

Zoology

RULES AND REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of B.Sc Advanced Zoology and Biotechnology course shall be required to have passed the Higher Secondary Examinations conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Syndicate of the University of Madras.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than three academic years, passed the examinations of all the Six Semesters prescribed and must have earned 140 credits.

3. COURSE OF STUDY:

The main subject of study for Bachelor Degree shall consist of the following:

PART – I: Foundation Courses exclusive for Languages.

PART – II: English

PART – III: Core courses

Allied Subjects I and II and Elective papers

PART- IV: Non Major Electives and Soft Skill Subjects

PART – V: Extension Activities/Sports/NCC

4. PASSING MINIMUM:

A candidate shall be declared to have passed in each paper/practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 40% of the marks prescribed for the examination.

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Part I, II, III & IV

Successful candidates passing the examination and securing the marks (i) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class

respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

Candidates who pass all the examinations (Parts I, II, III and IV) prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

On obtaining an undergraduate degree the students will be able to:

PEO1: Apply and advance the knowledge and skills acquired, to become a creative professional in their chosen field.

PEO2: Engage in self-directed continuous learning, aimed at global competency, which will promote professional and personal growth

PEO3: Develop management skills and entrepreneurial skills, by harnessing core competencies tempered by values and ethics

PEO4: Work towards achieving economic and social equity for women through application of relevant knowledge

PEO5: Contribute to promoting environmental sustainability and social inclusivity

PROGRAMME OUTCOMES (POS)

PO1 – To promote and apply scientific knowledge for finding sustainable solution to solve the issues pertaining to the society/industry.

PO2 – Identify, Analyze and formulate novel ideas to yield, substantial results in the fields of research utilizing the principles of Physical and Biological science.

PO3 – Relate key concepts and scientific principles to various scientific phenomenon and their application in day-to-day life.

PO4 – Cultivate unparalleled comprehension of fundamental concepts relevant to basic sciences leading to an individual progress and career advancement at the National and Global levels.

PO5 – To communicate effectively their views and ideas orally/written in English and in other related languages.

PO6 – Design solutions for complex problems and design system components or processes that meet the specific needs with appropriate consideration for public health and safety, cultural, societal and environmental conditions.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1- Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology, bio-instrumentation and applied Zoology.

PSO 2- Analyze the relationships among animals with their ecosystems.

PSO 3-Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Sericulture, Biochemistry, Fish biology, Animal biotechnology, Immunology and research methodology.

PSO 4- Understand the applications of Zoology in Agriculture, Medicine and daily life.

PSO 5- Gains knowledge about research methodologies, effective communication and skills of problem solving methods.

PSO 6- Contributes the knowledge for Nation building

PROGRAMME PROFILE -B.Sc. Advanced Zoology & Biotechnology

SEMESTER	PART	COURSE CODE	TITLE OF THE PAPER	CREDITS	HRS/ WEEK	TOTAL HOURS	MARKS		
							CA	SE	TOTAL
I	I		Tamil/ Hindi/ French/ Sanskrit	3	6	90	40	60	100
	I		English	3	4	60	40	60	100
	III	ZB18/1C/INV	PAPER-I –Invertebrata	5	8	120	40	60	100
	III	ZB18/2C/PR1	PRACTICAL-I Invertebrata and Chordata	0	2	60	END OF SECOND SEMESTER		
	III	PB15/1A/AB1	Allied Botany Paper I (Offered by PBPB)	4	4	60	40	60	100
	III	PB15/2A/ABP	Allied Botany Practical (Offered by PBPB)	0	2	60	END OF SECOND SEMESTER		
	IV		1 a/1b/1c*	3	2	30	NA	50	50
	IV		Soft skill Subject**	3	2	30	NA	50	50
TOTAL WORKING HOURS/ CREDITS				21	30				
II	I		Tamil/ Hindi/ French/ Sanskrit	3	6	90	40	60	100
	I		English	3	4	60	40	60	100
	III	ZB18/2C/CHO	PAPER-II-Chordata	5	8	120	40	60	100
	III	ZB18/2C/PR1	PRACTICAL-I Invertebrata and Chordata	4	2	60	40	60	100
	III	PB15/1A/AB1	Allied Botany Paper II (Offered by PBPB)	4	4	60	40	60	100
	III	PB15/2A/ABP	Allied Botany Practical (Offered by PBPB)	2	2	60	40	60	100
	IV		1 a/1b/1c*	2	2	30	NA	50	50
	IV		Soft skill Subject**	3	2	30	NA	50	50
TOTAL WORKING HOURS/ CREDITS				26	30				

*1a- Basic Tamil ; 1b- Advanced Tamil;
1c- Inter Disciplinary NME subject offered by the other Departments.

MESTER	PART	COURSE CODE	TITLE OF THE PAPER	CREDITS	HRS/ WEEK	TOTAL HOURS	MARKS		
							CA	SE	TOTAL
III	I		Tamil/ Hindi/ French/ Sanskrit	3	6	90	40	60	100
	I		English	3	4	60	40	60	100
	III	ZB18/3C/CBY	PAPER-III -Cell Biology	5	8	120	40	60	100
	III	ZB18/4C/PR2	PRACTICAL- II- Cell Biology and Genetics	0	2	60	END OF FOURTH SEMESTER		
	III	ZB18/3A/BC1	Allied Biochemistry Paper I (Offered by Zoology Department for Batch I)	4	4	60	40	60	100
		CH15/3A/ZGC	Allied Chemistry – General Chemistry (Offered by Chemistry Department for Batch –II)						
	III	ZB18/4A/AB	Allied Biochemistry Practical Offered by Zoology Department for Batch-I students)	0	2	60	END OF FOURTH SEMESTER		
		CH15/4A/PRA	Allied Chemistry Practical Volumetric And Organic Analysis (Offered by Chemistry for Batch-I)						
	IV		EVS	2	2	30	NA	50	50
	IV		Soft skill Subject	3	2	30	NA	50	50
TOTAL WORKING HOURS/ CREDITS				20	30				
IV	I		Tamil/ Hindi/ French/ Sanskrit	3	6	90	40	60	100
	I		English	3	4	60	40	60	100
	III	ZB18/4C/GEN	PAPER-IV –Genetics	5	8	120	40	60	100
	III	ZB18/4C/PR2	PRACTICAL- II- Cell Biology and Genetics	4	2	60	40	60	100
	III	ZB18/4A/BC2	Allied Biochemistry Paper II (Offered by Zoology for Batch-I)	4	4	60	40	60	100
		CH15/4A/ZBC	Allied Chemistry Bio Organic Chemistry (Offered by Chemistry for Batch –II)						
	III	ZB18/4A/ABC	Allied Biochemistry Practical (Offered by Zoology (for Batch-I)	2	2	60	40	60	100
		CH15/4A/PRA	Allied chemistry Practical (Offered by Chemistry for Batch-I)						
	IV		Value Education	2	2	30	NA	50	50
	IV		Soft skill Subject**	3	2	30	NA	50	50
TOTAL WORKING HOURS/ CREDITS				26	30				

**Soft Skill Subject Offered by the Department of English.

SEMESTER	PART	COURSE CODE	TITLE OF THE PAPER	CREDITS	HRS/ WEEK	TOTAL HOURS	MARKS		
							CA	SE	TOTAL
V	III	ZB18/5C/APY	PAPER-V -Animal Physiology	4	5	75	40	60	100
	III	ZB18/5C/DBY	PAPER-VI –Developmental Biology	4	4	60	40	60	100
	III	ZB18/5C/EBY	PAPER-VII -Environmental Biology	4	4	60	40	60	100
	III	ZB18/5C/BIO	PAPER-VIII –Biotechnology	4	5	75	40	60	100
	III	ZB18/5C/EZY	PAPER-IX -Economic Zoology	4	4	60	40	60	100
	III	ZB18/5E/BIN	ELECTIVE-I-Bio-Instrumentation	2	4	60	40	60	100
	III	ZB18/6C/PR3	PRACTICAL III-Developmental Biology, Environmental Biology, Evolution, Medical Laboratory Techniques and Bio-Instrumentation.	0	2	60	END OF SIXTH SEMESTER		
	III	ZB18/6C/PR4	PRACTICAL IV- Animal Physiology, Microbiology, Immunology Biotechnology and Economic Zoology.	0	2	60	END OF SIXTH SEMESTER		
	V		Extention activities	1					
	TOTAL WORKING HOURS/ CREDITS				23	30			
VI	III	ZB18/6C/IMY	PAPER-X –Immunology	4	5	75	40	60	100
	III	ZB18/6C/EVO	PAPER-XI –Evolution	4	5	75	40	60	100
	III	ZB18/6C/MIC	PAPER-XII – Microbiology	4	5	75	40	60	100
	III	ZB18/6E/MLT	ELECTIVE-II-Medical Laboratory Techniques	2	5	75	40	60	100
	III	ZB18/6E/ENT	ELECTIVE-III-Entomology	2	5	75	40	60	100
	III	ZB18/6C/PR3	PRACTICAL III-Developmental Biology, Environmental Biology, Evolution, Medical Laboratory Techniques and Bio-Instrumentation.	4	2	60	40	60	100
	III	ZB18/6C/PR4	PRACTICAL IV- Animal Physiology, Microbiology, Immunology Biotechnology and Economic Zoology.	4	2	60	40	60	100
	TOTAL WORKING HOURS/ CREDITS				24	29			
TOTAL CREDITS				140					

The above highlighted Courses of UG programme enrich the skills in employability/Skill development/Entrepreneurship which caters to the needs of the student.

RUBRICS FOR CONTINUOUS ASSESSMENT	
Assignment	Content/originality/Presentation/Schematic Representation and Diagram/Bibliography
Seminar	Organisation/Subject Knowledge/Visual Aids/Confidence level/presentation-Communication and Language
Field Visit	Participation/Preparation/Attitude/Leadership
Participation	Answering Questions/Clearing Doubts/Participating in Group Discussions/Regular Attendance
Case Study	Finding the Problem/Analysis/Solution/Justification
Problem Solving	Understanding Concepts/Formula and Variable Identification/Logical Sequence/Answer
Group Discussion	Preparation/Situation Analysis/Relationship Management/Information Exchange/Delivery Skills
Flipped/Blended Learning	Preparation/Information Exchange/ Group interaction/Clearing doubts

- FIRST FOUR RUBRICS SHOULD BE INCLUDED.
- OTHERS ARE OPTIONAL BASED ON TEACHING-LEARNING METHODOLOGY ADOPTED FOR THE PROGRAMME OF STUDY

END SEMESTER EVALUATION PATTERN-UG

THEORY PAPERS

PART III (Offered by the Department)

SEMSTER I/II/III/IV/V/VI

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL

EXAMINER MAXIMUM MARKS: 100 TO BE CONVERTED TO 60

PASSING MARK: 40

PART IV

SINGLE VALUATION

ORAL TEST/WRITTEN TEST

MAXIMUM MARKS: 50

PASSING MARK: 20

PRACTICAL PAPERS

PART III

SEMSTER I/II/III/IV/V/VI

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 60

PASSING MARKS: 24

COURSE PROFILE SEMESTER I

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOUR S/WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/1C/INV	PAPER-I – Invertebrata	5	8	6-2-0	120	40	60	100
ZB18/1A/ZO1	Allied Zoology Paper I (for PBPB students)	4	4	3-1-0	60	40	60	100
ZB18/IN/AQU	Aquaculture	3	2	-	30	-	50	50
	TOTAL CREDITS	12						

SEMESTER I

PAPER I - INVERTEBRATA

Total Hours: 120

Course Code: ZB18/1C/INV

Credits: 4

L-T-P: 6 2 0

COURSE OBJECTIVES:

1. To classify animal kingdom & its general characters.
2. To impart knowledge on invertebrates with its structure and various functions of major phylum.
3. To classify, characterize and to understand the invertebrate phyla with special reference to general and specific characteristics of each phyla.

COURSE OUTLINE:

UNIT – I:

(24 Hrs)

Introduction to animal kingdom-general characters and classification of Invertebrata up to class - levels of organization - unicellularity vs multicellularity - organization of germ layers (upto triploblastic) Development of coelom- acoelomate, pseudocoelomate and eucoelomate organization-symmetry – types.

Phylum: Protozoa

General Characters, Classification with Examples, Type study – *Paramecium*, Parasitic Protozoan – *Plasmodium vivax*

UNIT – II:

(24 Hrs)

Phylum: Porifera

General Characters - Classification, Type study – *Scypha* (Sycon), Canal System in Sponges.

Phylum: Coelenterata

General Characters - Classification, Type study – *Obelia geniculata*, Polymorphism, Coral Reefs

UNIT – III:**(24 Hrs)****Phylum: Helminthes**

General Characters, Classification, Type Study – *Taenia solium*. Nematode Parasites In Man-*Ascaris lumbricoides* *Ancylostoma duodenale*-*Wuchereria bancrofti*-*Enterobius vermicularis*-*Trichuris trichiura*. Parasitic Adaptations and Disease Control.

Phylum: Annelida

General Characters, Classification, Type Study: *Neanthes* (*Nereis*), Metamerism, Nephridia and coelomoducts

UNIT – IV:**(24 Hrs)****Phylum: Arthropoda**

General Characters, Classification, Type Study: *Penaeus indicus* (Prawn), Crustacean Larvae and their Significance, Peripatus and its affinities, Economic Importance and Social Life of Insects.

Phylum: Mollusca

General Characters, Classification, Type Study: *Pila*, Economic Importance of Mollusca

UNIT – V**(24 Hrs)****Phylum: Echinodermata**

General Characters, Classification, Type Study: *Asterias* (star fish), Echinoderm Larvae and their Significance, Water Vascular System, Nutrition in Invertebrates, Locomotion in Invertebrates

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Invertebrate Zoology	Jordan.E.L and Verma.P.S,	Revised Edn., S.Chand and Co. Ltd. Ram Nagar, New Delhi,	2014.
2	Manual of Zoology Vol -I (Invertebrata) Part I & II	Ekambaranatha Ayyar. M. and Ananthakrishnan. T.N	Vishwanathan (p) Ltd. Chennai	2010.

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Modern Textbook of Zoology – Invertebrates,	Kotpal R.L,	Rastogi Publications - Meerut;	2016 edition (2014).
2	Invertebrate Zoology 5th edition	Dhami P.S. and Dhami J.K,	S. Chand & Co., New Delhi,	2012.
3	Biology of the Invertebrates / Edition 7,	Jan A Pechenik,	McGraw-Hill Higher Education,	2014.
4	Invertebrate Zoology	Robert D. Barnes,	Publisher: Saunders College Publishing/Harcourt Brace; 5th Revised edition edition (1 January 1987),	1994.
5	Invertebrate Zoology, VIII Edition.	Ruppert and Barnes, R.D.	Holt Saunders International Edition.	2006

JOURNALS:

<https://onlinelibrary.wiley.com/journal/17447410>

http://kmkjournals.com/journals/Inv_Zool

E-LEARNING SOURCES:

https://www.educationworld.com/a_tech/sites/sites061.shtm

<https://www.amnh.org/research/invertebrate-zoology>

<https://nsufl.libguides.com/biol3300>

<https://eol.org/>

<https://archive.org/details/zoologyofinverte00ship>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Distinguish invertebrates based on germ layers, coelom and symmetry and to explain the general characters with reference to major phyla. To interpret the phylum protozoans with paramecium and plasmodium as examples.
CO 2	To differentiate the hierarchy change from unicellular organization to multicellular forms with distinct morphological and physiological changes (e.g.. poriferans to coelentrates)
CO 3	To illustrate the structure, function & parasitic adaptation in helminthes and characterize annelids.
CO 4	To identify Arthropoda and compare it as the largest of all other phylum and understand Mollusca with structural and functional details
CO 5	classify and characterize Echinoderms with their evolutionary relationships, affinities to chordates

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	3	1	1
CO 2	2	3	2	2	1	1
CO 3	3	3	2	2	2	2
CO 4	3	3	1	2	2	2
CO 5	3	3	1	2	1	1
Average	2.8	3	1.6	2.2	1.4	1.4

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1. K 2	B-5/8x8 marks	300	40	100	No.- is
K2, K 3	C-2/3x20 marks	1200	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER I

ALLIED ZOOLOGY PAPER 1 (for PBPB students)

Total Hours: 60

Course Code: ZB18/1A/ZO1

Credits: 4

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from acellular to multicellular animals.
2. To describe the basic fundamental concepts & its significance in cell organelles and cell division.
3. To impart knowledge on Mendelian laws of heredity, to discuss and differentiate the sex linked inheritance and sex determination.

COURSE OUTLINE:

UNIT I

(12 Hrs)

Study of types including life cycles-Protozoa-*Paramecium*-Porifera-Sycon -Coelenterata-*Obelia*

UNIT II

(12 Hrs)

Platyhelminthes-*Taenia solium*-Annelida-*Hirudinaria granulosa* (Leech)-Arthropoda-*Penaeus indicus* (Prawn)

UNIT III

(12 Hrs)

Mollusca-*Lamellidens marginalis* (Freshwater Mussel) - Echinodermata-*Asterias* (Star fish)

UNIT IV

(12 Hrs)

Cell Biology-Structure of animal cell-brief account of the structure and functions of cell organelles-Endoplasmic reticulum, Golgi complex, Mitochondria, Lysosomes, cell divisions-Amitosis-Mitosis-Meiosis

UNIT V

(12 Hrs)

Genetics-Laws of Mendelism-Sex determination and sex linked inheritance

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Manual of Zoology Vol.I Invertebrata. Part I and II,	Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan	Viswanathan Printers and Publishers Pvt.,Ltd.Madras	(1992) REVISED ED. 2010.
2	Cell Biology, Genetics,	Verma, P.S. and V.K. Agarwal	S. Chand & Co., New Delhi – 110 055	2010 Reprint, ,

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Invertebrate Zoology	Jordan.E.L and Verma.P.S,	Revised Edn., S.Chand and Co. Ltd. Ram Nagar, New Delhi,	2014.
2.	Fundamentals of Zoology.	Ghosh and Manna	New Central book Agency (P) Ltd.	(2004).
3	Zoology,	Miller and Harley	4th Edn., Tata- McGraw Hill Publ. Co, Ltd, New Delhi.	2002).
4	Genetics. 8 th edition	Verma,P.S and V.K.Agarwal	S.Chand and Co.New Delhi	1995
5	Cell and Molecular Biology 8 th edition.	Verma, P.S. and V.K.Agarwal	S.Chand and Co.New Delhi	2007

JOURNALS:

<https://www.hindawi.com/journals/ijz/>

<https://scialert.net/current.php?issn=1811-9778>

E-LEARNING SOURCES:

<http://www.biologydiscussion.com/notes/biology-notes-on-plants-and-animals/48680>

<https://www.onlinebiologynotes.com/>

<https://www.khanacademy.org/science/biology/>

www.biologicaldiversity.org

<https://www.nature.com>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Differentiate the invertebrate and vertebrate animals and to understand its taxonomy, morphology and structural difference.
CO 2	Identify and to describe the distinctive features of various groups of invertebrates how the organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions.
CO 3	List out the structure and functions of different cell organelles in the cell.
CO 4	Differentiate the different phases of cell division.
CO 5	Relate the basic concepts of Mendelian laws and compare sex determination and sex linked inheritance with suitable examples

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	2	1
CO 2	3	3	2	2	2	1
CO 3	2	2	3	2	2	1
CO 4	3	1	2	2	3	1
CO 5	3	1	2	3	3	1
Average	2.8	2	2.2	2.2	2.4	1

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER I

NON MAJOR ELECTIVE (Offered to students of other departments)

AQUACULTURE

Total Hours: 30

Course Code: ZB18/IN/AQU

Credits: 3

COURSE OBJECTIVES:

1. To state various techniques used in fishery and polyculture practices.
2. To classify different culture technologies of molluscs, prawn and fishes.
3. To list out Economic factors in aquaculture and Problems associated with aquaculture.

COURSE OUTLINE:

UNIT I

Introduction to aquaculture, Scope and importance of aquaculture, Concepts of extensive and intensive culture, Pisciculture. Types- Monoculture, Poly culture, Integrated fish farming- Paddy cum Fish culture

UNIT II

Culture methods, Pen culture, Sewage Fed culture, Aquarium setting and maintenance, Ornamental Fishes Molluscan Oyster culture – Edible molluscs and pearl oyster culture. Crustacean culture- Prawn culture

UNIT III

Problems associated with aquaculture, Manmade hazards affecting aquaculture, Economic factors in aquaculture, Organizations involved in aquaculture

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Aquaculture	N. Arumugam	Saras Publication	2014
2.	Fish and Fisheries	Aravind N. Shukla	Discovery publication House	2013

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Hand book of Fisheries and Aquaculture	Dr. S. Ayyappan	Indian Council of Agricultural Research, New Delhi	2017
2.	Aquaculture and Fish Farming	Brendan Marshal	Larsen and Keller	2017
3	Aquaculture Principles and Practices	TVR. Pillay and M.N. Kutty	Wiley India Pvt Ltd	2011
4.	Fishery Science and Indian Fisheries	C.B.L. Srivastava and Sushma Srivastava	Kitab Mahal	2006
5.	A Text book of Aqua culture	Rao KRSS. Reddy Ms	Discovery publication Delhi	2004

JOURNALS:

Aquaculture, Elsevier
Journal of Applied Aquaculture

E-LEARNING SOURCES:

<http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/3072/art06.pdf?sequence=1>
<http://fishcount.org.uk/farmed-fish-welfare/development-of-intensive-fish-farming>
http://www.fao.org/fileadmin/templates/SEC/docs/Fishery/cage/3DAAPM_en.pdf
<https://www.tandfonline.com/doi/abs/10.1080/10641262.2010.535046>
<https://www.sciencedirect.com/topics/nursing-and-health-professions/pisciculture>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Appreciate the different culture methods in fish farming and have an awareness on integrated fish farming practices.
CO 2	Understand the complete protocol of aquarium settings and its maintenance which enhance their entrepreneurial skills in ornamental fish and pearl culture.
CO 3	Encounter and overcome the problems in aqua farming.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	-	1	3	1	3
CO 2	3	-	1	3	1	3
CO 3	3	-	1	3	1	3
Average	3	-	1	3	1	3

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1, K2	A-10/12 X 5 marks	350	50	50

COURSE PROFILE SEMESTER II

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/2C/CHO	PAPER-II-Chordata	5	8	6-2-0	120	40	60	100
ZB18/2A/ZO2	Allied Zoology Paper II (for PBPB students)	4	4	3-1-0	60	40	60	100
ZB18/2C/PR1	PRACTICAL-I Invertebrata and Chordata	4	2	0-0-2	60	40	60	100
ZB18/2A/AZO	Allied Zoology Practical	2	2	0-0-2	60	40	60	100
ZB18/2N/VER	Vermitechnology	3	2	-	30	-	50	50
	TOTAL CREDITS	15						

SEMESTER II

PAPER – II CHORDATA

Total Hours: 120

Credits: 5

Course Code: ZB18/2C/CHO

L-T-P:5 6 2 0

COURSE OBJECTIVES:

1. To explain the morphology of chordates with special emphasis on their adaptation.
2. Analyse the advances in their complexity with reference to their habitat
3. To classify and characterize vertebrates and study the physiology of animals

COURSE OUTLINE:

UNIT-I

(24 Hrs)

General characters and Classification of Prochordata, Cephalochordata, Hemichordata, Urochordata Affinities of Prochordata

UNIT-II.

(24 Hrs)

Agnatha : General characters and Classification up to order, Cyclostomata – General Characters and Classification. Type Study – *Petromyzon*

Pisces – General Characters and Classification up to order, Type Study – *Scoliodon sorrakowah*, Brief description of five common Fishes found in India- Sardinella, Mackerel, Catla, Rohu, Mrigal. Accessory Respiratory Organs, Parental Care in Fishes, Migration in Fishes

UNIT-III

(24 Hrs)

Amphibia– General characters and Classification up to order, Type Study – *Rana hexadactyla* (Frog), Parental care and Paedogenesis in Amphibia, Brief description of five common Amphibians found in India- Bufo, Hyla, Rhacophorus, Ichthyophis, Ambystoma.

Reptilia – General characters and Classification based on skull, Type Study – *Calotes versicolor* (Garden lizard), Brief description of five common Reptiles found in India- Hemidactylus, Chameleon, Varanus, Turtle, Tortoise. Identification of Poisonous and Non-Poisonous Snakes, Poison Apparatus

UNIT- IV**(24 Hrs)**

Aves - General characters and Classification up to order, Type Study –*Columba livia*, Brief description of five common Birds found in India- Crow, Sparrow, Peacock, Mynah, Indian Parrot, Flightless Birds, Flight Adaptations in Birds, Migration in Birds

UNIT- V**(24 Hrs)**

Mammals - General characters and Classification up to order, Type Study – *Oryctolagus cuniculus* (Rabbit), Brief description of five common Mammals found in India- Lion, Elephant, Cow, Horse, Cat, Brief description of Egg Laying Mammals, Marsupials, Placental mammals, Dentition in Mammals, Aquatic Adaptations in Mammals

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Chordata	EL Jordan & P.S. Verma	S. Chand Publishers	2014
2	Kotpal R L	Text book of zoology vertebrates	Global media publications	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Biology of Chordates	B.N. Pandey , Vartika Mathur	PHI Learning	2018
2.	Vertebrates Comparative Anatomy, Function and Evolution. IV Edition.	Kardong, K.V.	Mc Grawhill Higher Education.	2005
3.	Comparative Anatomy of the Vertebrates. IX Edition.	Kent, G.C. And Carr R.K.	The McGraw-Hill Companies.	2000
4	The Life of Vertebrates. III Edition.	Young, J.Z	Oxford University Press.	2004
5.	Chordata - I	Mohan P. Arora	Himalaya Publishing House Pvt. Ltd	2018

JOURNALS:

International journal of biological sciences

Journal of Zoological Systematics and Evolutionary Research

E-LEARNING SOURCES:

www.ucmp.berkeley.edu/chordata/chordata.html

<http://www.notesonzooology.com/phylum-chordata/cyclostomes/cyclostomes-origin-and-habitat-vertebrates-chordata-zoology/7873>

<http://www.biologydiscussion.com/zooology/amphibians/class-amphibian-characters-and-classification-animal-kingdom/69912>

<https://www.kolkatabirds.com/citibirds.html>

https://animaldiversity.org/accounts/Columba_livia/

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the characteristics changes from invertebrates to Prochordates and Chordates.
CO 2	To differentiate jawless fishes from other fish forms. Students will be able to illustrate fish physiology with neat labeled diagram.
CO 3	To explain Amphibian physiology with neat labeled diagrams and can highlight on Parental care in Amphibia. Relate and classify Reptilia and also can explain Calotes physiology.
CO 4	Outline the special characters of birds with reference to their respiration, flight adaptation.
CO 5	Discuss giving reasons mammalia as the highest form of vertebrates with reference to their brain development and other adaptation

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	2	2	2
CO 2	3	3	3	2	2	2
CO 3	3	3	3	2	2	2
CO 4	2	2	3	2	2	2
CO 5	2	2	3	2	2	2
Average	2.6	2.6	3	2	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER II

ALLIED ZOOLOGY PAPER - II

Total Hours: 60 hrs

Course Code: ZB18/2A/ZO2

Credits: 4

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain the organization of chordates
2. To analyse the basic concepts of physiology and ecology
3. To describe the concepts of evolution

COURSE OUTLINE:

UNIT I

(12 Hrs)

Study of Vertebrate types – Pisces-*Scoliodon sorrakowah* (Shark) - Amphibia-*Rana hexadactyla* (Frog) – Reptilia - *Calotes versicolor*. with reference to External characters , digestive system , respiratory system , Structure of heart and brain, Urinogenital system

UNIT II

(12 Hrs)

Study of Aves-*Columba livia* (Pigeon) – Mammals - *Rattus rattus* (Rat) with reference to External characters , digestive system , respiratory system , Structure of heart and brain, Urinogenital system

UNIT III

(12 Hrs)

Physiology - Digestion, Respiration and Excretion in Mammals – Developmental Biology- Types of eggs – Cleavage - Blastulation and Gastrulation in Frog

UNIT IV

(12 Hrs)

Ecology-Temperature, Light and Water as abiotic factors – Animal associations (Commensalism, Mutualism and Parasitism)

UNIT V

(12 Hrs)

Evolution - Origin of life – Lamarckism - Neo Lamarckism – Darwinism – NeoDarwinism - Mutation Theory of De Vries

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Cell Biology, Genetics and Evolution.	Arumugam,N	Saras Publication	2004
2.	Manual of Zoology Vol.I Invertebrata. Part I and II,	Ekambaranatha Ayyar, M. and T.N.Ananthakrishnan	Viswanathan Printers and Publishers Pvt.,Ltd.Madras	2010

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	The Process of Evolution	Erlich,P.R.and Richard,W.Holm	McGraw Hill., New York	1963
2.	Principles of Ecology	Verma ,P.S. and V.K.Agarwal	S.Chand and Co. Ltd. Ram Nagar, New Delhi.	2007
3	Chordata 14 th edition	EL Jordan & P.S. Verma,	S. Chand Publishers.	2013
4	Modern text book of zoology vertebrates 3 rd edition	R L Kotpal	Rastogi publications	2018
5	Comparative Anatomy of the Vertebrates. Ix Edition.	Kent, G.C. And Carr R.K.	The McGraw-Hill Companies.	2000

JOURNALS:

International journal of biological sciences

Journal of Zoological Systematics and Evolutionary Research

E-LEARNING SOURCES:

<http://www.notesonzooology.com/reptilia/nervous-system-of-calotes-with-diagram-zoology/3902>

<http://www.biozoomer.com/2013/12/fish-skull-frog-skulllizard-skullbird.html>

https://animaldiversity.org/accounts/Rattus_rattus/

<https://www.onlinebiologynotes.com/development-of-frog-embryonic-development/>

https://embryology.med.unsw.edu.au/embryology/index.php/Frog_Development

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Explain the vertebrate animals with examples.
CO 2	Analyze the process of physiological concepts and basic embryology
CO 3	Explain and differentiate the role of biotic and abiotic factors.
CO 4	Explain the types of animal associations.
CO 5	Discuss the evolution process from origin of life.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	3	2	1	2
CO 2	3	3	3	2	1	2
CO 3	3	2	2	2	2	2
CO 4	3	2	2	2	1	1
CO 5	3	2	2	3	1	2
Average	2.8	2.2	2.4	2.2	1.2	1.8

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1. K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER II

PRACTICAL I -INVERTEBRATA AND CHORDATA

Total Hours: 60

Course Code: ZB18/2C/PR1

Credits: 4

L-T-P: 0 0 2

COURSE OBJECTIVES:

1. To identify the invertebrates and chordates with their distinct morphological characters.
2. To dissect and study the systems in Cockroach and Synagris.
3. To relate structure and function few invertebrate and vertebrate specimens. To identify the different bones in frog, Bird and Mammalian dentition

COURSE OUTLINE:

I. DISSECTION

A. COCKROACH/ PRAWN

1. External characters

2. Digestive system

3. Nervous system

4. Reproductive system

B. Any bony fish:

5. External characters

6. Digestive system

7. Urinogenital system

II. MOUNTING

Mouth parts of

1. Cockroach

2. Mosquito

3. Shark: Placoid-Carp-Cycloid

III. SPOTTERS

A. Classify giving reasons up to order:

1. *Paramecium*
2. *Scypha*
3. *Obelia colony*
4. *Taneaia solium*
5. *Ascaris*
6. *Neanthes*
7. *Penaeus*
8. *Pila globosa*
9. *Asterias*
10. *Balanoglossus*
11. *Amphioxus*
12. *Scoliodon sorrakowah*
13. *Rana hexadactyla*
14. *Calotes versicolor*
15. *Columba livia*
16. *Oryctolagus cuniculus*

B. Draw labeled sketches:

17. *Obelia medusa*
18. *Nereis* T.S
19. Bipinnaria larva
20. *Amphioxus* T.S
21. Quill feather

C. Comment on biological significance:

22. *Entamoeba*
23. *Paramecium*-conjugation
24. *Plasmodium*
25. *Ascaris*
26. *Heteronereis*
27. *Peripatus*
28. Nauplius larva
29. *Sacculina* on crab

30. Sea anemone on hermit crab

31. *Vipera russelli*

32. Bat

D- Relate structure and function:

33. Sponge-spicules

34. Sponge-gemmule

35. *Taenia-scolex*

36. *Neanthes*-parapodium

37. *Panaeus*-petasma

38. Starfish-tubefoot

39. Snake-poison apparatus

E. Types of fins:

Homocercal fin, Heterocercal fin, Diphyrcal fin

F. Osteology/palate in Birds/Dentition

Osteology

Frog:

40. Skull and lower jaw

41. Vertebral column

42. Pectoral girdle

43. Pelvic girdle

44. Forelimb

45. Hindlimb

Palate in Birds

46. Pigeon-palate

47. Crow-palate

48. Duck-palate

Dentition

49. Rabbit-dentition

50. Dog-dentition

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	A Manual of Practical Zoology: Chordates	P S Verma	S Chand Publishing	2010
2	A Manual of Practical Zoology: Invertebrates	Verma P.S	S Chand	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Practical Zoology	Kishore R Pawar , Ashok E Desai	Nirali Prakashan	2017
2.	Practical Zoology Volume 1	Jayasurya , N. Arumugam	Saras Publication	2013
3.	A Manual of Practical Zoology: Invertebrates	Verma P.S.	S Chand	2010
4	Textbook Of Practical Zoology VOLUME 3	Rastogi Publication	S.S.Lal	2009
5	Advanced Practical Zoology	P S Verma, P C Srivastava	S Chand Publishing	2012

E-LEARNING SOURCES:

<http://www.biologydiscussion.com/invertebrate-zoology/cockroach/dissection-of-cockroach-with-diagram-zoology/45031>

<https://sciencing.com/shrimp-nervous-system-17846.html>

<https://biology4isc.weebly.com/morphology-and-anatomy-of-cockroach.html>

<https://www.carolina.com/teacher-resources/Interactive/dissection-buying-guide/tr42204.tr>

<https://opentextbc.ca/biology/chapter/15-1-digestive-systems/>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To identify the invertebrates and chordates with their distinct morphological characters.
CO 2	To demonstrate the digestive and nervous systems in Cockroach and digestive and Urinogenital system of Synagris.
CO 3	To compare the different types fins in fish
CO 4	To explain structure and function few invertebrate and vertebrate specimens
CO 5	To identify the deferent bones in frog, Bird and Mammalian dentition

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	3	2
CO 4	3	3	3	2	3	2
CO 5	3	3	3	2	2	2
Average	3	3	3	2.6	2.8	2.4

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Dissection, Demonstrations, Slides, Spotters Charts, LCD Projector and OHP

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	20+5=25	60
K3 & K2	II.	7+3= 10	
K1	III.	6X 2.5=15	
K1	IV.	10	

SEMESTER II

ALLIED ZOOLOGY PRACTICAL

Total Hours: 60

Credits: 2

Course Code: ZB18/2A/AZO

L-T-P: 0 0 2

COURSE OBJECTIVES:

1. To understand the relationships between invertebrates & Chordates with the structure and functional organization of animals and their environment
2. To learn the basic principles of Mendelian laws and drosophila mutants
3. To learn the working mechanism of instruments, and animal adaptations.

COURSE OUTLINE:

I DISSECTIONS:

1. Cockroach- Digestive, Nervous and Reproductive system.

2. Fish- Digestive and Urinogenital system.

3. Calotes- Digestive and Urinogenital system.

II MOUNTING:

1. Mouth parts of Mosquito, Honey bee and Cockroach.

2. Placoid scale.

3. Fowl brain.

III DEMONSTRATION OF MENDELIAN LAWS (Law of dominance, Law of independent assortment) **NORMAL AND MUTANT Drosophila** (Vestigial wing, Rotated abdomen, Barr eye).

IV PHYSIOLOGY- RESPIROMETER AND BP APPARATUS.

V SPOTTERS:

- a) Amoeba, Paramecium, Sycon, Obelia colony, Obelia Medusa, Fasciola, Taenia, Ascaris, Hirudinaria, Penaeus, Unio, Asterias, Scoliodon, Rana, Calotes, Rattus.
- b) Ecology-Animal association (Mutualism, Parasitism Commensalism),
- c) Embryology- Egg, Sperm, and Cleavage 2,4,8,16,32 cell stage, Blastula and Gastrula of frog.
- d) Evolution- Adaptation- Stick insect, leaf insect and Chameleon.

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Advanced Zoology Practical	Sinha. J, Chatterjee. A. K, Chattopadhyay. P	Arunabha Sen Books and Allied (P) Ltd	2011
2.	A Textbook of Practical Zoology Vertebrate	Lal S. S.,	Rastogi Publication	2004
3	A Textbook of Practical Zoology Invertebrate	Lal S. S.,	Rastogi Publication	2004
4	Manual of Zoology: v. 1 & 2	Prof. Ekambaranatha Avyyar & Prof. Anantkrishnan	Viswanathan, S., Printers & Publishers Pvt Ltd	2009
5	General Zoology Laboratory Manual	J.E. Wodsedalek Charles F. Lytle &	McGraw Hill Higher Education; 13th Revised edition edition	2000

E-LEARNING SOURCES:

<https://www.austincc.edu/sziser/Biol%201413/Zoology%20Lab%20Manual.pdf>

[http://www.tnscert.org/tnscert/ebooks/tnscert-ebook/pdf-files/31-08-](http://www.tnscert.org/tnscert/ebooks/tnscert-ebook/pdf-files/31-08-2018/Zoology%20Practical%20EM%2031-08-2018%2001-53PM.pdf)

[2018/Zoology%20Practical%20EM%2031-08-2018%2001-53PM.pdf](http://www.tnscert.org/tnscert/ebooks/tnscert-ebook/pdf-files/31-08-2018/Zoology%20Practical%20EM%2031-08-2018%2001-53PM.pdf)

<http://www.uou.ac.in/sites/default/files/slm/BSCZO-104.pdf>

<https://www.chegg.com/homework-help/general-zoology-laboratory-manual-to-accompany-zoology-solutions-manual-sm3-6302>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Analyze the unique structural details of invertebrates and chordates through dissections.
CO 2	Analyse & identify invertebrates and Chordates in laboratory, use taxonomic keys for identification to have the knowledge of mouth parts of insects, scales of fishes.
CO 3	State the Mendelian laws and mutant types
CO 4	Relate the working mechanism of physiological apparatus
CO 5	Attain knowledge about the taxonomic position, ecology, embryology and evolution of animals.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3
CO 4	2	3	3	3	3	3
CO 5	3	3	3	3	3	3
Average	2.8	3	3	3	3	3

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Demonstration and dissection

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	15+5= 20	60
K3	II.	7+3=10	
K2	III.	7	
K2 & K1	IV.	5	
K2 & K1	V.	4X2=8	
K1	VI.	10	

SEMESTER II

NON MAJOR ELECTIVE (Offered to students of other departments)

VERMITECHNOLOGY

Total Hours: 30

Course Code: ZB18/2N/VER

Credits: 3

COURSE OBJECTIVES:

1. To explain the vermiculture with its scope and importance
2. To classify physical, chemical and biological requirement for vermiculture.
3. To differentiate suitable species and enemies of earth worm for vermicomposting.

COURSE OUTLINE:

UNIT-I

Earthworm: Ecological classification of Earthworms- epigeic, anecic and endogeic species – Vermiculture definition - Physical, chemical and biological requirements of earthworm culture. Earthworms as indicators of soil fertility (10Hrs)

UNIT-II

Vermicomposting - Types – Suitable species of earthworm for vermicomposting – Requirements of vermicomposting – Precautions to be taken – Enemies of earthworm – Harvesting the worms and vermicompost – Uses of vermi-wash - Advantages of vermicomposting – Nutrient content of vermicompost – Changes in soil due to vermicompost. (10Hrs)

UNIT-III

Economics of vermicomposting - Applications of vermicomposting in Agricultural and Horticultural practices-Economics of running a small scale vermicomposting unit. (10Hrs)

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Vermicomposting for Sustainable	P.K.Gupta	Agriculture Agrobics (India)	2004
2	Vermiculture and Organic Farming Hardcover	Sathe Tukaram Vithatran	Daya Publishing House	2004
3	Earthworms for Solid Waste Management Hardcover	M. Satyendra	International Book Distributing Co	2008
4	Hand Book Of Biofertilizers & Vermiculture	Eiri Board	Engineers India Research Institute	2009
5	the worm farmers handbook	Rhonda sherman	Chelsea green publishing company	2018

JOURNALS:

International Journal of Environment and Waste Management
Journal of Experimental Zoology

E-LEARNING SOURCES:

<http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-3610/Lecture-10-BINM-Vermicompost.pdf>
<https://www.earthwormsoc.org.uk/earthworm-ecology>
<https://en.wikipedia.org/wiki/Vermicompost>
http://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
<https://www.calrecycle.ca.gov/organics/worms/wormfact>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the scopes and importance of vermiculture.
CO 2	To discuss the different methods of the vermiculture
CO 3	To explain the applications of vermicomposting in agriculture and horticulture practices. Apply entrepreneur skill on vermiculture

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	3	3	2	1
CO 2	3	2	3	3	1	1
CO 3	3	3	3	3	1	1
Average	2.7	2.3	3	3	1.3	1

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1, K2	A-10/12 X 5 marks	350	50	50

COURSE PROFILE SEMESTER III

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/3C/CBY	PAPER-III - Cell Biology	5	8	6-2-0	120	40	60	100
ZB18/3A/BC1	Allied Biochemistry Paper I (for Batch I students)	4	4	3-1-0	60	40	60	100
	TOTAL CREDITS	9						

SEMESTER III
PAPER – III CELL BIOLOGY

Total Hours: 120
Credits: 5

Course Code: ZB18/3C/CBY
L-T-P: 6 2 0

COURSE OBJECTIVES:

1. To perceive the structural and functional details of cell and cell organelles
2. To explore the role of nucleus and chromosomes.
3. To gain knowledge in cytological techniques

COURSE OUTLINE:

UNIT- I (18 hrs)

Brief history of cell biology- cell theory-detailed account of prokaryotic and Eukaryotic cell- plasma membrane – structure and functions. Cytoplasm - Physical, Biological properties and functions

UNIT- II (30 hrs)

Cell organelles - structure and functions of Endoplasmic reticulum, Golgi apparatus, ribosomes, Structure and functions of lysosomes, polymorphism- structure and functions of mitochondria, cellular respiration – centrioles

UNIT- III (30 hrs)

Nucleus, nucleolus - structure and functions. Chromosome - structure, classification. Euchromatin, heterochromatin, Sat chromosomes, Karyotype, chromosomal banding. Special chromosomes – Polytene and Lampbrush

UNIT- IV (24hrs)

Cell cycle and stages- cell division and significance – amitosis, mitosis, meiosis- Cancer biology – characteristics of cancer cells – Types of cancer– Differences between normal and cancerous cell – theories on carcinogenesis

UNIT V (18 hrs)

Cytological techniques – cell fractionation – fixation, staining - principles of light microscopy, Phase contrast microscopy, electron microscopy

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Textbook of Cytology	Verma.P.S and Agarwal V K	S. Chand and company	2012
2	Molecular cell biology - 6th edition	Harvey Lodish,Arnold Berk,Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher,HiddePloegh and Paul Matsudaira	W. H. Freeman	2007

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Cell and Molecular Biology: Concepts and Experiments	Gerald Karp	John Wiley & Sons	2007
2	Cell Biology	Dr.C.B.Powar	Himalaya Publishing House	2010
3	Molecular Biology of the Cell	Bruce Alberts, Alexander Johnson, Julian LewisMartin Raff, Keith Roberts and Peter Walter	Garland Science	2008
4	The Cell: A Molecular Approach	Geoffrey M. Cooper and Robert E. Hausman.	Sinauer Associates Inc	2009
5	Cell Biology	Channarayappa	Universities Press	2010

JOURNALS:*Cell Biology**Cell biology international***E-LEARNING SOURCES:**

<https://www.jagranjosh.com/general-knowledge/what-is-the-difference-between-prokaryotic-and-eukaryotic-cells-1523518350-1>

<https://www.toppr.com/guides/biology/the-fundamental-unit-of-life/cell-organelle/>

<https://www2.le.ac.uk/projects/vgec/highereducation/topics/dna-genes-chromosomes>

<https://www.fasebj.org/doi/abs/10.1096/fasebj.7.12.8375618?journalCode=fasebj>

<https://www.slideshare.net/drtousif/cytotechniques-53024981>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO1	Interpret the basic difference between prokaryotic and eukaryotic cell
CO2	Explains individual cell organelle functions and their interactions.
CO3	Describe the role of nucleus and chromosomes.
CO4	Identify different stages of cell cycle and paraphrase the mechanism of carcinogenesis
CO5	Apply the concepts of cytological techniques like cell fraction, staining and microscopy.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	2	2	2
CO 2	3	2	2	2	2	2
CO 3	3	2	2	3	2	2
CO 4	3	2	3	3	2	2
CO 5	2	2	3	3	3	2
Average	2.8	2	2.4	2.6	2.2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER III

ALLIED BIOCHEMISTRY PAPER 1 (for Batch I students)

Total Hours: 60

Course Code: ZB18/3A/BC1

Credits: 4

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain the core principle, scope and definition of biochemistry
2. To describe the importance of fluid balance in animals and its causes.
3. To classify the carbohydrates, lipids and proteins based on its structure and illustrate their role in biological process.

COURSE OUTLINE:

UNIT - I

(12 Hrs)

Definition, scope and significance of Biochemistry – Important discoveries in biochemistry. Water – Molecular structure and its physical properties

UNIT – II

(12 Hrs)

Definition of pH, its determination, maintenance of pH in blood - Buffers and electrolytes in the body and their functions. Fractionation of biological material by chromatography and electrophoresis

UNIT – III

(12 Hrs)

Carbohydrates: Structure, reactions of mono, di and oligosaccharides. Polysaccharides in plants - cellulose, starch and pectins: Carbohydrate metabolism- Glycolysis, Krebs's tricarboxylic acid cycle, Glucogenesis, Gluconeogenesis, Glcogenolysis and pentose pathway. Maintenance of blood glucose

UNIT – IV

(12Hrs)

Lipids: Classification of lipids, saturated and unsaturated fatty acids, cholesterol, bile acids, fatty acid break down and acetate release

UNIT – V

(12 Hrs)

Protein – Classification according to solubility, shape, composition and function, functional groups of aminoacids, peptide bond, primary, secondary and tertiary and quaternary structure of proteins, Ramachandran plot, protein breakdown, transamination, oxidative deamination and urea cycle. Interrelationship of Protein, Lipid and Carbohydrate metabolism

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Fundamentals of Biochemistry for Medical Students	Ambika Shanmugam	Wolters Kluwer India Pvt. Ltd.;	2016
2.	Biochemistry	Satyanarayana	Elsevier India	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Lehninger Principles of Biochemistry	David L. Nelson	W H Freeman & Co	2012
2.	Biochemistry	Jeremy M. Berg , Lubert Stryer , John Tymoczko, Gregory Gatto	WH Freeman;	2019
3	Fundamentals of Biochemistry S (2006)	Eric E. Conn, Paul K. Stumpf, George Bruening ,. Roy H. Doi	Chand;	2016
4	BIOCHEMISTRY	Dr. Mrs. Padmaja H. Agarkar	Nirali Prakashan	2019
5	Harper'S Illustrated Biochemistry,	Murray R K	cbspd	2006

JOURNALS:

The International Journal of Biochemistry & Cell Biology

Indian journal of Medical Biochemistry

E-LEARNING SOURCES:

<https://accessmedicine.mhmedical.com/content.aspx?bookid=1366§ionid=73242196>

<https://opentextbc.ca/anatomyandphysiology/chapter/26-4-acid-base-balance/>

<https://opentextbc.ca/anatomyandphysiology/chapter/24-2-carbohydrate-metabolism/>

https://www.amboss.com/us/knowledge/Lipids_and_fat_metabolism

<https://proteinstrutures.com/Structure/Structure/Ramachandran-plot.html>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Identify, explain and apply the basic concepts of biology and chemistry in living organisms
CO 2	To explain the role of pH, buffer and electrolytes importance in human body.
CO 3	Discuss the carbohydrates and its biological functions in our body and describing the regulation of blood glucose with reference to diabetes.
CO 4	To compare saturated and unsaturated fatty acids and explain their importance in metabolic pathways.
CO 5	To explain the different structure of protein and its significance to physiology

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	2	2	2
CO 2	3	3	3	3	2	2
CO 3	3	3	3	2	2	2
CO 4	3	3	3	3	2	2
CO 5	3	2	3	3	2	2
Average	3	2.6	3	2.6	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

COURSE PROFILE SEMESTER IV

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/4C/GEN	PAPER-IV-Genetics	5	8	6-2-0	120	40	60	100
ZB18/4A/BC2	Allied Biochemistry Paper II (for Batch I students)	4	4	3-1-0	60	40	60	100
ZB18/4C/PR2	Practical II – Cell Biology & Genetics	4	2	0-0-2	60	40	60	100
ZB18/4A/ABC	Allied Biochemistry Practical for batch I students	2	2	0-0-2	60	40	60	100
	TOTAL CREDITS	15						

SEMESTER IV

PAPER – IV- GENETICS

Total Hours: 120

Credits: 5

Course Code: ZB18/4C/GEN

L-T-P: 6-2-0

COURSE OBJECTIVES:

1. To explain the concept of classical Genetics and basic principles of Mendelian inheritance and to procure knowledge in sex determination and sex-linked inheritance in drosophila, chicken and human.
2. To outline the structure and functions of DNA & RNA and to highlight the molecular basis of gene mutation.
3. To acquire knowledge on cytoplasmic and mitochondrial inheritance

COURSE OUTLINE:

UNIT- I

(28hrs)

Mendelian inheritance- Laws of inheritance. Mendelian traits in man. Gene interaction - codominance, incomplete dominance, epistasis. – Multiple alleles (Blood group inheritance in human) – crossing over – cytological proof for crossing over – significance of crossing over - chromosome mapping

UNIT- II

(20hrs)

Sex determination – Heterogametic theory of sex determination – Geneic balance mechanism – Hormonal control of sex determination – Environmentally controlled sex determining mechanism, X- Linked inheritance in Drosophila, Chicken and man. Y – Linked inheritance in Drosophila and Man. X-Y linked inheritance in Drosophila, and man. Sex limited and sex – influenced genes

UNIT- III

(28hrs)

Structure and functions of DNA — Watson & Crick model of DNA – Polymorphic forms of DNA – Mechanism of DNA replication - steps in prokaryotic replication – enzymes involved in DNA replication. RNA structure, types and functions – Genetic code - Protein synthesis (prokaryotes). Transcriptional control – Lac Operon

UNIT- IV

(24hrs)

Gene – Gene concept-cistron, muton, recon. Molecular basis of gene mutations – mutable and mutator genes. Chromosomal aberration types – intrachromosomal and interchromosomal. Human syndromes (21 trisomy, 18 trisomy, 47XXY, 45 XO). Non disjunction

UNIT- V

(20hrs)

Cytoplasmic inheritance, mitochondrial DNA. Genetic counselling, Eugenics, Euthenics, Euphenics – Inborn errors of metabolism

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	P S Verma and V K Agarwal	Genetics	S Chand Publishing; Ninth edition	2010
2.	Benjamin Pierce	Genetics: A Conceptual	WH Freeman; 6th edition	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Singh b	Genetics	Kalyani publishers	2016
2.	Strickberger	Genetics	Pearson	2015
3.	Klug, cummings&spencer	Concepts of genetics	Pearson education India; tenth edition	2016
4.	Gardner, Simmons and Snustad	Principles of Genetics	Wiley; 8 Edition	2006
5.	James D. Watson A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard.	Molecular Biology of the Gene	Pearson Education; Seventh edition	2017

JOURNALS:

Indian Journal of Human Genetics - Medknow Publications

Journal of Genetics- Springer

E-LEARNING SOURCES:

<http://knowgenetics.org/mendelian-genetics/>

<https://www.toppr.com/guides/biology/principles-of-inheritance-and-variation/sex-determination/>

https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/hs-rna-and-protein-synthesis-review?utm_account=Grant&utm_campaignname=Grant_Science_Dynamic&gclid=Cj0KCCQjwv8nqBRDGARIsAHfR9wD4CIJH_7zsRoGhQ9jxkSXe3cB2w4T6gLjeU6BDL8JYDOMnNCny0mwaAsnaEALw_wcB

<https://www.biology.iupui.edu/biocourses/N100/2k2humancsomaldisorders.html>

<http://knowgenetics.org/history-of-eugenics/>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO1	Explain common Mendelian traits and patters of inheritance in Humans. Moreover, genetic basis of blood grouping can be applied in identification of blood groups in individuals
CO2	Cite the concept of hormone in sex determination and inheritance of sex-linked genes in drosophila, chicken and man
CO3	Apply theinsight of how DNA encodes genetic information, the role of mRNA & tRNA and how DNA directs protein synthesis.
CO4	Evaluate the different types of mutation and biological basis of human syndrome.
CO5	Predict the strategies to improve the quality and quantity of the existing population through genetic techniques.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	2	3
CO 2	3	2	2	2	1	2
CO 3	2	2	3	3	3	2
CO 4	2	2	2	3	3	2
CO 5	1	2	2	3	3	3
Average	2.2	2	2.4	2.8	2.4	2.4

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER IV
ALLIED BIOCHEMISTRY PAPER II (for Batch I students)

Total Hours: 60
Credits: 4

Course Code: ZB18/4A/BC2
L-T-P: 3-1-0

COURSE OBJECTIVES:

1. Define the term and its effect on biochemical reactions in living organisms.
2. Discuss the metabolic pathway and to explain how glucose, fats and proteins enter pathways for energy release and classify vitamins with their role and function, To understand the principles of biochemistry.
3. To study the composition of DNA and RNA and to describe the difference between them.

COURSE OUTLINE:

UNIT - I

(12 Hrs)

Enzymes: Definition, Classification based on their function, apoenzyme, isoenzyme and coenzymes, mechanism of enzyme action – enzyme substrate complex, properties of enzymes, enzyme inhibition – enzyme kinetics

UNIT – II

(12 Hrs)

Bioenergetics: oxidative phosphorylation, electron transport chain, high energy compounds

UNIT – III

(12 Hrs)

Vitamins: Definition and classification- Water Soluble vitamins- thiamine, riboflavin, panthothenic acid, ascorbic acid, pyridoxine, Vitamin – B12 - Fat Soluble Vitamins – A, D, E and K with reference to the occurrence, deficiency and biochemical function

UNIT – IV

(12 Hrs)

Hormones: Definition, Endocrine glands and its secretion - Biological functions of pituitary hormones, thyroid hormones, parathormone, insulin, glucagon, adrenal hormones and sex hormones

UNIT – V

(12 Hrs)

Nucleic acids – Nucleosides, Nucleotides, DNA and RNA (occurrence & structure) and protein biosynthesis

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Fundamentals of Biochemistry for Medical Students	Ambika Shanmugam	Wolters Kluwer India Pvt. Ltd.;	2016
2.	Biochemistry	Satyanarayana	Elsevier India	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Lehninger Principles of Biochemistry	David L. Nelson	W H Freeman & Co	2012
2.	Biochemistry	Jeremy M. Berg , Lubert Stryer , John Tymoczko, Gregory Gatto	WH Freeman;	2019
3	Fundamentals of Biochemistry S (2006)	Eric E. Conn, Paul K. Stumpf , George Bruening ,. Roy H. Doi	Chand;	2016
4	Biochemistry	Dr. Mrs. Padmaja H. Agarkar	Nirali Prakashan	2019
5	Harper'S Illustrated Biochemistry,	Murray R K	cbspd	2006

JOURNALS:

The International Journal of Biochemistry & Cell Biology
Indian journal of Medical Biochemistry

E-LEARNING SOURCES:

<http://www.biologydiscussion.com/enzymes/enzymes-meaning-mechanism-classification-factors-and-importance/17003>

<http://bio1511.biology.gatech.edu/module-3-molecules-membranes-and-metabolism/05-respiration-chemiosmosis-and-oxidative-phosphorylation/>

<https://www.britannica.com/science/vitamin>

<https://opentextbc.ca/biology/chapter/11-4-endocrine-system/>

<https://www.britannica.com/science/nucleic-acid>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the enzyme, enzyme classification, basic properties of enzymes, models for enzyme-substrate binding and kinetics of enzymatic reactions
CO 2	To identify key intermediates and the location of the key processes in cellular respiration, to explain the chemiosmotic mechanism of ATP synthesis
CO 3	To explain the word vitamin and list the characteristics of vitamins & Classify the vitamins according to its solubility.
CO 4	Explain the concepts related to intercellular communication and the maintenance of homeostasis; define the metabolic role of individual tissues and hormones in physiological and / or pathological processes in the body.
CO 5	Discuss the different composition and roles of nucleic acids in the cell and their interactions with each other & structures of nucleic acids at the molecular level.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	2	2	2
CO 2	3	3	3	2	2	2
CO 3	3	3	3	3	2	2
CO 4	3	3	3	2	2	2
CO 5	3	3	3	2	2	2
Average	3	3	3	2.2	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER IV

PRACTICAL II CELL BIOLOGY & GENETICS

Total Hours: 60

Credits: 4

Course Code: ZB18/4C/PR2

L-T-P: 0-0-2

COURSE OBJECTIVES:

1. To develop practical skill for the enumeration of RBC & WBC, measure length & breadth of the cell using micrometre and to identify the different stages of mitosis.
2. To visualise the blood smear which throws light on the structure of neutrophils, lymphocytes, eosinophils, monocytes and basophils and to view the structure of polytene chromosomes.

COURSE OUTLINE:

1. Use of microscopes – stage and ocular micrometer and cell measurements
2. Counting of RBC using haemocytometer
3. Counting of WBC using haemocytometer
4. Blood smear preparation – Differential count of WBC
5. Study of mitotic division using onion root tip
6. Observation of epithelial cell of human buccal smear
7. Mounting of salivary glands of chironomid larva (giant chromosome).
8. STUDY OF PREPARED SLIDES OF DIFFERENT TISSUES
 - A. Hyaline cartilage
 - B. Squamous epithelium
 - C. Bone tissue
 - D. Cardiac muscle
 - E. Involuntary muscle
 - F. Voluntary muscle
9. MENDELIAN INHERITANCE
 - A. Monohybrid cross
 - B. Dihybrid cross
10. MENDELIAN TRAITS
 - A. Rolling/folding of tongue
 - B. Widow's peak
 - C. Crooked little finger
 - D. Mid digital hair
11. INTERACTION OF GENES
 - A. Incomplete dominance (straight hair & curly hair)
 - B. Codominance (Sickle cell anaemia)
 - C. Polygenic Inheritance (skin colour in man)

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Cell Biology: Practical manual	Dr.Renu Gupta, Dr. Seema Makhija ,Dr. Ravi and Toteja	Prestige Publishers	2018
2	A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology	M.M. Trigunayat	Scientific Publishers (India)	2019

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Cell and Molecular Biology: Concepts and Experiments	Gerald Karp	John Wiley & Sons	2007
2.	Cell Biology	Dr.C.B.Powar	Himalaya Publishing House	2010
3.	Benjamin Pierce	Genetics: A Conceptual	WH Freeman; 6th edition	2017
4.	Singh b	Genetics	Kalyani publishers	2016
5.	Strickberger	Genetics	Pearson	2015

WEB SOURCE

<https://www.ncbi.nlm.nih.gov/pubmed/21356826>

<https://www.healthline.com/health/wbc-count>

<https://www.healthline.com/health/white-blood-cell-count-and-differential>

<https://vlab.amrita.edu/?sub=3&brch=188&sim=1102&cnt=1>

<https://vlab.amrita.edu/?sub=3&brch=258&sim=1666&cnt=1>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO1	Relate the Importance of RBC, WBC, its normal range and its abnormalities.
CO2	Identify the different types of tissues namely hyaline cartilage, squamous epithelium, bone tissue, cardiac muscle, involuntary muscle and voluntary muscle.
CO3	Interpret the different mendilian traits and patters of inheritance with respect to humans.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	2	2	2
CO 2	2	2	2	2	2	2
CO 3	3	2	2	2	2	2
Average	2.6	2	2	2	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Demonstration, Enumeration and slide preparation

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	13+7= 20	60
K2 & K1	II.	6+4=10	
K2	III.	8	
K1	IV.	4X3= 12	
K1	V.	10	

SEMESTER IV

ALLIED BIOCHEMISTRY PRACTICAL (for Batch I students)

Total Hours: 60

Credits: 2

Course Code: ZB18/4A/ABC

L-T-P: 0-0-2

COURSE OBJECTIVES:

1. To determine few carbohydrates and amino acids qualitatively
2. To prepare starch from potato, casein from milk and gluten from wheat flour and to determine oxalate and glycine volumetrically in the sample.
3. To explain the principle and technique of chromatography by demonstration.

COURSE OUTLINE:

I. Qualitative analysis of carbohydrates - glucose, fructose, lactose, xylose and starch.

II. Qualitative analysis of amino acids – tryptophan, tyrosine, arginine and cysteine.

III. Preparation of starch from potato.

IV. Preparation of casein from milk.

V. Preparation of gluten wheat flour.

VI. Volumetric analysis

i. Estimation of oxalate.

ii. Estimation of glycine.

VIII. Chromatography- Demonstration

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Practical Manual of Biochemistry	S. P. Singh	CBS Publishers & Distributors	2013
2.	Biochemistry Practical Manual	Soundravally Rajendiran , Pooja Dhiman	Elsevier India	2019

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Manual of Practical Biochemistry	Anju Jain, Veena Singh Ghalaut	Arya Publishing Company	2018
2.	Lehninger Principles of Biochemistry	David L. Nelson	W H Freeman & Co	2012
3	Biochemistry	Jeremy M. Berg , Lubert Stryer , John Tymoczko, Gregory Gatto	WH Freeman;	2019
4	Fundamentals of Biochemistry S (2006)	Eric E. Conn, Paul K. Stumpf , George Bruening , Roy H. Doi	Chand;	2016
5	Biochemistry	Dr. Mrs. Padmaja H. Agarkar	Nirali Prakashan	2019

E-LEARNING SOURCES:

<https://vlab.amrita.edu/?sub=3&brch=63&sim=1094&cnt=1>

<http://www.biologydiscussion.com/enzymes/enzymes-meaning-mechanism-classification-factors-and-importance/17003>

<http://bio1511.biology.gatech.edu/module-3-molecules-membranes-and-metabolism/05-respiration-chemiosmosis-and-oxidative-phosphorylation/>

<https://www.britannica.com/science/vitamin>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To analyse the given carbohydrate Sample qualitatively.
CO 2	To analyse qualitatively the amino acid samples with neat procedures.
CO 3	To prepare starch,casein and gluten from potato,milk and wheat flour respectively.
CO 4	To evaluate oxalate and glycine volumetrically with neat procedure and principle.
CO 5	To explain the principle and protocol of chromatographic technique

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	2
CO 2	3	3	3	3	3	2
CO 3	3	3	3	3	3	2
CO 4	3	3	3	3	3	2
CO 5	2	2	2	2	2	2
Average	2.8	2.8	2.8	2.8	2.8	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Analysis, estimation and slide preparation.

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	25	60
K3	II.	25	
K1	III.	10	

COURSE PROFILE SEMESTER V

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/5C/APY	PAPER-V- Animal Physiology	4	5	3-1-0	75	40	60	100
ZB18/5C/DBY	Paper VI – Developmental Biology	4	4	3-1-0	60	40	60	100
ZB18/5C/EBY	Practical VII – Environmental Biology	4	4	3-1-0	60	40	60	100
ZB18/5C/BIO	Paper VIII Biotechnology	4	5	3-1-0	75	40	60	100
ZB18/5C/EZY	Paper IX – Economic Zoology	4	4	3-1-0	60	40	60	100
ZB18/3E/BIN	Elective I – Bio- Instrumentation	2	4	3-1-0	60	40	60	100
	TOTAL CREDITS	22						

SEMESTER V

PAPER – V ANIMAL PHYSIOLOGY

Total Hours: 75
Credits: 4

Course Code: ZB18/5C/APY
L-T-P: 3-1-0

COURSE OBJECTIVES:

1. To explain the complex aspects of Digestive, Circulatory, Respiratory and Excretory functions and their related diseases.
2. To state the physiological mechanisms in neuromuscular co-ordination and identify the related disorders.
3. To analyse the physiological aspects of vision and hearing

COURSE OUTLINE:

UNIT- I

(15 Hrs)

Definition and Scope of Animal Physiology. Nutrition- Types of nutrition –balanced diet- Biological function of vitamins -Digestion- Mechanical and Chemical changes of food in the alimentary canal- Digestive enzymes- Digestion of carbohydrates, Proteins and Lipids. Nutritional disorders – PEM, vitamin deficiencies, deficiency of iron, iodine and calcium. Gastro intestinal disorders- Ulcer, Gastritis, GERD

UNIT- II

(15 Hrs)

Circulation- Types of circulation – Types of heart – structure of human heart - – Cardiac cycle – ECG, Pacemaker, Blood pressure and pulse pressure- heart beat. Composition of blood and their functions – Blood clotting mechanism, Lymph and lymphatic system. Heart diseases - atherosclerosis, myocardial infarction, Rheumatic heart diseases, Stroke - Arterial block - angiogram, angioplasty

UNIT- III

(15 Hrs)

Respiration–Respiratory Quotient -.Respiratory pigments – structure of haemoglobin. Exchange and transport of gases –Transport of O₂- oxyhaemoglobin curve, Bohr effect- Transport of CO₂ -carbonic acid, carbaminohaemoglobin, bicarbonate and chloride shift. Respiratory disorders- Hypoxia, hypo and hypercapnia, asphyxia, carbon monoxide poisoning, bronchitis, asthma -physiological effects of smoking

UNIT- IV**(15 Hrs)**

Excretion – Types of excretory products- **Urea cycle** –Structure and functions of nephron , **Mechanism of urine formation** - composition of urine - **Renal disorders** – nephritis, haematuria, renal calculi, acidosis and alkalosis- dialysis and kidney transplantation. **Osmo regulation** –Osmoregulators and Osmoconformers - **Mechanism of osmoregulation in fresh water and marine fishes**

UNIT- V**(15 Hrs)**

Nervous system –Types and structure of neuron – Conduction of nerve impulse– Nervous disorders – **Epilepsy, Alzheimer’s disease, Parkinson’s disease.** Muscle physiology- Types of muscles – **Ultrastructure of skeletal muscle,** Properties of muscle-**Tetanus, Fatigue and Rigor mortis** - Physiological and Biochemical events in muscle contraction.**Sensory receptors-** **Structure of human eye and ear -physiology of vision and hearing**

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Text book of Animal Physiology	Verma P.S., Agarwal V.K. and Tyagi, B.S	S. Chand & Co	1995
2	Text Book of Human Physiology	Sarada Subrahmanyam., Madhavan Kutty ,K., & Singh H.D	S. Chand & Co, Reprint	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Human Physiology	Lauralee Sherwood	6th Edition. Thomson Brooks United States.	2007
2	Animal Physiology	Eckert, R. And D. Randell	Cbs Publishers And Distributors N. Delhi	1994
3	A Text Book of Animal Physiology	Nagabhushanan, R., Kaobarkar M.S. And Sarojini, R	Oxford Ibh Publishing Co., New Delhi	1998
4	Animal Physiology	Schmidt-Nielson K.	Prentice Hall India Ltd	2002
5	Text book of medical physiology	Guyton & Hall	W.B.Sauders company ,Newyork.	2001

JOURNALS:

International Journal of Animal Physiology and Animal nutrition-ISSN- 1439-0396.
Indian Journal of Animal Research-ISSN -0367-6722.

E-LEARNING SOURCES:

<http://www.reportsanddata.com/sample-enquiry-form/1251>
www.lung.ca/sites/default/files/respiratory%20system.com
<http://www2estellamountain.edu.com>
<http://opentextbc.ca/chapter/.Com>
<http://courses.lumenlearning.com>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Explain in detail about the digestive process and its associated health hazards.
CO 2	Outline the circulatory functions in various organisms and the disorders associated with it.
CO 3	Compile the physiological processes of respiration in various organisms and their respiratory health hazards.
CO 4	Compare the various excretory mechanisms in different animal groups and the diseases associated with it.
CO 5	Associate the functions of effector and their role in neurotransmission, muscular coordination and sensory perception in organisms.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	3	2
CO 2	2	2	3	3	3	2
CO 3	2	2	3	2	3	2
CO 4	2	2	3	3	2	3
CO 5	2	2	3	3	3	3
Average	2.2	2	3	2.8	2.8	2.4

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER V

PAPER – VI DEVELOPMENTAL BIOLOGY

Total Hours: 60

Credits: 4

Course Code: ZB18/5C/DB1

L-T-P: 3-1-0

COURSE OBJECTIVES:

1. To introduce the basic concept of developmental biology such as gametogenesis, organogenesis, teratogenesis and regeneration.
2. To outline the overall mechanism of fertilization and cleavage.
3. To explain the advanced technology in ART (Assisted reproductive technology)

COURSE OUTLINE:

UNIT – I

(12 Hrs)

Basic concepts of developmental biology – Theories- Gametogenesis - Types of sperm - structure of human sperm - Spermatogenesis - Types of eggs - Structure of mammalian egg- classification of eggs based on yolk content distribution - classification of eggs based on cleavage - Egg membranes- Oogenesis

UNIT – II

(12 Hrs)

Fertilization – mechanism and significance - theories of fertilization- parthenogenesis. Cleavage - Patterns of cleavage, Factors controlling cleavage- fate map- blastulation and gastrulation in frog and chick

UNIT – III

(12 Hrs)

Organogenesis – Development of brain, eye and ear in frog. Organizer concept – mechanism of induction- Teratogenesis- Regeneration

UNIT – IV

(12 Hrs)

Extra embryonic membranes in chick - Foetal membranes in mammals-Placentation in mammals – Types and Functions.

UNIT – V

(12 Hrs)

Human reproduction – Puberty- Menstrual cycle and Menopause - Pregnancy – Trimesters – Development- Parturition – Lactation- Twins – Types- Infertility – Causes- Test tube baby and ART

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Verma P.S and Agarwal V.K	Chordate Embryology	S Chand; Reprint of 1975 first edition edition	2010
2.	M.A. Subramanian	Developmental Biology	MPJ	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	B.I. Balinsky	An Introduction to Embryology	Cengage Learning India; 5 edition	2012
2.	A.K. Berry	An Introduction to Embryology	Emkay Publications; 2002 edition	2016
3.	Scott F. Gilbert	Developmental Biology	Sinauer Associates Inc.,U.S.; 8th Revised edition edition	2006
4.	Sadler	Langman's Medical Embryology	Wolters Kluwer India Pvt. Ltd.; Thirteenth edition	2016
5.	K.S.Madhavan	Developmental Biology	Arjun Publishing House; 1 edition2	2018

JOURNALS:

Indian journal of experimental biology (IJEb) - CSIR-NISCAIR
Journal of developmental biology - Elseiver

E-LEARNING SOURCES:

<https://teachmephysiology.com/reproductive-system/embryology/gametogenesis/>
<https://embryology.med.unsw.edu.au/embryology/index.php/2016Lecture-Gametogenesis-Fertilization-Movie>
<http://sitn.hms.harvard.edu/flash/2018/regeneration-axolotl-can-teach-us-regrowing-human-limbs/>
<http://www.yourarticlelibrary.com/biology/placentation-in-mammals-definition-development-and-types-biology/4987>
<https://www.mayoclinic.org/tests-procedures/in-vitro-fertilization/about/pac-20384716>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO1	Recite spermatogenesis and oogenesis.
CO2	Paraphrase the events that lead up the process of fertilisation.
CO3	Apply the concept of development in reproductive biology.
CO4	Predict the difference between extra embryonic membrane and placenta in various classes of animals
CO5	Resolve problems in infertility which plays a major role in current scenario.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	1	1	1
CO 2	3	2	2	1	1	1
CO 3	3	3	3	3	2	3
CO 4	3	2	2	2	1	2
CO 5	3	1	2	3	3	3
Average	3	2	2.2	2	1.6	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER V

PAPER – VII ENVIRONMENTAL BIOLOGY

Total Hours: 60
Credits: 4

Course Code: ZB18/5C/EBY
L-T-P: 3-1-0

COURSE OBJECTIVES:

1. To accredit the concept of Ecology and the role of biosphere
2. To outline the importance of environmental biotechnology and its application.
3. To educate the student about the conservation of natural resources and to develop appropriate and indigenous eco-friendly skills and techniques to various environmental issues.

COURSE OUTLINE:

UNIT - I :

(12 Hrs)

Scope – Concept – Branches in Ecology – Autoecology and Synecology- Micro and Macro environment- Types of media and substratum- their influence on animals.

Biosphere – Hydrosphere, Lithosphere, Stratosphere – Biocoenosis (Community) and Biogeocoenosis (Ecosystem). **Abiotic factors**- Water, soil, light and Temperature

Biotic factors – Animal relationships – Symbiosis, Commensalism, Mutualism, Antagonism, Predation, Parasitism and Competition

UNIT - II :

(12 Hrs)

Biogeochemical cycles – Nitrogen, Carbon and Oxygen – Sedimentary cycles (P and S) limiting factors- basic concepts -Leibig's law of minimum- Shelford's law of tolerance.

Ecosystem – Pond ecosystem – Primary and Secondary production – Food chain – Food Web- Trophic levels – Energy flow- Ecological pyramids- Pyramid of Biomass, Number and Energy. **Terrestrial Ecology** – Biomes- Characters- tundra, grassland, forest and desert biomes- Types of forests in India- Adaptations of animals inhabiting deserts

UNIT - III :

(12 Hrs)

Fresh Water Ecology – Physico chemical nature of fresh water – Biotic communities – lentic (lakes and ponds) and lotic(river) environment- Stratification of ponds and lakes.

Marine Ecology – Characteristics- salinity, temperature, pressure, zonation and stratification – Biotic communities of pelagic, benthic, intertidal (rocky shore, sandy shore and muddy shore) and sublittoral zones. **Estuarine Ecology** – Characteristics – Biotic communities and their adaptations. Importance of mangroves in coastal ecosystems- conservation and management

UNIT - IV :

(12 Hrs)

Population Ecology – Population – definition – characteristics- Natality, Mortality, Population density- Density dependent factors- Population fluctuations- Age pyramids- Population growth, estimation, equilibrium and regulation – J and S shaped curves, emigration, immigration and migration. **Community Ecology** – Types of communities – characteristics of community- Stratification- Ecotone- Edge effect- Ecological niche- ecological succession. **Pollution** – Types of pollution and pollutants – Air pollution and water pollution their biological effect and control

UNIT - V:

(12 Hrs)

Environmental Biotechnology -Biotechnological methods of Pollution detection- Pollution abatement – Bioremediation- Genetically engineered microbes in Bio-Treatment of waste water - Eco-Friendly Bioproducts for Environmental Health - Bio-Piracy. **Wildlife management** – Preservation of wild life – wild life laws enforced- sanctuaries and national parks.- significance, causes of extinction, concepts of threatened species - red data book- IUCN, WWF - protected areas, biosphere reserves

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Environmental Biology (Principles of Ecology)	Dr. P.S. Verma and Dr. V.K. Agarwal	S.Chand (Publisher) Edition.	2010
2.	Ecology, Micro Biology, Animal Behaviour, Pollution and Toxicology for B.Sc.,	Dr. Veera Bala Rastogi	(KNRN) Publishers	2016

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Ecology. II Edition.	Colinvaux, P. A.	Wiley, John And Sons, Inc.	1993
2.	Ecology. VI Edition	Krebs, C. J.	Benjamin Cummings	2001
3.	Ecology. V Edition.	Ricklefs, R.E.,	Chiron Press	2000
4	Ecology and Environmental science	S.V.S. Rao	PHI	2013
5	Ecology and Environmental	P.D. Sharma	Rastogi publishers	2011

JOURNALS:

E-LEARNING SOURCES:

- <https://www.amazon.in/Ecology-Book-Ideas-Simply-Explained/.../024135...>
- <https://video.nationalgeographic.com/video/environment>
- <https://www.epa.gov/students/environmental-videos-students-and-educators>
- https://www.google.com/search?q=environmental+issues+videos&rlz=1C1AOHY_enIN748IN748&tbm=isch&source
- https://en.wikipedia.org/wiki/Human_overpopulation

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Differentiate micro and macroenvironment, interaction of abiotic and biotic factor and animal relationship can be well understood.
CO 2	Procure knowledge about Biogeochemical cycle, food chain, food web and energy flow in the ecosystem.
CO 3	Enables the students to know about the stratification of pond, lakes and marine ecosystem. Importance of coral reef can be better understood.
CO 4	Grasp ideas on population ecology, community ecology and biological effects of pollution
CO 5	Inculcate biotechnological methods of pollution detection , role of GEM in waste water treatment , wildlife management laws and organization involved in wildlife conservation.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	3	2
CO 2	2	3	3	3	3	3
CO 3	3	2	3	3	2	3
CO 4	3	3	2	3	3	2
CO 5	2	3	3	3	3	3
Average	2.5	2.8	2.5	2.8	2.8	2.5

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1. K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER V

PAPER VIII- Biotechnology

Total Hours: 75
Credits: 5

Course Code: ZB18/5C/BIO
L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To develop students towards understanding basic concepts, history and practical applications of animal biotechnology in medicine and agriculture.
2. To describe the gene manipulation techniques using different vectors for gene cloning.
3. To explain the techniques of Hybridization, PCR and DNA-finger printing

COURSE OUTLINE:

UNIT- I (15 Hrs)

Biotechnology and Gene cloning – definition, scope, centers in Tamil Nadu and India. Recombinant DNA technology - steps involved in gene cloning – cloning vectors – plasmid (pBR 322, pBR 327), Cosmids, Phagemids, Phage vectors (lambda and M13) enzymes in gene cloning - gene isolation – automated gene synthesis, PCR

UNIT- II (15 Hrs)

Gene manipulation- gene transfer methods - selection and isolation of recombinants - direct and indirect methods. Expression of cloned genes in Prokaryotes. Construction of genomic libraries and screening methods

UNIT- III (15 Hrs)

Molecular markers – RAPD, SNPS, RFLP and DNA finger printing. Nucleic acid hybridization - blotting types and applications. FISH. DNA sequencing – Maxam & Gilbert, Sanger & Coulson method and automated DNA sequencing.

UNIT- IV (15 Hrs)

Applications of biotechnology in agriculture - Terminator gene technology, Bio pesticides (*Bacillus thuringiensis*). Biofertilizers – *Rhizobium* and *Azotobacter*. Single Cell Protein (SCP). Applications of Biotechnology in medicine and human health – gene therapy

UNIT- V (15 Hrs)

Current issues in biotechnology- GMO and Transgenic Animals. IPR - Patent, Copyright and Trade mark, TRIPS and GATT, Ethical issues related to Biotechnology

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Biotechnology	Kumaresan V	Saras Publications	2005
2.	Biotechnology	U Satyanarayana	Books & Allied (P) Ltd - Kolkata	2005

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Molecular Biotechnology Principles & applications of recombinant DNA, 5 th edition	Bernard R. Glick, Cheryl L. Patten	ASM Press	2017
2.	Modern Industrial Microbiology & Biotechnology 2 nd edition	Nduka Okafor, Benedict C. Okeke	CRC Press	2017
3.	Medical Biotechnology	Judit Pongranecz, Mary Keen	Elsevier Health – UK	2009
4.	Recombinant DNA Technology	Keya Chaudhuri	The Energy & Resources Institute, TERI	2013
5.	Environmental Biotechnology: Basic concepts & applications. 2 nd edition	Indu Shekahr Thakur	IK International Publishing House	2011

JOURNALS:

Review in Molecular Biotechnology
Indian Journal of Biotechnology

E-LEARNING SOURCES:

http://www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/Recombinant_dna.html

<https://www.mybiosource.com/learn/gene-transfer-technique/>

<https://www2.le.ac.uk/offices/press/for-journalists/code-of-a-killer-1/a-beginners-guide-to-dna-fingerprinting>

<https://www.tsijournals.com/articles/world-history-of-modern-biotechnology-and-its-applications.html>

<https://www.sciencedirect.com/science/article/pii/B9780128092316000053>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the history of biotechnology and their scope in agriculture, medical and environmental aspects.
CO 2	To select appropriate host and vector system for cloning and expression.
CO 3	To analyze gene expression using Blotting, PCR and Microarray.
CO 4	To apply Genetic Engineering principles for Biotechnological and Biomedical applications.
CO 5	To identify the basic issues of Biosafety, Bioethics and IPR

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	1	2	3	2	3
CO 2	3	3	2	1	1	1
CO 3	2	3	3	1	1	1
CO 4	2	2	3	3	2	2
CO 5	1	1	1	3	2	3
Average	2.2	2	2.2	2.2	1.6	2

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0**

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Semiar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER V

PAPER IX- ECONOMIC ZOOLOGY

Total Hours: 60
Credits: 4

Course Code: ZB18/5C/EZY
L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain the various aspects of applied zoology.
2. Illustrate aquaculture and methods of culture practices.
3. Expand the knowledge on modern poultry farm. List down the economic importance of mammals

COURSE OUTLINE:

UNIT- I

(12 Hrs)

Vermiculture – Selection of species for vermiculture – Vermicomposting- Organic resources for vermiculture - Vermicomposting methods - Pit Method , Heap Method and Windrow method -Harvesting of Compost - Factors affecting vermicomposting- Vermiwash - Advantages of vermicompost

UNIT- II

(12 Hrs)

Introduction to aquaculture -. Different culture practices - Extensive, semi intensive, intensive. Types of aquaculture – Culture of Indian major carps – Induced breeding technique – Fresh water and marine prawn culture – Pearl oyster and edible oyster culture – Seaweed culture. Fish processing and preservation – Principles of fish preservation – Methods of fish preservation

UNIT- III

(12 Hrs)

Ornamental fisheries – Freshwater ornamental fishes – Egg layers and live bearers - Setting up of an aquarium tank – Safety measures and devices for aquarium maintenance – Marine ornamental fishes - Prospects of ornamental fisheries – Export potential – Role of women in ornamental fish culture

UNIT- IV

(12 Hrs)

Economic importance of Fowl – Different breeds of fowl – Rearing methods – Management of modern poultry farm – Diseases affecting poultry - Prevention of poultry diseases

UNIT- V

(12 Hrs)

Economic importance of Mammals – Dairy, Sheep, economically important breeds for wool and meat. Piggery farming – economic importance and scope-indirect and direct value

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Economic Zoology	Shukla, G.S and V.B. Upadhyay	Rastogi Publications	2010
2.	Elements of Economic Entomology, 7 th edition.	Vasantharaj David, B.	Namrutha publications	2012.

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Introduction To Economic Zoology 1st edition	S. Sarkar, G Kundu, K K Chaki	New Central Book Agency (NCBA);	2016
2.	Economic Zoology, 1st edition	S Chaudhuri	New Central Book Agency (NCBA);	2017
3	Applied Zoology	Banerjee	New Central Book Agency;	2016
4	A Textbook Of Applied Zoology	B.S. Tomar,	Emkay Publications	2007
5	A Text Book of Fish Biology & Fisheries	S S Khanna H R Singh	Narendra Publishing House;	2014

JOURNALS:

International Journal of Pure and Applied Zoology
The Journal of Basic and Applied Zoology

E-LEARNING SOURCES:

<https://www.bioscience.com.pk/topics/zoology/item/628-economic-zoology>
<https://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process>
<http://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/culture-techniques-of-fishes/breeding-larval-rearing-and-growth-out-of-indian-major-carp>
http://www.fao.org/fishery/culturedspecies/Labeo_rohita/en
http://agritech.tnau.ac.in/animal_husbandry/ani_chik_poultry%20rearing.html
<https://www.roysfarm.com/poultry-farming/>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the scopes and importance of Economic Zoology.
CO 2	To prepare the flow chart for the vermiculture.
CO 3	To explain the culture and maintenance of major carp, prawn, oyster and seaweed.
CO 4	To explain the importance of dairy and dairy products with their nutritional significance.
CO 5	To apply entrepreneur skill on animal husbandry.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	2	2
CO 2	3	3	3	3	2	2
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	2
CO 5	3	3	3	3	2	2
Average	3	3	3	3	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER V

ELECTIVE I- BIO INSTRUMENTATION

Total Hours: 60

Credits: 2

Course Code: ZB18/5E/BIN

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain the techniques of microscopy and sterilization of lab wares.
2. To illustrate chromatographic and electrophoretic separation of molecules
3. To define the current trends in cryotechniques, radioisotopes, biosensors and to analyse the sequencing of nucleotides

COURSE OUTLINE:

UNIT – I (14 Hrs)

Units of measurements – metric system, conversion of units, microscopy – principles, types (simple, light, phase contrast,) autoclave – principle, applications and types - centrifuge – principles, types (clinical, ultra centrifuges)

UNIT – II (14Hrs)

pH - Sorenson's pH scale, pH meter-principle and applications- manometry - Warburg manometer – principle and working - chromatography – principles, types (paper, TLC, column) and applications; electrophoresis-principle, types-paper and gel (AGE & PAGE), applications

UNIT – III (12 Hrs)

Cryotechniques- cryopreservation of cells, tissues, organs and organisms, cryotomy; radio isotopic technique – radio immuno assay- applications of radio isotopes

UNIT – IV (10 Hrs)

Biosensors- principle, types (enzyme, bacterial electrodes, environmental bio sensors & bio reporters), applications

UNIT – V (10 Hrs)

DNA and RNA sequencing methods - PCR – principle and application - DNA micro array and application.

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Bioinstrumentation	Veerakumari, L.	MJP Publishers, Chennai	2015
2.	Biophysics and Bioinstrumentation	N. Arumugam and V. Kumaresan	Saras Publication	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Manometric And Biochemical Techniques, 5th Ed.	W.W. Unbriet, Z.H. Burri And Stamffier J.F.	Burges Pub. Co. Minneapolis	1972
2.	Bioinstrumentation and Biosensors	Donald L. Wise	CRC Press	1991
3.	Biophysics: An Introduction	R.M.J Cottenill	John Wiley & Sons Ltd., England	2002
4.	Biophysics (Principles and Techniques)	M.A. Subramanian	Mjp Publishers, Chennai	2005
5.	Bioinstrumentation	M.H. Fulekar & Bhawana Pandey	I K International Publishing House Pvt. Ltd	2013

JOURNALS:

International Journal of Instrumentation Technology
Journal of Instrument Society of India

E-LEARNING SOURCES:

<https://www.biologymad.com/cells/microscopy>
<https://en.m.wikipedia.org/wiki/chromatography>
<https://www.ncbi.nlm.nih.gov/radioisotopes>
<https://en.m.wikipedia.org/wiki/cryopreservation>
<https://www.elprows.com/biosensors>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Explain the principle, working mechanism & uses of microscopes and sterilization instruments.
CO 2	Use technical knowledge of and practical experience with analyses in chromatography and electrophoresis
CO 3	Outline the methods and uses of cryopreservation of live cells.
CO 4	Apply the most common sensor principles used today and critically evaluate the applications of biosensors.
CO 5	Analyse the features on nucleic acid sequences and interpret the results of the analysis.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	1	3	3	3	1
CO 2	2	1	3	2	3	1
CO 3	2	1	3	3	3	2
CO 4	2	1	3	2	3	2
CO 5	2	2	3	3	2	1
Average	2	1.2	3	2.6	2.8	1.4

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		compulsory Section B/C- must be have 2 theory and 3problems

COURSE PROFILE- SEMESTER VI

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WK	L-T-P	TOTAL HOURS	MARKS		
						CA	SE	TOTAL
ZB18/6C/IMY	PAPER-X – Immunology	4	5	3-1-0	75	40	60	100
ZB18/6C/EVO	PAPER-XI – Evolution	4	5	3-1-0	75	40	60	100
ZB18/6C/MIC	PAPER-XII – Microbiology	4	5	3-1-0	75	40	60	100
ZB18/6E/MLT	ELECTIVE-II- Medical Laboratory Techniques	2	5	5-1-0	75	40	60	100
ZB18/6E/ENT	ELECTIVE-III- Entomology	2	5	3-1-0	75	40	60	100
ZB18/6C/PR3	PRACTICAL III- Developmental Biology, Environmental Biology, Evolution, Medical Laboratory Techniques and Bio-Instrumentation.	4	2	0-0-4	60	40	60	100
ZB18/6C/PR4	PRACTICAL IV- Animal Physiology, Microbiology, Immunology Biotechnology and Economic Zoology.	4	2	0-0-2	60	40	60	100
	Total	24						

SEMESTER VI

Paper X -Immunology

Total Hours: 75
Credits: 4

Course Code: ZB18/6C/IMY
L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain cells, tissues and effector molecules involved in defence mechanisms and to understand types of immunity.
2. To relate the interactions of antigens, antibodies, complement and other immune components and to classify the different types of vaccines in disease control and know the principles and applications of immunotechniques
3. To interpret concepts of transplantation and tumour immunology and to explain the types of hypersensitivity and autoimmune disorders

COURSE OUTLINE:

UNIT – I

(15 Hrs)

Definition and concepts – types of innate immunity- acquired immunity - components of immune system – organs involved in immune system – cells involved in immune response

UNIT – II

(20 Hrs)

Antigens – antigen response- hapten, adjuvant, frossman antigen. Immunoglobulins – types, structure, characteristics- interaction between Ag and Ab – cell mediated immunity- humoral immunity. Brief introduction to complementary system

UNIT –III

(15 Hrs)

Chemokines- chemicals involved in immune response – Interleukin, Interferon, TNF. Transplantation immunology – MHC – HLA – tissue typing and match, graft management

UNIT – IV

(15 Hrs)

Hyper sensitivity –types and treatment. Auto immune disorders . Tumour immunology .Immunotherapy

UNIT- V

(10 Hrs)

Vaccines – types, immunization schedule for children. Monoclonal antibodies. ELISA. Immuno electrophoresis – rocket 86mmune electrophoresis, RIA

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Immunology	Kannan. I	MJP Publishers	2008
2.	Text Book of Immunology	Haleem Khan, C. Rajendra Sagar and A. Sadgune	Ane Books Pvt. Ltd	2011

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Immunology	Kindt. T.J., Goldsby, R.A., Osborne, B.A., Kuby, J. VI Edition.	W.H. Freeman and company.	2006
2.	Roitt's Essential Immunology XI Edition.	Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M.)	Blackwell Publishing	2006
3.	Immunology	Hannigan, Moore & Quinn	Scion Publishing Ltd., UK	2010
4.	Immunology	David Male, Jonathan Brostoff, David B Roth and Ivan M Roit	Elsevier Health, UK	2012
5.	Immunology	Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby	W.H. Freeman & Co Ltd	2002

JOURNALS:

International Journal of Immunology
Indian Journal of Allergy, Asthma and Immunology

E-LEARNING SOURCES:

<https://www.haelio.com/components>
<https://www.ncbi.nlm.nih.gov>
<https://www.sciencedirect.com/tissuetyping>
<https://www.healthline.com/health>
<https://www.emedicinehealth.com/in>
<https://www.prospecbio.com/monoclonal>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Student identifies the role of cells and organs involved in immune response and also compares and contrasts innate and acquired immunity.
CO 2	Student identifies the role of antigens, antibodies, complement components and the interactions of Ag-ab complexes, along with the understanding of CMI response and humoral immune response.
CO 3	Student outlines the processes involved in tumor and transplantation immunology and MHC.
CO 4	Analyse the reasons involved in various hypersensitivity reactions and , autoimmune disorders and the concepts that would help them to improve their immune system.
CO 5	Student will be able to plan the vaccination protocol in adults and children and will be able to select the appropriate application in investigation viz., Hybridoma technology, ELISA, immunoelectrophoresis, and Radio immune assay.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	2	3
CO 2	3	3	3	3	2	3
CO 3	3	2	3	3	2	3
CO 4	3	2	2	3	3	3
CO 5	3	2	3	3	3	3
Average	3	2.2	2.4	3	2.4	3

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3 problems

SEMESTER VI

PAPER-XI –Evolution

Total Hours: 75 hrs

Credits: 4

Course Code: ZB18/6C/EVO

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To explain the evidences of the past era life of fauna to future generation and to explore the different time line in evolutionary process.
2. To procure knowledge on fossilization and palaeontology.
3. To analyse the evolutionary trends of vertebrate classes.
- 4.

COURSE OUTLINE:

UNIT – I

(15-Hrs)

Historical aspects of evolutionary concepts - Origin of life- chemical and biological evolution - Urey & Miller Experiment. Evidences in favour of evolution – comparative - morphology and anatomy – embryology – physiology and Biochemistry

UNIT – II

(15-Hrs)

Palaentological evidence – fossilization – dating of fossils. Geological time scale. Fossils in India - Zoogeographical realms. Micro and macro evolution. Evolutionary trends. Orthogenesis and ortho selection

UNIT – III

(15 Hrs)

Theories of Evolution - Lamarckism, Neo - Lamarckism, Darwinism, Neo - Darwinism, mutation theory - Modern synthetic theory – genetic basis of evolution

UNIT – IV

(15 Hrs)

Modes of evolution- Speciation- Types- Isolating mechanisms – Geographic and reproductive isolation – adaptive radiation- convergent and Parallel evolution- Mimicry and colouration – living fossil – Insular fauna

UNIT – V

(15 Hrs)

Evolution of vertebrate groups- fishes, amphibians, reptiles, birds and mammals. Evolution of Horse and Man - Biological & Cultural evolution.

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Principles of Organic Evolution	Dr. Gopala Krishnan, Dr. Itta Sambasivaiah and Dr. Kamalakar Rao	Himalaya Publishing House	1984
2.	Organic Evolution (Evolutionary Biology)	Veer Bala Rastogi	Medtech; 13 edition	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Organic Evolution	B.L. Chaudhary	Scientific Publishers India	2018
2.	Text Book Of Organic evolution	Arora M P	Himalaya Pub. House	2013
3.	Introduction to Evolutionary Biology	Mandal	Oxford & IBH Pub. Co	2005
4.	Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time	Edwin H. Colbert, Michael Morales and Eli C. Minkoff	Wiley; Fifth edition	2011
5.	Vertebrates: Comparative Anatomy, Function, Evolution	Kenneth Kardong	McGraw Hill Education; 4 edition	2005

JOURNALS:

Journal of the Palaeontological Society of India
Frontiers in Ecology and Evolution

E-LEARNING SOURCES:

<https://courses.lumenlearning.com/wmopen-biology1/chapter/outcome-evidence-for-evolution/>
<http://sciencenetlinks.com/student-teacher-sheets/lamarck-and-darwin-summary-theories/>
https://www.blackwellpublishing.com/ridley/a-z/Isolating_mechanisms.asp
<https://www.ck12.org/biology/vertebrate-evolution/lesson/Vertebrate-Evolution-BIO/>
<https://study.com/academy/lesson/fossil-definition-types-characteristics-examples.html>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO1	Relate the morphology, physiology, biochemistry and embryology evidences of evolution
CO2	Explain the evolutionary theories by Lamark, Darwin and other evolutionist.
CO3	Describe the various parameters of evolution such as isolation mechanism, speciation, convergent & parallel evolution and adaptative radiation
CO4	Cite the strategies of vertebrate evolution.
CO5	State the overall concept of fossils and its formation.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	1	2	1	1	1
CO 2	3	1	2	1	1	1
CO 3	3	2	2	2	2	1
CO 4	3	3	1	2	1	1
CO 5	3	2	3	2	1	1
Average	3	1.8	2	1.6	1.2	1

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER VI

Paper XII - Microbiology

Total Hours: 75 hrs

Credits: 4

Course Code: ZB18/6C/MIC

L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To provide information on the history and scope, classification, of microbes and To emphasize the importance of integrating new knowledge on Microorganisms.
2. The recent advances in the field of microbiology and its importance with reference to bacteria, virus structure and functions, the role of microbes as beneficial and as pathogens is also studied.
3. To understand the applied aspects of microbiology in soil ,water, air, industrial products and dairy industries

COURSE OUTLINE:

UNIT-I

(15 Hrs)

History and scope of Microbiology. Contributions of Anton Von Leuwenhoek, Edward Jenner, Robert Koch, Louis Pasteur. R.H. Whittaker 5 kingdom classification. Brief classification of Viruses Bacteria, Fungi and Protozoa. Sterilization-Physical Methods - Heat, Filtration, Chemical Methods - Alcohols, Phenols, Radiation - UV and Gamma Rays

UNIT-II

(15 Hrs)

Structure of Bacteria – Shape and size, Cell wall (Gram Positive and Gram Negative), Cell membrane, Flagellum, Pilus, Endospores and Inclusion bodies. Culture techniques – Media and its types, Pure Culture – Pour Plate, Spread Plate and Streak Plate techniques. Staining-Gram and Acid fast. Methods of preservation of cultures

UNIT-III

(15 Hrs)

Virus – Salient features -Structure and Life cycle of T₄ Bacteriophage. Life cycle, Pathogenesis, Diagnosis, Prevention and Treatment of AIDS and Hepatitis, General Characteristics of Poliomyelitis, Measles, Mumps, Rubella and their medical relevance.(Vaccination) - Fungi – *Candida*, and Protozoan *Entamoeba*

UNIT-IV

(15 Hrs)

Soil Microbiology - Microbes in Soil - Bacteria, Fungi, Actinomycetes, Algae and Viruses, Rhizosphere. Nitrogen Cycle, Carbon Cycle. Biofertilizers – *Rhizobium*. Water Microbiology- Sources of Water, Potable Water, Municipal Purification of Water. Air Microbiology - Composition of Air, Microbes in Air

UNIT-V

(15 Hrs)

Application of Microbes in Industrial Products -Ethanol,Wine, Beer,Vinegar preparation. Dairy products - Cheese, Curd, Bread and Butter. Preservation of food – Physical and chemical methods

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Microbiology	Mani. A., Selvaraj A. M. Narayanan L.M & Arumugam N	Saras Publication – Nagerkoil – India.	1996
2	Microbiology	Sharma P.D.	Rastogi & Company, Meerut	1995

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Microbiology 5 th edn.	Pelczar M.J., Chan E.C.S. and Kreig N.R	McGraw- Hill, New York	2010
2.	Microbiology 6 th edn.	Prescott L.M, Harley J.P and Klein D.A.	McGraw- Hill Publications	2005
3.	Microbiology 2 nd edn,	R.C.Dubey , D.K.Maheshwari	S.Chand and Company ltd. New Delhi.	2010
4	GeneralMicrobiology Vol I and II	Powar, C.B. and Daginawala,	Himalaya Publishing house, Bombay	1991.
5	Microbiolog – J.B.	Volk Wesley and Wheeler,	Lippincott and Co. Philadelphia, USA.	1980.

JOURNALS:

https://en.wikipedia.org/wiki/Journal_of_Bacteriology

<https://www.journals.elsevier.com/journal-of-microbiology-immunology-and-infection>

<https://www.microbiologyresearch.org/content/journal/micro>

E-LEARNING SOURCES:

[https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_\(Boundless\)/1%3A_Introduction_to_Microbiology/1.2%3A_Microbes_and_the_World/1.2B%3A_Classification_of_Microorganisms](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/1%3A_Introduction_to_Microbiology/1.2%3A_Microbes_and_the_World/1.2B%3A_Classification_of_Microorganisms)

<http://textbookofbacteriology.net/structure.html>

<https://www.sciencedaily.com/terms/virus.htm>

<https://www.cliffsnotes.com/study-guides/biology/microbiology/industrial-microbiology/microbial-products>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Explain & outline the microbial classification with examples.
CO 2	Describe structure of bacteria and methods of culturing & preservation in laboratory.
CO 3	Explain the importance of bacteria and virus with reference to clinical importance to humans.
CO 4	Evaluate the role of microbes in soil, water.
CO 5	Analyze the different industrial products using microbes and its products.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	2	3	3	2	3
CO 4	2	3	3	3	2	3
CO 5	3	3	3	3	3	2
Average	2.8	2.8	3	3	2.6	2.8

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER VI

ELECTIVE II- MEDICAL LABORATORY TECHNIQUES

Total Hours: 75 hrs

Credits: 2

Course Code: ZB18/6E/MLT

L-T-P: 5 1 0

COURSE OBJECTIVES:

1. To explain the basic sterilization techniques, maintenance of glassware's and prepare the students in basic understanding of diseases and their pathogenesis.
2. To prepare the students towards understanding Hematology and their relevant testing methods for allergy, diabetes and life style disorders.
3. To use the practical approaches that is used in the laboratory for the analysis of Urine, Stool and pregnancy tests.

COURSE OUTLINE:

UNIT – I (15 Hrs)

Introduction and scope–records and preparation of reports – cleaning, maintenance and care of glassware- sterilization – physical and chemical method –disposal of specimens and infected materials – safety precautions and first aid treatment for superficial wounds, burns, chemical poisoning, handling pathogens, microbes, microbiological and electric shock.

UNIT – II (15 Hrs)

Haematology – collection of blood sample – smear preparation –blood cells – enumeration of RBC and WBC- packed cell volume – erythrocyte sedimentation rate – MCV – MCH – MCHC – platelet count – bleeding time – clotting time- prothrombin time – haemoglobin estimation – blood pressure- Liver function tests – enzymes SGOT, SGPT, liver pigments

UNIT – III (15Hrs)

Urine – collection – physical and chemical parameters routinely analyzed –pregnancy test –analysis of stool

UNIT – IV (15 Hrs)

Analysis of semen and cerebrospinal fluid. Pathology – tests for viral diseases – poliomyelitis, hepatitis, HIV –tests for bacterial diseases – tuberculosis and cholera – tests for protozoans – amoebic dysentery, malaria - tests for helminthes – filariasis

UNIT – V (15 Hrs)

Tests for life style disease - cardiac disorders – diabetes I & II –obesity –allergy –tests for auto immune disease – SLE, MG, RA, autoimmune hepatitis

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Medical Laboratory Technology – A Procedure Manual for Routine Diagnostic Tests, Vol. I	Mukherjee K.L.	Jaypee Brothers, New Delhi	2003
2.	Hand book of clinical laboratory techniques	P.S Ajmani	AITBS	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Introduction to Medical Laboratory Technology.	Baker F.J. and Silvertan R.E.	Hodder Arnold Publication.	1998
2.	Basic clinical laboratory techniques – 6 th edition	Barbara H. Estridge Anna P. Reynolds	Cengage Learning	2011
3.	Manual of Medical Laboratory Techniques	S. Ramakrishnan K.N Sulochana	Jaypee Brothers Medical Publishers	2012
4.	Henry's Clinical Diagnosis and Management by Laboratory methods	McPherson & Pincus	Elsevier	2016
5.	Concise Book of Medical Laboratory Technology. Methods & Interpretations. 2 nd edition	Ramnik Sood	JJaypee Brothers Medical Publishers	2015

JOURNALS

Journal of clinical laboratory analysis – Wiley online library
National Journal of Laboratory medicine

E-LEARNING SOURCES:

<https://www.westlab.com/blog/2018/02/05/different-sterilization-methods-used-in-the-laboratory>

<https://www.healthline.com/health/urinalysis>

<https://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/tests-and-procedures/stool-test/?region=on>

<https://www.healthline.com/health/pregnancy/tests>

<https://www.healthline.com/health/pregnancy/tests>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Explain safe laboratory practices and sterilization techniques.
CO 2	To list the appropriate diagnostic methods for evaluation of common hematologic disorders
CO 3	Analyze analytical studies in Urine and Stool testing methods.
CO 4	Identify testing methods adopted for viral, bacterial and protozoan diseases.
CO 5	State special investigative procedures relating to lifestyle diseases

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	1	3	3	1	3
CO 2	1	1	3	3	1	1
CO 3	2	1	1	3	1	1
CO 4	2	2	3	3	2	2
CO 5	2	1	3	3	2	1
Average	1.8	1.2	2.6	3	1.4	1.6

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER VI

ELECTIVE III ENTOMOLOGY

Total Hours: 75 hrs
Credits: 2

Course Code: ZB18/6E/ENT
L-T-P: 3 1 0

COURSE OBJECTIVES:

1. To identify the various pests and affected plants.
2. To substitute prescribed dosage of pesticides and management of pest population
3. To classify Insecta and study various organs systems and mouth parts with reference to common insects

COURSE OUTLINE:

UNIT- I

(15-Hrs)

General Characters of Class Insecta. Classification- Study of the following Insect Orders with salient features and suitable examples: Thysanura, Orthoptera, Odonata, Hymenoptera, Lepidoptera and Coleoptera. Insect Biology- External Characters, Digestive System, Respiratory System, Nervous System and Reproductive System. Insect Mouth Parts: Biting and Chewing, Piercing and Sucking, Sponging and Siphoning. Methods of insect Collections and Preservation

UNIT- II

(15 Hrs)

Beneficial insects and their culture - Apiculture - Species of honey bee - Methods of Bee keeping - Bee products -uses- diseases and enemies of honey bee. Sericulture- different types of silkworm- Types of silk- rearing methods - silk extraction and reeling- diseases of silkworm – lac insect- economic importance of lac.

UNIT-III

(15 Hrs)

Human Insect Pest- Insect vectors- Binomics, Diseases caused and Control Measures with reference to Housefly, Mosquito, Rat Fleas and Bed Bug. House hold insect pests- Ants, Termites, Silver fish and cockroaches

UNIT-IV

(15 Hrs)

Definition of Pest – Insect pests - Reasons for Insect attaining the Pest status – Pest of rice- rice stem borer, rice gall midge, rice hopper, rice bug. Pest of cotton – hopper, boll worms, cotton aphids. Pest of coconut – rhinoceros beetle, weevil, caterpillar. Pest of sugarcane – shoot borer, stem borer, top borer, control measures

UNIT- V

(15 Hrs)

Factors affecting Insect life - Effect of Light, Temperature, Humidity and Food – Pest Control Methods - Physical, Mechanical, Chemical and Biological methods of control. Recent trends in pest control, Transgenic control of insects. Integrated pest management

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Elements of Economic Entomology,	Vasantharaj David, B.	Namrutha publications.	2012
2.	General and Applied Entomology.	Nayar, K.K., T.N. Ananthakrishnan and B.V.David.	Tata McGraw Hill Publishing Co., Ltd., New Delhi	1992.

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Entomology Hard cover	Shagufta	Aph Publishing Corporation	2012
2.	Textbook of Applied Entomology Volume 2	K. P. Srivastava & G. S. Dhaliwal	Kalyani Publishers;	2013
3	A Text Book of Fundamental and Applied Entomology Hardcover	Tanweer Alam, M.S. Ali, S.V.S. Raju & M. Raghuraman	Kalyani Publishers	2015
4	Applied Entomology 3rd Edition,	D.S. Reddy	science technology	2018
5	Elements of Economic Entomology 8th Edition (Elements of Economic Entomology) 8th Edition edition	DAVID B. VASANTHARAJ ET.AL	Brillion Publishing;	2016

JOURNALS:

Journal of Entomology and Zoology Studies
International Journal of Entomology Research

E-LEARNING SOURCES:

<https://www.bioscience.com.pk/topics/zoology/item/628-economic-zoology>
<https://study.com/academy/lesson/class-insecta-characteristics-orders.html>
<https://texasinsects.tamu.edu/insect-orders/>
<https://extension.psu.edu/beekeeping-honey-bees>
<https://www.farmingindia.in/beekeeping-in-india-honey-bee-farm/>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the biology of insects.
CO 2	Design the methods of bee keeping and silkworm rearing
CO 3	Discuss the disease causing insect with diagrams.
CO 4	To explain the various insect pests and their control measures.
CO 5	To explain various factors affecting insect life and their control measures.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	2	2
CO 2	2	2	3	3	2	2
CO 3	2	2	2	3	2	2
CO 4	2	3	3	3	2	2
CO 5	2	3	3	3	2	2
Average	2.2	2.4	2.8	3	2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20		Question
K1, K 2	B-5/8x8 marks	200	40	100	No.- is
K2, K 3	C-2/3x20 marks	500	40		Compulsory Section B/C- must be have 2 theory and 3problems

SEMESTER VI

Practical III- Developmental biology, Environmental biology, Evolution, Medical laboratory techniques and Bioinstrumentation

Total Hours: 60 hrs
Credits: 4

Course Code: ZB18/6C/PR3
L-T-P: 0 0 4

COURSE OBJECTIVES:

1. To identify the cleavage and developmental stages of frog and chicken.
2. To interpret the importance of environmental biology and its applications were employed to assess various parameters to strengthen their practice knowledge and to relate the evolutionary significance of animal groups.
3. To learn practical approaches in urine sugar and haemoglobin analyse and to gain technical experience in basic laboratory instruments

COURSE OUTLINE:

DEVELOPMENTAL BIOLOGY

Study of the following prepared slides

1. Study of cleavage stages in frog
 - a. 2 cell stage
 - b. 4 cell stage
 - c. 8 cell stage
 - d. Blastula of frog
 - e. Gastrula of frog
2. Study of different stages of chick embryo.
 - a. 24 hrs chick embryo
 - b. 48 hrs chick embryo
 - c. 72 hrs chick embryo
 - d. 96 hrs chick embryo
- 3 a. Placenta of sheep
 - b. Placenta of human

ENVIRONMENTAL BIOLOGY

Estimation of carbonates and bicarbonates in tap and sea water.

Estimation of Carbondioxide in tap and sea water

Estimation of pH in tap and sea water.

Adaptation of rocky shore animals.

Adaptation of sandy shore animals

Usage of
maximum and minimum thermometer

- b. Hygrometer
- c. Sacchi's disc
- d. pH meter
- e. Rain gauge

EVOLUTION

1. Morphological evidences

- a. Forelimb of Amphibian
- b. Forelimb of Reptile
- c. Forelimb of Birds

2. Mimicry and colouration

- a. Stick insect
- b. leaf insect

3. Adaptation pattern

- a. Echenies
- b. Draco
- c. Chameleon
- d. Bat

4. Fossils

- a. Limulus
- b. Peripatus (connecting link)
- c. Archaeopteryx (connecting link)

MEDICAL LABORATORY TECHNIQUES

1. Estimation of haemoglobin

2. Estimation of urine sugar

STUDY OF

- a. Blood pressure apparatus
- b. Centrifuge
- c. Hot air oven

BIO INSTRUMENTATION

- 1. Horizontal gel electrophoresis
- 2. Deep freezer
- 3. Autoclave

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	A Practical Guide to Developmental Biology	A. Gibbs	Ane/Oxford Exclusive	2006
2.	Water analysis	W. Fresenius, K.E. Quentin & W. Schneider	Springer	2011
3	Protective Coloration and Mimicry	A Roger Caras	Westover Pub. Co	2016

E-LEARNING SOURCES:

amp/s/pharmawiki.in/autoclave-sterilization-principle-working-pdf

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Identify different embryonic cell stages of frog and chick embryo.
CO 2	Grasp knowledge about the importance and the range of carbonates, bicarbonates, carbondioxide and pH in the water sample provided for the survival of aquatic animals, the necessity of a hygrometer, sacchi's disc, pH meter and rain guage can be well understood. Especially field trip was the part of the curriculum; this will pave way to know about the adaption of rocky shore and sandy shore animals.
CO 3	Understand the role of mimicry, colouration, adaptation pattern towards evolution; morphological and fossil evidences of evolution.
CO 4	Competency to perform analytical studies in urine sample and human haemoglobin.
CO 5	Handle the biological instruments in the laboratory provided.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	1	2	2	1
CO 2	3	1	3	2	2	3
CO 3	3	3	2	2	2	2
CO 4	3	1	3	3	2	2
CO 5	3	1	2	2	3	2
Average	3	1.8	2.2	2.2	2.2	2

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	20	60
K3	II.	6	
K2	III.	3x4=12	
K2	IV.	4x3=12	
K1	V.	10	

SEMESTER VI

PRACTICAL IV: ANIMAL PHYSIOLOGY, MICROBIOLOGY, IMMUNOLOGY, BIOTECHNOLOGY AND ECONOMIC ZOOLOGY

Total Hours: 60 HRS
Credits: 4

Course Code: ZB18/6C/PR4
L-T-P: 0 0 2

COURSE OBJECTIVES:

1. To assess and analyse the respiratory quotient , the enzyme function and the nitrogenous waste in animals.
2. To identify bacteria using staining techniques and to isolate bacteria using streak and spread plate methods.
3. To distinguish the lymphoid cells and organs and to understand the immunology of ABO blood grouping and the principles of immuno- electrophoresis.
4. To appraise the principles, working and applications of PCR, Blotting techniques, chromatography, centrifuge, spectrometer and calorimeter.
5. To list the different breeds of fowl and understand the life cycle of economically important insects.

COURSE OUTLINE:

I ANIMAL PHYSIOLOGY

1. Estimation of Oxygen consumption in a fish with reference to body weight.
2. Detection of nitrogenous waste products in fish tank water, frog tank water, bird excreta and mammalian kidney
3. Survey of Digestive enzymes in cockroach
4. Use of Kymograph unit, Respirometer.

II MICROBIOLOGY:

1. Media preparation- broth, agar, slants , plating
2. Spotters; *Staphylococcus aureus*, *E.coli*, *Rhizopus*, *Aspergillus flavus*, *A.niger*, *Penicillium*, *Candida albicans*
3. Instruments- autoclave, inoculation chamber
4. Staining: simple and differential staining- Gram staining

5. Antibiotic sensitivity test – classification and collection of antibiotics, based on origin, mode of action and application
6. Isolation of bacteria by pure culture- streak plate – pour plate method
7. Examination of milk- methyl blue- reduction test

III IMMUNOLOGY:

1. ABO Blood Grouping
2. Lymphoid organs – Prepared slides- Thymus, Bone marrow , Lymph node and Spleen
3. Immuno-electrophoresis-Demonstration

IV BIOTECHNOLOGY:

1. Demonstration of PCR techniques
2. Blotting techniques [a] Southern blot (b) Northern blot (c) Western blot
3. Paper chromatography (Demonstration)
4. Instrumentation- components and application of instruments-Centrifuge- Electrophoresis –colorimeter- spectrophotometer
5. Visit to industries , laboratory- report to be submitted

V ECONOMIC ZOOLOGY:

1. Mounting of sting apparatus of honey bee
2. Study of life cycle of hemimetabolus, holometabolus and ametabolus insects
3. Study of parasitic and predatory insects
4. Identification of breeds of fowls-Rhode Island, White Leghorn
5. Identification of members of bee colony
6. Identification of silkworm types

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Advanced Practical zoology	Dr.P.S.Verma & Dr.P.C.Srivastava-	S.Chand Publishing Company Pvt.Ltd.	2012
2.	Animal Physiology practical manual	C.Sylvia Lewis	Casuarina,N.T	2014
3.	Roitt's Essential Immunology XI Edition	. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M.).	Blackwell Publishing	2006.
4.	Practical Biotechnology	P.Ramadass & A.Wilson Aruni	Jaypee Publishing	2007
5.	A Text book of Practical Microbiology	Dr.R.C.Dubey& Dr.D.K.Maheshwari	S.Chand Publishing Company	2010
6.	Introduction To Economic Zoology 1st Edition	Sarkar, G Kundu, K K Chaki	New Central Book Agency (Ncba);	2016.

E-LEARNING SOURCES:

<https://www.microbiologyresearch.org/content/journal/micro>

<https://www.healthline.com/health>

<http://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/culture-techniques-of-fishes/breeding-larval-rearing-and-growth-out-of-indian-major-carp>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Students will be able to perform,analyse and report on experiments & observations in physiology.
CO 2	Students identify and isolate bacterial cultures..
CO 3	To compare the cells and organs in lymphoid systems,and outline the procedure involved in ABO blood grouping .
CO 4	Demonstrate the principles, working and applications of PCR,Blotting techniques,chromatography,centrifuge ,spectrometer and calorimeter .
CO 5	Will be able to utilize the knowledge in fowl breeding and in entomology.

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	3	3	2	2
CO 2	3	2	3	3	2	2
CO 3	3	2	3	3	2	3
CO 4	3	2	3	3	2	3
CO 5	3	2	3	3	2	3
Average	2.8	2	3	3	2	2.6

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN-UG*

Bloom's Category	Section	Marks	Total
K3	I.	20	60
K3	II.	12	
K2	III.	6	
K1	IV.	3X4=12	
K1	V.	10	

RECOMMENDED TEXT BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Vermitechnology	M Seethalekshmy R Santhi	Saras Publication;	2012
2	Vermitechnology	A. Mary Violet Christy	MJP Publisher	2014

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Vermicomposting for Sustainable	P.K.Gupta	Agriculture Agrobics (India)	2004
2	Vermiculture and Organic Farming Hardcover	Sathe Tukaram Vithatran	Daya Publishing House	2004
3	Earthworms for Solid Waste Management Hardcover	M. Satyendra	International Book Distributing Co	2008
4	Hand Book Of Biofertilizers & Vermiculture	Eiri Board	Engineers India Research Institute	2009
5	the worm farmers handbook	Rhonda sherman	Chelsea green publishing company	2018

JOURNALS:

International Journal of Environment and Waste Management
Journal of Experimental Zoology

E-LEARNING SOURCES:

<http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-3610/Lecture-10-BINM-Vermicompost.pdf>

<https://www.earthwormsoc.org.uk/earthworm-ecology>

<https://en.wikipedia.org/wiki/Vermicompost>

http://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html

<https://www.calrecycle.ca.gov/organics/worms/wormfact>

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	To explain the scopes and importance of vermiculture.
CO 2	To discuss the different methods of the vermiculture
CO 3	To explain the applications of vermicomposting in agriculture and horticulture practices. Apply entrepreneur skill on vermiculture

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	3	3	2	1
CO 2	3	2	3	3	1	1
CO 3	3	3	3	3	1	1
Average	2.7	2.3	3	3	1.3	1

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2
WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, e-content, assignment, Quiz and Seminar

QUESTION PAPER PATTERN**QUESTION PAPER PATTERN**

Knowledge Level	Section	Word Limit	Marks	Total
K 1, K2	A-10/12 X 5 marks	350	50	50

SEMESTER III – SELF STUDY PAPER

INDUSTRIAL MICROBIOLOGY

CREDITS - 2

COURSE OBJECTIVES

1. To understand the scope and contributions in the field of industrial microbiology.
2. To appreciate the microbes involved in industry and their commercial products.
3. To enhance the knowledge on the GMOs and gain an insight into the safety measures in handling the industrial microbes.

COURSE OUTLINE:

UNIT I

An introduction to industrial microbiology – Definition, Scope, History & major contributions in the field of industrial microbiology.

UNIT II

List of Important microbes used in various industrial purposes, culturing of industrial microorganisms – types and techniques.

UNIT III

Metabolites – Define, primary and secondary metabolites and their utilization by industrial processes.

UNIT IV

Development of Industrial microorganisms, production of enzymes by fermentation, Industrial alcohol, antibiotics, industrial biotransformation and steroid production.

UNIT V

Role of industrial microbes as food, bioplastics, gmos - its application and hazards. Hygiene and safety in industrial usage of microbes.

REFERENCE BOOKS

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Industrial Microbiology: Fundamentals And Applications	A.K. Agrawal	Agrobios (India)	2006
2	INDUSTRIAL MICROBIOLOGY: AN INTRODUCTION	Waites M J	Publisher: Blackwell	2002

3	INDUSTRIAL MICROBIOLOGY	PRESCOTT AND DUNNS	REED Publisher: CBS; 4th edition	2004
4	Cruegers Biotechnology: A Textbook of Industrial Microbiology	Wulf Crueger	Publisher: Medtech	2017

COURSE OUTCOMES:

Students will be able to

CO No.	CO Statement
CO 1	Outline the contribution in the field of industrial microbiology.
CO 2	Elaborate on the various culture techniques of industrial microbes.
CO 3	Appreciate the commercial utilization of primary and secondary metabolites.
CO 4	Apply the techniques involved in the production of microbial products.
CO 5	Utilize the microbes in the production of bioplastics, food and beverages

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3
Average	3	3	3	3	3	3