)	Minor/ Elective	Minor	Minor	Major	Credits	
		Credits 4 + 2	Credits 4 + 2	Credits 4 + 2	Credits 4	Credits 3	Credits 2	Credits		{Minimum Credits} [Max Duration in years]
Year	Sem.	Own Faculty	Own Faculty	Any Faculty	Other Department/Faculty	Vocational Faculty	Co- Curricular Course	Inter/Intra Faculty related to main Subjects	Total	
1	I	Cytology, Genetics and Immunology (L)	Introduction to Microbiology (L)	Chemistry - I (L)		As per choice of student	Food, Nutrition and Hygiene		23	(50) {46} [4] Certificate Course in Medical Diagnostics &Public Health
		Cell Biology and Cytogenetics Lab (P)	Microbiology Lab (P)	Chemistry Lab - I (P)						
	II	Biochemistry and Physiology (L)	Human Physiology & Histology (L)	Chemistry - II (L)	Physics – I (L)	As per choice of student	Health and Hygiene		27	
		Physiological, Biochemical & Hematology Lab (P)	Human Physiology & Histology Lab (P)	Chemistry Lab - II (P)						
2	III	Molecular Biology, Bioinstrumentation & Bio-techniques (L)	Animal Biotechnology (L)	Chemistry - III (L)		As per choice of student	Physical Education		27	(100) {96} [7] Diploma in Molecular
		Bioinstrumentation & Molecular Biology Lab	Animal Biotechnology Lab	Chemistry Lab - III (P)						
		Gene Technology and Human Welfare (L)	Enzymology (L)	Chemistry - IV (L)	Physics – II (L)	As per choice of student	Human values			

	IV	Genetic Engineering Lab, Genetic Counselling & Telemedicine (P)	Enzymology Lab (L)	Chemistry Lab - IV (P)			and Environmental Studies		**23**	Diagnostics andGenetic Counselling
3	V	Diversity of Non-Chordates, Parasitology and Economic Zoology (L)	Nano-biotechnology (L)				Analytical Abilityand Digital awareness	Community Connect (2) + Summer internshipof term IV (1)	**25**	(150) {146} [10] Degree in Bachelor of Science
		Diversity of Chordates and Comparative Anatomy (L)	Medical Zoology (L)							
		Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology (L)	Nano-biotechnology Lab (P)							
		Evolutionary and Developmental Biology (L)	Structural Bioinformatics (L)							
	VI	Ecology, Ethology, Environmental Science and Wildlife (L)	IPR (L)				Communication Skills and Personality Development		25	
		Lab on Environmental Science, Behavioral Ecology, Developmental Biology, Wildlife, Ethology	Structural Bioinformatics Lab (P)							
		Diversity of Non-Chordates, Parasitology and Economic Zoology (L)	Nano-biotechnology (L)							
		Diversity of Chordates and Comparative Anatomy (L)	Medical Zoology (L)							

BSc Zoology Course Structure

Year	Semester	Course Code	Paper Title	Theory /Practical	Credits
1st	I	B050101T	Cytology, Genetics and Immunology	Theory	4
			Introduction to Microbiology	Theory	4
			Chemistry - I	Theory	4
			Vocational Course	Practical	3
			Food and Nutrition	Theory/Practical	2
		B050102P	Cell Biology and Cytogenetics Lab	Practical	2
			Microbiology Lab	Practical	2
			Chemistry Lab - I	Practical	2
			Total Credits		**23**
	II	B050201T	Biochemistry and Physiology	Theory	4
			Mycology & Phycology	Theory	4
			Chemistry - II	Theory	4
			Physics - I	Theory	4
			Vocational Course	Practical	3
			Health and Hygiene	Theory/Practical	2
		B050202P	Physiological, Biochemical & Hematology Lab	Practical	2
			Mycology & Phycology Lab	Practical	2
			Chemistry Lab - II	Practical	2
			Total Credits		**27**
2nd	III	B050301T	Molecular Biology, Bioinstrumentation & Bio-techniques	Theory	4
			Animal Biotechnology	Theory	2
			Chemistry - III	Theory	4
			Vocational	Practical	4
			Physical Education and Yoga	Theory/Practical	2
		B050302P	Bioinstrumentation & Molecular Biology Lab	Practical	3
			Animal Biotechnology Lab	Practical	2
			Chemistry Lab - III	Practical	2
			Total Credits		**23**
	IV	B050401T	Gene Technology and Human Welfare	Theory	4
			Enzymology	Theory	4
			Chemistry - IV	Theory	4
			Physics - II	Theory	4
			Vocational	Practical	3
			Human Values and Environmental Studies	Theory/Practical	2
		B050402P	Genetic Engineering Lab, Genetic Counselling & Telemedicine	Practical	2
			Enzymology Lab	Practical	2
			Chemistry Lab – IV	Practical	2
			Total Credits		**27**
3rd	V	B050501T	Diversity of Non-Chordates, Parasitology and Economic Zoology	Theory	4
		B050502T	Diversity of Chordates and Comparative Anatomy	Theory	4
			Nano-biotechnology	Theory	4
			Medical Zoology	Theory	4
			Analytic Ability and Digital Awareness	Theory/Practical	2
		B050503P	Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	Practical	2
			Nano-biotechnology Lab	Practical	2
			Community connect	Practical	2
			Summer internship of term IV (Will be done after 4th Semester)	Practical	1

			Total Credits		**25**
	VI	B050601T	Evolutionary and Developmental Biology	Theory	4
		B050602T	Ecology, Ethology, Environmental Science and Wildlife	Theory	4
			Structural Bioinformatics	Theory	4
			IPR	Theory	4
			Communication Skills and Personality Development	Theory/Practical	2
		B050603P	Lab on Environmental Science, Behavioral Ecology, Developmental Biology, Wildlife, Ethology	Practical	2
			Structural Bioinformatics Lab	Practical	2
			Research Project	Practical	3
			Total Credits		**25**
4th	VII		Animal Behavior	Theory	4
			Biology of Reproduction	Theory	4
			Medical Microbiology	Theory	4
			Epidemiology & Biostatistics	Theory	4
			Epidemiology & Biostatistics Lab	Practical	4
			Research Project	Practical	6
			Total Credits		**26**
	VIII		Endocrinology	Theory	4
			Bioprocess Technology	Theory	4
			Cell Signaling & Cancer Biology	Theory	4
			Research Methodology	Theory	4
			Physics - III	Theory	4
			Endocrinology Lab	Practical	4
			Research Project	Practical	6
			Total Credits		**30**

Programme/Class: Certificate	**Year**: First	**Semester**: First
Subject: ZOOLOGY		
Course Code: B050101T	**Course Title**: Cytology, Genetics and Immunology	

Course outcomes:

The student at the completion of the course will be able to:

1. Understand the structure and function of all the cell organelles.
2. Know about the chromatin structure and its location.
3. To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
4. How one cell communicates with its neighboring cells?
5. Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another.
6. Understand the Mendel's laws and the deviations from conventional patterns of inheritance.
7. Comprehend how environment plays an important role by interacting with genetic factors.
8. How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families.
9. To have an in depth understanding about Immune System & its mechanisms.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……..

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**Structure and Function of Cell Organelles I** • Plasma membrane: chemical structure—lipids and proteins • Cytoskeleton: microtubules, microfilaments, intermediate filaments • Cell-cell interaction: cell adhesion molecules, cellular junctions • Introduction to all national Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be included as part of the Continuous Internal Evaluation (CIE)	6
II	**Structure and Function of Cell Organelles II** • Mitochondria: Structure, oxidative phosphorylation • Peroxisome and ribosome: structure and function • Endomembrane system: protein targeting and sorting, endocytosis, exocytosis	6
III	**Nucleus and Chromatin Structure** • Structure and function of nucleus in eukaryotes • Chemical structure and base composition of DNA and RNA • DNA supercoiling, chromatin organization, structure of chromosomes • Types of DNA and RNA	8

IV	**Cell cycle, Cell Division and Cell Signalling** • Cell division: mitosis and meiosis • Cell cycle and its regulation, apoptosis • Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors, JAK-STAT pathway	**8**
V	**Mendelism and Sex Determination** • Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses • Complete and Incomplete Dominance • Penetrance and expressivity • Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in *Drosophila,* Sex Determination in Humans • Sex-linked characteristics and Dosage compensation	**8**
VI	**Extensions of Mendelism, Genes and Environment** • Extensions of Mendelism: Multiple Alleles, Gene Interaction • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects • Genomic Imprinting, Anticipation • Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics	**8**
VII	**Human Chromosomes and Patterns of Inheritance** • Human karyotype • Chromosomal anomalies: Structural and numerical aberrations with examples • Pedigree analysis • Patterns of inheritance: autosomal dominant, autosomal recessive,X-linked recessive, X-linked dominant	**8**
VIII	**Immune System and its Components** • Historical perspective of Immunology, Innate and AdaptiveImmunity, Structure and functions of different classes of immunoglobulins, Hypersensitivity • Immune system: innate and adaptive immunity, clonalselection, complement system • Humoral immunity and cell mediated immunity • Immunoglobulin and T-cell receptor genes: organization of Iggene loci, molecular mechanism of generation of antibody diversity • HLA complex: organization, class I and II HLA molecules,expression of HLA genes	**8**

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).

5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W HFreeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology,13th Edition. Wiley Blackwell (2017).
9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7	8	9
Unit 1	*								
Unit 2		*							
Unit 3			*						
Unit 4				*					
Unit 5					*				
Unit 6						*			
Unit 7							*	*	
Unit 8									*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	-	1	1	2		
CO2	3	-	1	1	2		
CO3	3	2	1	1	2		
CO4	3	2	1	1	2		
CO5	3	2	1	2	2		
CO6	3	-	1	-	2		
CO7	3	2	1	-	3		
CO8	3	2	1	-	3		
CO9	3	1	1	-	2		

Programme/Class: Certificate	**Year**: First	**Semester**: First
Subject: ZOOLOGY		
Course Code: B050102P	**Course Title**: Cell Biology & Cytogenetics Lab	

Course outcomes:

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Describe the applications of simple and compound microscopes
2. Prepare slides and stain them to see the cell organelles.
3. Evaluate the cell division process
4. Understand the fundamentals of chromosomal aberrations by preparing karyotypes.
5. Describe the integration of gene with in the family via pedigree analysis in families.
6. Investigate and demonstrate the antigen-antibody reaction.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	• To study the different stages of Mitosis in root tip of onion. • To study the different stages of Meiosis in grasshopper testis. • To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. • To check the permeability of cells using salt solution of different concentrations.	**15**
II	• To study different mammalian blood cell types using Leishman stain. • Determination of ABO Blood group • Cell counting and viability test from splenocytes of farm bred animals/cell lines. • Enumeration of red blood cells and white blood cells using haemocytometer	**15**
III	• Study of mutant phenotypes of *Drosophila.* • Preparation of polytene chromosomes. • Study of sex chromatin (Barr bodies) in buccal smear and hair budcells (Human). • Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc.from the pictures provided. • To prepare family pedigrees.	**15**
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	**15**

	https://sites.dartmouth.edu	

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W HFreeman (2007).
6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. HeritagePublishers, New Delhi

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*	*	*			
Unit 2	*					*
Unit 3	*		*	*	*	
Unit 4				*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	-	2		
CO2	3	3	2	-	2		
CO3	3	3	2	2	2		
CO4	3	3	2	1	2		
CO5	3	3	2	1	2		
CO6	3	3	2	-	2		

Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: ZOOLOGY		
Course Code:	**Course Title: Introduction to microbiology**	

Course outcomes:

The student at the completion of the course will be able to:

1. To study the history of microbiology and its basic concepts.
2. To understand the morphology and types of nutrition across different bacterial species
3. To get acquaint with growth kinetics of bacteria
4. How bacteria can be isolated
5. To understand the general structure and properties of viruses
6. Basic understanding of mechanisms behind drug action against microbes
7. To study the microbial diseases and their control
8. Application of microorganisms in human welfare

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……..

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Introduction to Microbiology** • History of Microbiology • Spontaneous generation; Koch Postulates • Whittaker's 5 kingdom concept; Pasteurization.	6
II	**Morphology and Nutrition of Bacteria** • Morphology and fine structure of Bacteria; outer surface of bacteria; Cell wall of Gram +ve and Gram –ve bacteria • Classification of bacteria based on nutrition, Aerobic and anaerobic bacteria • Brief overview on Archaea; Cyanobacteria, PPLO	6
III	**Growth and Sporulation in Bacteria** • Modes of cell division (Binary fission; budding and Septum formation); Normal growth of bacteria; • Growth curve • Growth inhibitory substances (temperature, acidity, alkalinity, water availability, oxygen)	8
IV	**Methods of Isolations & Control of Microbial Growth** • Pure culture, Method of isolating pure culture (Streak method, Pour-plate and spread plate technique); • Synchronous and asynchronous Growth • Physical and chemical methods to control the growth of microorganisms	8
V	**Viruses and Their Control** • General properties of viruses • Structure of viruses • Classification of viruses • Life Cycle and its control • Lytic vs Lysogenic cycle	8

VI	**Antimicrobial chemotherapy** • General characteristics of antimicrobial drugs • Mechanism of action of antimicrobial agents • Factors effecting efficacy of antimicrobial drugs • Drug resistance - mechanisms	**8**
VII	**Microbial diseases and their control** • Host parasite relationship • Human diseases cause by virus and bacteria • Pathogenesis of viral and Bacterial infections	**8**
VIII	**Applications of microbes** • In welfare of Human • in Chemical and Medical Industry • In Food Industry • In Environmental Remedies	**8**

Suggested Readings:

1. Pelezar, M.J. Reid, R.D. and E.C.S.Chan, Tata McGraw Hill, New Delhi. (2004). Microbiology. (5th ed.)
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
4. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*					*
Unit 2	*					*
Unit 3		*	*			*
Unit 4		*				*
Unit 5			*			*
Unit 6				*		*
Unit 7				*	*	*
Unit 8				*		*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	-	1	2	1		
CO2	3	3	2	2	2		
CO3	3	-	1	1	2		
CO4	3	1	1	2	3		
CO5	3	3	2	3	2		
CO6	3	3	1	3	1		
CO7	3	2	1	3	3		
CO8	3	2	1	2	1		

Programme/Class: Certificate	**Year**: First	**Semester**: First
Subject: MICROBIOLOGY		
Course Code:	**Course Title**: Microbiology Lab	

Course outcomes:

At the completion of the course students will learn

1. The good laboratory practices and the precautions to be taken while working in microbiology lab.
2. Preparation of different kinds of media used for culturing of microorganisms.
3. Aseptic culture techniques and sterilization protocols to be followed while working with microorganisms.
4. Various techniques used to isolate pure form of microorganism from different sources
5. Isolate and culture bacteria in laboratory under aerobic conditions.
6. The sub-culturing of microorganisms from one media to another media and also to differentiate them on the basis of gram's staining.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	• General lab rules • Safety measures in microbiology lab • Preparations of cotton plugs • Aseptic culture techniques • Preparation of LB media • Preparation of nutrient agar media	**15**
II	• Sterilization techniques o Working of an Autoclave o Working of Laminar air flow o Working of a Hot Air Oven • To obtain the pure culture of microorganism o Streak Plate Method o Spread Plate Method o Pour Plate Method	**15**
III	• Isolation and enumeration of microorganisms of soil by serial dilution. • Isolation and enumeration of microorganisms from air. • Isolation and enumeration of microorganisms from water. • Sub-culturing (picking of technique) of microorganisms from one medium to another. • Counting of bacterial colonies using a colony counter. • Gram's Staining- Differentiate between Gram's positive and Gram's negative bacteria	**15**

IV	**Virtual Labs** https://www.youtube.com/watch?v=N21SbC7_Tco https://www.youtube.com/watch?v=LSu8YmW4mhM&t=44s https://www.youtube.com/watch?v=o9kbHGokemA https://www.youtube.com/watch?v=5tWHsr2U81U https://www.youtube.com/watch?v=VCM4tpSwyDM https://www.youtube.com/watch?v=xW3ljnvqMJk https://www.youtube.com/watch?v=c6v84FQ36kM https://www.youtube.com/watch?v=sxa46xKfIOY&t=1s	**15**

Suggested Readings:

1. Basic practical microbiology: A manual. Dariel Burdass, John Grainger & Janet Hurst. Published by the Microbiology Society, Charles Darwin House, 12 Roger Street, London, UK
2. Practical manual of Biotechnology. RK Mahajan, J Sharma and R Mahajan. Vayu Education of India.

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*	*				
Unit 2	*		*			*
Unit 3				*	*	
Unit 4				*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	-	1		
CO2	3	3	-	-	3		
CO3	3	3	1	-	2		
CO4	3	3	-	2	3		
CO5	3	3	1	3	2		
CO6	3	3	2	2	3		

Programme/Class: Certificate	**Year**: First	**Semester**: Second
Subject: ZOOLOGY		
Course Code: B050201T	**Course Title**: Biochemistry and Physiology	

Course outcomes:

The student at the completion of the course will be able to:

1. Develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates
2. How simple molecules together form complex macromolecules.
3. Understand the basic concepts of bioenergetics and its role in the functioning of a cell.
4. Mechanisms of energy production at cellular and molecular levels.
5. Understand systems biology and various functional components of an organism.
6. Explore the complex network of these functional components.
7. Comprehend the regulatory mechanisms for maintenance of function in the body.
8. Describe the various muscular part of our body

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**Structure and Function of Biomolecules** • Structure and Biological importance of carbohydrates(Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) • Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) • Structure, Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins; Simple and conjugate proteins.	8
II	**Bioenergetics** • Principles of Bioenergetics**,** Bioenergetics and Thermodynamics • Biological Oxidation-Reduction Reactions, Free Energy Calculations, The Cell's Energy Currency- Phosphoryl Group Transfers and ATP • Free-Energy-Driven Transport across Membranes	8
III	**Metabolism of Carbohydrates and Lipids** • Metabolism of Carbohydrates: glycolysis, citric acid cycle,gluconeogenesis, phosphate pentose pathway • Glycogenolysis and Glycogenesis • Lipids --- Biosynthesis of palmitic acid; Ketogenesis,	8

	• β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms	
IV	**Metabolism of Proteins and Nucleotides** • Catabolism of amino acids: Transamination, Deamination, Urea cycle • Nucleotides and vitamins • Review of mitochondrial respiratory chain, Oxidativephosphorylation, and its regulation	**6**
V	**Digestion and Respiration** • Structural organization and functions of gastrointestinal tract and associated glands • Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Histology of trachea and lung • Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration	**7**
VI	**Circulation and Excretion** • Components of blood and their functions • Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN • Structure of mammalian heart • Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation • Structure of kidney and its functional unit; Mechanism of urine formation	**8**
VII	**Nervous System and Endocrinology** • Structure of neuron, resting membrane potential • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers • Types of synapse • Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them • Classification of hormones; Mechanism of Hormone action	**8**
VIII	**Muscular System** • Histology of different types of muscle; • Ultra-structure of skeletal muscle; • Molecular and chemical basis of muscle contraction; • Characteristics of muscle twitch; Motor unit, summation and tetanus	**7**

Suggested Readings:

1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
2. Zubay *et al:* Principles of Biochemistry: WCB (1995)
3. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)
4. Murray *et al:* Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons(2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, PearsonEducation (2010).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).

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

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*					*
Unit 2		*				*
Unit 3			*			*
Unit 4				*		*
Unit 5					*	*
Unit 6					*	*
Unit 7				*		*
Unit 8				*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	-	1	-	2		
CO2	3	2	1	-	1		
CO3	3	1	2	2	1		
CO4	3	2	2	-	1		
CO5	3	1	1	2	2		
CO6	3	1	2	2	3		
CO7	3	1	2	2	1		
CO8							

Programme/Class: Certificate	**Year:** 1st	**Semester:** 2nd
Subject: ZOOLOGY		
Course Code:	**Course Title:** Human Physiology and Histology	

Course outcomes:

The student at the completion of the course will be able to:

1. Understand the various levels of organization in body
2. Describe the various tissue levels of human body
3. Define the integumentary systems of human body
4. Explain the complete human skeletal system
5. Explain the Joints and its types in the human system
6. Classify the complete human nervous system
7. Understand the anatomy and physiology of sense organs
8. Get complete understanding about various human tissues and their working mechanisms

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	**Topic**	**Total No. of Lectures (60)**
I	**An Introduction to Human Body** • Levels of structural organization and body systems • Characteristics of Living Human Organism • Homeostasis	**6**
II	**Tissue level of Organization** • Types of Tissues – • Epithelial tissue • Connective tissue • Epithelial and synovial membranes • Aging and tissues	**8**
III	**The Integumentary Systems** • Structure of skin • Accessory structures of skin • Types of skins • Functions of skin	**7**
IV	**The skeletal system: Bone Tissue** • Structure of bone • Histology of bone tissue • Bone formation • Functions of bone and the skeletal system • Bone's role in Calcium homeostasis	**8**
V	**Joints** • Joint Classification - Fibrous joints and Cartilaginous joints • Synovial joints and its types. • Types of movements at synovial joints • Aging and joints.	**8**
VI	**Spinal Cord and Spinal Nerves** • Spinal cord anatomy • Spinal nerves • Spinal cord physiology	**7**

VIII	**The Brain and Cranial Nerves** • Brain organization, protection and blood supply • Cerebrospinal fluid • The brain stem and reticular formation • Functional organization of cerebral cortex • Aging and nervous system	**8**
VIII	**Anatomy and Physiology of Sense organs** • Olfaction: Sense of smell • Gustation: Sense of taste • Vision • Hearing and equilibrium • Aging and the special senses	**8**

Suggested Readings:

1. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).
2. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
3. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*					*
Unit 2						*
Unit 3		*				*
Unit 4			*			*
Unit 5			*			*
Unit 6				*		*
Unit 7				*		*
Unit 8					*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	-	1	-	2		
CO2	3	1	2	-	2		
CO3	3	1	2	1	2		
CO4	3	1	2	1	2		
CO5	3	-	1	1	3		
CO6	3	3	2	2	3		
CO7	3	2	1	1	2		
CO8	3	2	1	1	3		

Programme/Class: Certificate	**Year**: First	**Semester**: Second
Subject: ZOOLOGY		
Course Code: B050202P/R	**Course Title**: Physiological, Biochemical & Hematology Lab	

Course outcomes:

The student at the completion of the course will be able to:

1. Understand the structure of biomolecules like proteins, lipids and carbohydrates
2. Examine haemoglobin content and blood glucose level of human body
3. Demonstrate muscular actions of the body
4. Analyze the samples for the presence of different biomolecules
5. Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	• Estimation of haemoglobin using Sahli's haemoglobinometer • Preparation of haemin and haemochromogen crystals • Recording of blood pressure using a sphygmomanometer • Recording of blood glucose level by using glucometer • Preparation of molecular models of amino acids, dipeptides etc.	15
II	• Study of permanent slides of Muscles, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid • Recording of simple muscle twitch with electrical stimulation (orVirtual) • Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)	15
III	• Ninhydrin test for □-amino acids. • Benedict's test for reducing sugar and iodine test for starch. • Test for sugar and acetone in urine. • Qualitative tests of functional groups in carbohydrates, proteins andlipids. • Paper chromatography of amino acids. • Action of salivary amylase under optimum conditions.	15
IV	**Virtual Labs** 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

Suggested Readings:

1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman andCo., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company.
4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition.Lippincott
   W. & Wilkins.
6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. HeritagePublishers, New Delhi

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6
Unit 1	*	*				
Unit 2	*		*			*
Unit 3				*	*	
Unit 4				*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	-	1		
CO2	3	3	-	-	3		
CO3	3	3	1	-	2		
CO4	3	3	-	2	3		
CO5	3	3	1	3	2		
CO6	3	3	2	2	3		

Programme/Class: Certificate	**Year**: First	**Semester**: Second
Subject: ZOOLOGY		
Course Code:	**Course Title**: Human Physiology and Histology Lab	

Course outcomes:

The student at the completion of the course will be able to:

1. Understand the structure of different types of epithelial tissues
2. Know the structural organization of connective tissues
3. Distinguish various types of human tissues
4. Demonstrate various components of nervous system
5. Get complete understanding of tissue level organization of human body

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	Permanent Slides of Epithelial Tissues • Squamous Epithelium • Simple Columnar Epithelium • Stratified Columnar Epithelium - salivary gland ducts • Pseudostratified Ciliated Epithelium • Stratified Squamous Epithelium	15
II	Permanent Slides of Connective Tissues • Adipose Tissue • Tendon • Elastic Cartilage • Fibrocartilage • Chondroid Tissue/hyaline cartilage	15
III	Study of Nervous System via permanent slides or virtual images or models • Spinal Cord Thoracic • Cerebral Cortex • Cerebellum • Medulla • Pons	15
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

Suggested Readings:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition.Lippincott W. & Wilkins.
4. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
5. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. HeritagePublishers, New Delhi

Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

Programme/Class: Diploma	**Year**: Second	**Semester**: Third
Subject: ZOOLOGY		
Course Code:	**Course Title**: Animal Biotechnology	

Course outcomes:

After the successful completion of this course students will be able to:

CO1: Understand the methods of obtaining cells from the tissue for cell culture.
CO2: Classify the different types of media used in animal cell culture based on cell types and the cell line types.
CO3: Know about the animal cell cloning and the methods of transfecting cells in the culture.
CO4: Explain the stem cell technology and its applications.
CO5: Understand the basics of tissue and organ culture as well as the applications of transgenic animal in different sectors.
CO6: To get a complete knowledge about various techniques and methodology used in animal biotechnology.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**Introduction to Animal Cell Culture** • Structure and organization of animal cell; sources of cell • Techniques of obtaining cells by disaggregation of tissues, Enzymatic disaggregation • EDTA treatment; Types of cell culture, Equipments required for animal cell culture	6
II	**Development of Cell Lines** • Medium preparations and its various types Natural, artificial serum protein free media Advantages and disadvantages • sub culturing techniques, viable cell counts with haemocytometer, development of cell lines, types of cell lines, their characteristics • Suspension culture advantages & disadvantages, totipotency in animal cell culture.	8
III	**Animal Cell Cloning** • Cloning, types of cell cloning methods of cloning • Transfection; methods, retro-virus mediated gene transfer • Embryonic stem cell-mediated gene transfer, artificial twining, risk of cloning cloned animals.	7

IV	**Stem Cell Culture and Technology** • Stem cell technology; haematopoiesis • Methods to study repopulation assay, in vitro cloning assay, long term culture • Embryonic stem cell culture, Application of stem cell culture.	**8**
V	**Application of Animal Cell Culture Technology** • Transgenic cells and animals & their application; • Organ culture, Histotypic & organotypic culture, rearing animal models and advantages • Potential of transgenic animals to improve human welfare in Agriculture, medicine and industry, ethical and value issues in animal biotechnology	**8**
VI	**Transgenics** • Development of Transgenic animals • Application of Transgenic animals in various industries	**7**
VII	**Animal Health** • INTRODUCTION to animal heatlh • REPRODUCTIVE TECHNOLOGIES • EFFICIENCY OF PRODUCTION AND NUMBER OF ANIMALS NEEDED • MUTATIONS • GENE EXPRESSION • NUCLEAR TRANSFER • BIOMEDICAL APPLICATIONS • FARMING • POTENTIAL ANIMAL WELFARE BENEFITS •	**8**
VIII	**Environmental concerns in Animal Tissue Culture** • GENERAL PRINCIPLES • PRIORITIZING GE ANIMALS FOR LEVEL OF ENVIRONMENTAL CONCERN • RISKS POSED BY GE ANIMALS • RISK ASSESSMENT AND RISK MANAGEMENT	**8**

Suggested Readings:

1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006.
2. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007.
3. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Diploma	**Year**: Second	**Semester**: Third
Subject: ZOOLOGY		
Course Code:	**Course Title**: Animal Biotechnology Lab	

Course outcomes:
The student at the completion of the course will be able to:
CO1: To know about the various sterilization techniques and source of contamination.
CO2: To become familiar with the animal tissue culture media.
CO3: To understand the methods of animal cell culture.
CO4: To know about the various methods used for cell counting and cell viability testing.
CO5: To learn the method of cell preservation.
CO6: To get a complete knowledge about various techniques and methodology used in animal biotechnology.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Practical related to – Sterilization** Preparation and sterilization of glassware To perform media sterilization. To perform laboratory sterilization To study the sources of contamination and decontamination measures in ATC lab	15
II	**Practical related to – Media Preparation** Preparation of hanks balanced salt solution Preparation of Minimal essential growth medium **Practical related to – Cell Culture** To perform primary cell culture of tissue Preparation of established cell lines	15
III	**Practical related to – Cell Counting and Cell Viability** Cell counting and viability – Use of Haemocytometer & Trypan Blue To check cell viability and cell proliferation by MTT assay **Practical related to – Preservation of Cells** To preserve the cells in viable condition for future works by using proper preservative	15
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

Suggested Readings:

. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006.
2. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007.
3. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

Programme/Class: Diploma	**Year**: Second	**Semester**: Third
Subject: ZOOLOGY		
Course Code:	**Course Title**: Molecular Biology, Bio-instrumentation & Bio techniques	

Course outcomes:

After studying this course, students will be able to

CO1: Determine Prokaryotic and Eukaryotic DNA replication

CO2: Evaluate Prokaryotic and eukaryotic transcription

CO3: Determine Operon Concept and repair mechanims

CO4 : Perform experiments based on electrophoresis for separating proteins and nucleic acids.

CO5: Purify compounds from a mixture using column, ion-exchange, affinity chromatography, HPLC, affinity and gas chromatography.

CO6: Illustrate organelle and protein localization by microscopy.

CO7: Isolate cells by using fluorescence activated cell sorting (FACS) or magnetic activated cell sorting (MACS) and compare cell disruption techniques.

CO8: Conduct enzymatic and end-point assays using spectrophotometer, apply spectroscopy techniques to understand the structure of biological material.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**DNA replication** Prokaryotic and Eukaryotic DNA replication Mechanism of DNA replication Enzymes, factors and other accessory proteins involved in DNA replication. **Transcription** Prokaryotic and eukaryotic transcription- basis of initiation, elongation and termination post transcriptional modifications- polyadenylation capping and RNA splicing	**6**
II	**Translation** Prokaryotic and eukaryotic translation mechanisms of initiation, elongation and termination regulation of translation, post translational modifications of proteins **Operon Concept** Operon Concept the lac operon tryptophan operon	**8**
III	**DNA Repair and Recombination** Homologous recombinations Holiday junction DNA repair mechanisms	**7**

IV	**Introduction to Electrophoresis** Principle of electrophoresis Agarose gel and 2D-gel electrophoresis: Principle and applications	**8**
V	**Introduction to Chromatography** Paper Chromatography, TLC Column chromatography. Ion-exchange and Affinity chromatography	**8**
VI	**Introduction to Microscopy** Principle of microscope, Optical microscopy Electron Microscopy	**7**
VII	**Introduction to Cell Separation Techniques and Centrifugation** Cell isolation and cell disruption techniques FACS Centrifugation types ; Ultracentrifugation	**8**
VIII	**Introduction to Spectrometry and Spectroscopy** Spectroscopy- Absorption and fluorescence, Mass spectrometry LInstrumentation and working X-ray crystallography: crystal preparation, working and uses.	**8**

Suggested Readings:

A. Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2010.
B. Ninfa A.J., Ballou D.P. and Benore M., "Fundamental Laboratory Approaches for Biochemistry and Biotechnology", Wiley, 2009.
C. Sheehan D., "Physical Biochemistry: Principles and Applications", Wiley, 2009

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*

Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Diploma	**Year**: Second	**Semester**: Third
Subject: ZOOLOGY		
Course Code:	**Course Title**: Bio instruments & Molecular Biology Lab	

Course outcomes:

The student at the completion of the course will be able to:

CO1: Demonstrate safe laboratory practices and handle the equipment safely.
CO2: Estimate the quality and quantity of nucleic acids.
CO3: Operate autoclave, Laminar Air flow and Hot air oven and sterilize glass and plasticwares.
CO4: Separate and visualize nucleic acids and proteins using gel electrophoresis.
CO5: Operate spectrophotometer and perform absorbance assays.
CO6: Separation of pigments, drugs, amino acids and hormones using chromatographic techniques.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Practical based on introduction to molecular biology lab** Good lab practices in molecular biology laboratory. Preparation of standard solutions for molecular biology experiments	15
II	**Isolation of Nucleic acids and quantification** Isolation of DNA from bacteria Isolation of RNA from bacteria Gel electrophoresis	15
III	**Practical related to spectrophotometer** Principle and working of a spectrophotometer Measuring concentration of protein using spectrophotometer **Practical related to centrifuge** Working of refrigerated centrifuges **Practical related to chromatography** Use of paper chromatography for separation of plant pigments	15
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

Suggested Readings: 1. Cottenil R.M.S., "Biophysics: An Introduction", John Wiley and Sons, 2002. 2. Gupta A., "Instrumentation and Bioanalytical Techniques", Pragati Prakashan, 2009.		
Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science		

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

Programme/Class: Diploma	**Year**: Second	**Semester**: Fourth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Gene Technology and Human Welfare	

Course outcomes:

After the successful completion of this course students will be able to:
CO1: Identify various molecular tools for genetic engineering; host cells and right kind of enzymes to perform DNA digestion, ligation etc.
CO2: Classify different kinds of cloning vectors and their uses.
CO3: Analyze the use of Polymerase chain reaction in molecular cloning along and describe various DNA sequencing techniques.
CO4: Explain different ways of cloning blunt ended DNA fragments and transfection as well as transformation methods.
CO5: Recognize different types of gene libraries and apply different techniques of probing gene libraries.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**Molecular Tools of Genetic Engineering** Restriction enzymes Type I, II and III DNA polymerase and RNA polymerase' reverse transcriptase Modifying enzymes terminal deoxynucleotidyl transferase, polynucleotide kinase, Phosphatases and DNA ligase	**6**
II	**Nucleic Acid Isolation** Isolation of nucleic acid cDNA synthesis	**8**
III	**Techniques of Genetic engineering** DNA hybridization, colony hybridization and in-situ hybridization Screening methods; Blotting techniques (Southern, Northern and Western blotting)	**7**
IV	**Gene Library** Library construction Types of Genomic Libraries Organizations involved in construction of Libraries Human Genome Project	**8**
V	**Introduction to PCR** PCR Types of PCR RT-PCR	**8**
VI	**Sequencing Strategies** Nucleic acid sequencing High throughput sequencing Applications of Sequencing in research	**7**

VII	**Cloning Vectors** Introduction to cloning vectors; Phage vectors; cosmid vectors; phagemid vectors; Plasmid vectors BAC vectors and YAC vectors	**8**
VIII	**Cloning Techniques** Steps to cloning; Cloning after restriction digestion blunt and cohesive end ligation; creation of restriction sites by PCR cloning using linkers and adapters; cloning after homopolymer tailing; Strategies for cloning PCR products – TA cloning	**8**

Suggested Readings:

1. **Molecular Biotechnology. Principles and Applications.** 3rd Edition. Glick BR and Pasternak JJ. ASM Press @2003. ISBN 1-55581-224-4.
2. **Gene cloning and DNA Analysis- An Introduction.** 6th Edition. Wiley-Blackwell. Brown TA @2010.
3. **Genomes 3.** Brown TA. Garland Science Publishing @ 2007. ISBN 08153-41385

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		

CO8	2	2	2	3	3		

Programme/Class: Diploma	**Year**: Second	**Semester**: Fourth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Genetic Engineering Lab , Genetic Counselling & Telemedicine	

Course outcomes:

The student at the completion of the course will be able to:

CO1: recall basic concepts of solution preparation identify different blood groups
CO2: analyze antigen-antibody interactions by means of immunodiffusion techniques
CO3: illustrate agglutination reactions by means of different test assays
CO4: analyze immune responses generated after immunization
CO5: illustrate applied immunological diagnostic techniques
CO6: recognize different methods for analytical immunology

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	Preparation of solutions using the concept of molarity, normality and percentage	**15**
II	Practical related to isolation of plasmid from plasmid and DNA agarose gel electrophoresis Practical related to expression of gene of interest	**15**
III	Practical related to restriction digestion and preparation of competent cells Practical related to primer design and PCR	**15**
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**

Suggested Readings:

Mitra S. Genetic Engineering. 2nd Edition. McGraw Hill. @2015. ISBN: 9789339203535.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

Programme/Class: Diploma	**Year**: Second	**Semester**: Fourth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Enzymology	

Course outcomes:

After studying this course, students will be able to
CO1: Get an overview on enzymes, their nomenclature and factors affecting enzyme activity
CO2: Understand the factors affecting rate of biochemical reactions, lock and key as well as induced fit hypothesis
CO3: Learn kinetics of enzyme catalysis as well as inhibition reactions
CO4: Paraphrase the isolation, purification and immobilization of enzymes
CO5 : Implement use of enzymes in leather, dairy, pharmaceutical, food processing and various other industries for human welfare

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Enzymes as Catalysts: Overview--Proteins as catalysts (Historical background); Enzyme characteristics and properties Factors affecting Enzyme Activity; Co-enzyme; Co-factors	**6**
II	Enzyme nomenclature & classification; EC number of enzymes Structure and function of various enzymes	**8**
III	Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory Thermodynamics and its laws	**7**
IV	Catalysis, reaction rates and. Catalytic power and specificity of enzymes (concept of active site) Fischer's lock and key hypothesis, Koshland's induced fit hypothesis	**8**
V	Kinetics of single substrate reactions Enzyme inhibition; Irreversible and reversible inhibition, Competitive non-competitive and un-competitive inhibition	**8**
VI	Isolation and purification of enzymes; Localization of proteins in various organelles Related Techniques and their principles	**7**
VII	Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation Cross linking, covalent binding and their examples; Advantages and disadvantages of different immobilization techniques	**8**

VIII	Industrial and Clinical Applications of Enzymes: Comprehensive Account Applications in beverage industry Applications in leather industry, Applications in food processing industry Applications in dairy industry, Applications in pharmaceutical industry	**8**

Suggested Readings:

1. Palmer T., Bonner P. L., *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry*, Woodhead Publishing (2007)
2. Lubert Stryer: Biochemistry, WH Freeman, USA (2002)

Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Diploma	**Year**: Second	**Semester**: Fourth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Enzymology Lab	

Course outcomes:
After successfully completion of this practical course students will be able to:

CO1: Learn the identification of the enzyme activity present in different biological samples

CO2: Evaluate and perform isolation of various enzymes from microorganisms.

CO3: Evaluate and perform analysis of various enzyme activity against their target molecules.
CO4: Learn to identify blood group in a given sample.

CO5:Learn to isolate serum from given blood sample.
CO6: Overall learning about enzyme's isolation, activity determination and immobilization along with blood group determination and serum isolation.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	Identification of the enzymes present in different biological samples Isolation of enzymes from different biological sources Microbial production of enzymes (Amylase) Estimation of enzyme activity (Amylase)	15
II	Demonstration of Enzyme Activity (Starch Hydrolysis by amylase Demonstration of Enzyme Activity (Lipid Hydrolysis by Lipase Demonstration of Enzyme Activity (protein Hydrolysis by Protease	15
III	Enzyme Immobilization by Gel Entrapment Method To identify blood group in a given sample. To isolate serum from given blood sample	15
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

Suggested Readings:

1. Practical Enzymology by Hans Bisswanger Wiley VCH; 4th edition. **ISBN-10:** 3527320768
2. A Practical Book for Enzyme Technology by Lin Ying. Chemical Industry Press, **ISBN-10:** 7122037010

Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

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Programme/Class: Degree	**Year**: Third	**Semester**: Fifth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Diversity of Non-chordates, Parasitology & Economic zoology	

Course outcomes:

After successfully completion of this course students will be able to:
CO1: Recognize common and distinctive features of lower invertebrate phyla, including poriferans, protists and protozoans.
CO2: Sketch distinctive features of taxonomic classes within Cniderians and cteophorans.
CO3: Assess distinctive measurable features of different group of helminthes and pathogenicity caused by them.
CO4: Summarize characteristics of Annelids and Arthropodans with their economic importance.
CO5: Grade the evolution of mollusks and echinoderms as higher invertebrates and predict their role in zoology.
CO6: Combine the characteristic of different phyla to formulate and prepare phylogenetic relationship amongst invertebrates

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Protista, Metazoa and Porifera General characteristics and Classification of Protista; General account of locomotion in Protista Study of Euglena; Life cycle of Paramecium, Segmentation of Metazoa General characteristics and classification of sponges; Canal system in porifera	**6**
II	Cnidaria and Ctenophora General characteristics and Classification up to classes in Cnideria Structure and life cycle of Obelia; polymorphism in Obelia Evolutionary significance of Ctenophora	**8**
III	Platyhelminthes and Nemathelminthes General characteristics and Classification of platyhelminthes General characteristics and Classification of Nemathelminthes Life cycle of Taenia solium, Ascaris Lumbricoides andWuchereria bancrofti	**7**
IV	Annelida and Arthropoda General characteristics and Classification up to classes in Annelida; General characteristics and Classification up to classes in Arthropoda Excretion in Annelida; Vision and Respiration in Arthropoda	**8**
V	Mollusca and Echinodermata General characteristics and Classification up to classes of mollusks; Respiration in Mollusca General characteristics and Classification up to classes of echinoderms General characteristics and Classification up to classes of echinoderms; Water vascular systems in Asteroidea	**8**
VI	Insects of Economic Importance Mites and Ticks as Human and Animal Parasites.	**7**

VII	Helminths as Human and Animal Parasites. Nematodes that Affect Plants. Protozoan Parasites of Man and Animals.	**8**
VIII	**Economic Zoology** Fishery Sericulture Lac Culture Apiculture	**8**

Suggested Readings:

1. Purves, William K., Gordon H. Orians, David Sadava, and H. Craig Heller. Life: The Science of Biology: Volume III: Plants and Animals. Vol. 3. Macmillan, 2003. 2. Campbell, N., and J. Reece. "Biology 7th edition, AP." (2005)
2. Kotpal, R. L. Modern Text Book of Zoology: Invertebrates. Rastogi Publications, 2012.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Fifth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Diversity of Chordates and Comparative anatomy	

Course outcomes:

After successfully completion of this course students will be able to:
CO1: To learn about the general characteristics of protists, poriferans and cnidarians
CO2: To understand the general features of Platyhelminthes, aschelminthes and annelids
CO3: To understand the diversity of arthropods, molluscs, and echinoderms
CO4: To learn about the salient features of protochordates, pisces and amphibians
CO5: To get a brief idea about reptiles, aves and mammals
CO6:To understand the salient features of whole animal world
CO7:Understand about the various types of interactions in among different species and life history & pathogenicity of few species.
CO8: Know about the diseases spread by parasitic worms and their control.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Salient features of protochordates; General features of Branchiostoma Differences between Chordates & Non chordates	**6**
II	General characteristics of Pisces Overview of Migration in Fishes Classification of Pisces upto order Scales, respiration, osmoregulation	**8**
III	General features of Amphibia, Adaptations for living on land in Amphibia Classification of Amphibia upto order	**7**
IV	General features of reptiles, terrestrial adaptations in reptiles Classification of Reptiles upto order	**8**
V	General characteristics of Aves, flight adaptations in birds Migration in birds Classification of Birds upto order	**8**
VI	Mammalia-general features dentition in mammals Classification of Mammals upto order	**7**
VII	Comparative Anatomy of Integument, Digestive system Respiratory system	**8**
VIII	Comparative Anatomy of Nervous system, Receptors , Urogenital system	**8**

Suggested Readings:

1. Purves, William K., Gordon H. Orians, David Sadava, and H. Craig Heller. Life: The Science of Biology: Volume III: Plants and Animals. Vol. 3. Macmillan, 2003. 2. Campbell, N., and J. Reece. "Biology 7th edition, AP." (2005)
2. Kotpal, R. L. Modern Text Book of Zoology: Invertebrates. Rastogi Publications, 2012.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Evolutionary and Development Biology	

Course outcomes:

After studying this course, students will be able to

CO1: Determine Process of Spermatogenesis in humans and its hormonal control

CO2: Summarize the Egg types and egg membranes in animals

CO3: Describe the Cleavage types and role of yolk in cleavage

CO4: Determine the Production of Antibiotics

CO5: Analyze the Extra-embryonic membranes in humans

CO6: Compare the Placenta: types; structure and function of placenta in humans

CO7: Comprehend a student should be able to: understand and explain the main forces of evolution (natural selection, sexual selection, genetic drift

CO8: Understand the evidences of evolution and domains of life.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Gametogenesis Process of Spermatogenesis in humans and its hormonal control; Process of oogenesis in humans and its hormonal control Ultrastructure of sperm and ovum- changes in sperm body during maturation changes in ovum structure during maturation; layers of ovum and their function	**6**
II	Female Reproductive Biology Types of menstrual cycles in mammals- Estrous cycle menstrual cycle in human females- role of hormones in menstruation Egg types and egg membranes in animals	**8**
III	fertilization Physical events of fertilization- changes in sperm before ejaculation, female genital tract environment, features of female reproductive tract that help in sperm motility Molecular events of fertilization- changes in sperm before fertilization (capacitation) site of fertilization, mechanisms to prevent polyspermy, sperm-egg fusion; Cleavage types and role of yolk in cleavage	**7**
IV	Embryonic Development formation of blastula (humans); Morphogenetic movements and process of gastrulation (humans)- formation of epiblast and hypoblast, formation of primitive streak Extra-embryonic membranes in humans Organogenesis: brain and eye (humans)- organizer and its role; notochord formation; formation of brain vesicles; steps in development of eye	**8**
V	Embryonic Development- associated events Placenta: types; structure and function of placenta in humans	**8**

	Introduction to in vitro fertilization Concept of Potency; introduction to types of stem cells and embryonic stem cells	
VI	Life's Beginnings: Chemogeny, RNA world, Biogeny Origin of photosynthesis, Evolution of eukaryotes Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism	**7**
VII	Evidences of Evolution: Fossil record- types of fossils, transitional forms, geological time scale, evolution of horse, Molecular - universality of genetic code and protein synthesizing machinery, three domains of life	**8**
VIII	Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium. Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies	**8**

Suggested Readings:

1. Ridley,M (2004) Evolution III Edition Blackwell publishing • Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
2. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings. • Douglas, J. Futuyma (1997).Evolutionary Biology. Sinauer Associates

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		

CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Ecology , Ethology, Environmental Science & Wildlife	

Course outcomes:

After successfully completion of this course students will be able to:
CO1: To study about the history and taxonomic importance of ecological systems.
CO2: Design strategies to understand characteristics for population dynamics and other attributes.
CO3: To separate different communitybased upon structure, origin or other basis with focus on succession.
CO4: To diversify different ecosystems and elucidate the underlying ,echanism governing the different atmospheric cycle.
CO5: To formulate and apply the priorities of environment in India and apply them to ecological zones in India.
CO6: Create and execute strategies for integrating different aspects of ecology for applied understanding.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Introduction to ecology; Scope of ecology, Relation of ecology to other sciences, History of ecology	**6**
II	Basic concepts of ecology, Approaches to Ecology: Based upon - taxonomic affinities, habitat, level of organization, Laws of limiting factors, Study of climatic factors-light, temperature, rainfall and wind.	**8**
III	Basic concepts of ecology, Attributes (characteristics) of population-based on size, density, dispersion, age structure, natality, mortality and life tables	**7**
IV	Population dynamics: Exponential and logistic growth (equation and patterns), Theory of population growth	**8**
V	population ecology and evolution, r and k selection, modification of logistic theory; regulation of Population density	**8**
VI	Community characteristics, Composition, structure, origin and development of a community Characters used in community structure- analytical and synthetic characters; Classification of communities Basic type of Succession; Climax concept in succession; Ecotone and edge effect	**7**
VII	Types of ecosystems, Concepts of food chain and food web,Structure of ecosystem, Functional aspects of ecosystem productivity of ecosystem, Energy flow through the ecosystem, Y shaped energy flow model Nutrient cycles inecosystem, Atmospheric cycles in ecosystem-Carbon, nitrogen and sulphur cycles	**8**
VIII	Population Biology, Integrated land use planning; Healthy cropland and grassland, conservation of biological diversity	**8**

	Endangered fauna in India, Indian board for wild life (IBWL), project tiger, Concept of Biosphere sphere	

Suggested Readings:

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
3. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Lab on Environmental sciences, Behavioral Ecology, Developmental Biology , Wild life, Etymology	

Course outcomes:
After studying this course, students will be able to
CO1: Determine scope and market Biological control of air pollution
CO2: Summarize the Aerobic processes: activated sludge, oxidation ponds and trickling filter towers
CO3: Describe the pulp mill effluent, tannary effluent
CO4: Determine the Bioremediation of fuel oils and lubricants in soil and water.
CO5: Analyze the Use of R-DNA technology to enhance the efficacy microbial insecticides

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	An overview, concept, scope and market Biological control of air pollution Testing of water for physiochemical parameters including BOD & COD, Solid waste: Sources and management (composting and verrmicomposting)	**15**
II	origin, composition and treatment. Physical, chemical and biological treatment of waste water. Aerobic processes: activated sludge, oxidation ponds and trickling filter towers. Anaerobic processes: anaerobic digesters.	**15**
III	Study of Extraembryonic membranes in reptiles birds and mammals	**15**
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**

Suggested Readings:

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
3. RL Kotpal. A text book of Vertebrates

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

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Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: IPR	

Course outcomes:

By the end of this course students will be able to:
CO1: Administer and follow the guidelines of WIPO.
CO2: Understand the patents, copyrights and trademarks.
CO3: Understand the character merchandising and franchising.
CO4: Understand the utility of IPRs in biotechnology.
.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Introduction to Intellectual Property Rights The concept of intellectual property, Importance of IPR in biotechnology	**6**
II	WIPO- history, mission and activities, structure, administration	**8**
III	. Major International Instruments relating to the protection of IP;	**7**
IV	Patents Patents-basic concepts; Patent Infringement and its remedy	**8**
V	Copyrights basic concepts; Infringement and its remedy	**8**
VI	Trademark basic concepts; Infringement and its remedy	**7**
VII	IPR and Industry	**8**
VIII	Case studies of Major IPR conflicts	**8**

Suggested Readings:

1. Managing intellectual capital: organizational, strategic and policy dimensions Oxford Univ. press 2005 Teece, David J.
2. Techniques used in Bio product analysis, Butterworth Heinemann Ltd, 2017.
1. 3. Law relating to patents, trademarks, copyright designs geographical indications. Universal Law Publishing house by Wadehra, B.L.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		

Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Structural Bioinformatics	

Course outcomes:

On completion of the course the student will be able to :

CO1: Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology.

CO2: Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases.

CO3: To attain knowledge about data storage model/format, retrieval of information and integration.

CO4: Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/softwares with algorithm.

CO5: To apply different techniques for gene prediction, motif search and genome sequencing analysis.

CO6: Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures (60)
I	Introduction to Bioinformatics O1 A Introduction to bioinformatics; Scope and importance	**6**
II	Large scale generation of molecular biology data; Different fields in bioinformatics Omics; Bioinformatics scenario in India & the rest of the world	**8**
III	Introduction to data types and Sources; Classification and Presentation of Data; Quality of data; Private and Public data sources	**7**
IV	General Introduction of Biological Databases: Nucleic acid databases, Protein database	**8**
V	Specialized Genome databases, Structure database	**8**
VI	Data Storage and Integration Flat files, relational, object-oriented databases and controlled vocabularies File Format (GenBank, DDBJ, FASTA, PDB, SwissProt); Introduction to Metadata File Storage; Boolean Search and Fuzzy Search, Data integration	**7**
VII	Sequence Alignments and Analysis Biological sequences and Alignment Methods Global and Local alignment, Pairwise alignment and Multiple sequence alignment Phylogenetic tree analysis	**8**
VIII	Structure of Prokaryotic and Eukaryotic gene DNA and genome sequencing Motif and consensus; Gene Expression Gene finding composition-based finding, sequence motif based finding	**8**

Suggested Readings:

Attwood TK., "Introduction to Bioinformatics", Pearson Education, 2006.
J. S, Ignacimuthu.S, "Basic Bioinformatics", Narosa, 2013.
Roy Darbeshwar., "Bioinformatics", .Narosa,2009.

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5	6	7
Unit 1	*		*		*		
Unit 2		*	*		*		
Unit 3				*	*		
Unit 4					*		
Unit 5						*	
Unit 6							*
Unit 7						*	
Unit 8					*	*	*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		
CO6	2	1	1	2	2		
CO7	3	1	3	2	3		
CO8	2	2	2	3	3		

Programme/Class: Degree	**Year**: Third	**Semester**: Sixth
Subject: ZOOLOGY		
Course Code:	**Course Title**: Structural bioinformatics lab	

Course outcomes:

After studying this course, students will be able to

CO1: Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology.

CO2: Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases.

CO3: To attain knowledge about data storage model/format, retrieval of information and integration.

CO4: Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/softwares with algorithm.

CO5: To apply different techniques for gene prediction, motif search and genome sequencing analysis.

CO6: Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** ……

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topics	Total No. of Lectures (60)
I	Introduction to data types and Sources; Classification and Presentation of Data; Quality of data; Private and Public data sources General Introduction of Biological Databases: Nucleic acid databases, Protein databases Specialized Genome databases, Structure databases	**15**
II	Biological sequences and Alignment Methods Global and Local alignment, Pairwise alignment and Multiple sequence alignment Phylogenetic tree analysis	**15**
III	Flat files, relational, object-oriented databases and controlled vocabularies File Format (GenBank, DDBJ, FASTA, PDB, SwissProt); Introduction to Metadata File Storage; Boolean Search and Fuzzy Search, Data integration	**15**
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**

Suggested Readings:

Attwood TK., "Introduction to Bioinformatics", Pearson Education, 2006.

J. S, Ignacimuthu.S, "Basic Bioinformatics", Narosa, 2013.

Roy Ignacimuthu.S, "Bioinformatics", Narosa,2009

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Mapping of outcomes vs. Topics

Outcome No.\SyllabusTopics	1	2	3	4	5
Unit 1	*		*		*
Unit 2		*	*		*
Unit 3				*	*
Unit 4					*

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	3	1	1	1		
CO2	3	3	2	1	1		
CO3	3	3	2	2	2		
CO4	3	3	2	1	1		
CO5	3	3	2	1	2		

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