A.D.M.COLLEGE FOR WOMEN (AUTONOMOUS),
NAGAPATTINAM
(Nationally Re-accredited with "A" grade by NAAC-3rd Cycle)

PG & RESEARCH DEPARTMENT OF ZOOLOGY
(for the candidates admitted from the academic year 2021-2022 onwards)

M.Sc ZOOLOGY
SYLLABUS
Batch 2021- 23

A.D.M COLLEGE FOR WOMEN (AUTONOMOUS),
Nagapattinam

PG Programme - M.Sc Zoology

(For the candidates admitted from 2021 – 2022 onwards)

Bloom's Taxonomy Based Assessment Pattern

Knowledge Level

K1 – Acquire/Remember	**K2** – Understanding	**K3** – Apply	**K4** – Analyze	**K5** – Evaluate	**K6** – Create

1. Part I, II and III

Theory (External + Internal = 75 + 25 = 100 marks)

External/Internal					
Knowledge Level	**Section**	**Marks**	**Hrs.**	**Total**	**Passing Mark**
K1-K3	A (Answer all)	10 ×2 = 20	3	75	38
K3-K6	B (Either or pattern)	5 × 5 = 25			
K3-K6	C (Answer 3 out of 5)	3 × 10 = 30			

PG AND RESEARCH DEPARTMENT OF ZOOLOGY
(for the candidates admitted from the academic year 2021-2022)
M.Sc., ZOOLOGY

Programme Educational Objectives (PEO)

PEO 1:	The candidate undertaking this course will gain knowledge about the structure, function, advanced technique, hands on training and acquire sill
PEO 2:	To gain significant knowledge in various branch of zoology course
PEO 3:	To acquire research skill, plan & execute experimental technique independently as well as to analyze and interpret data
PEO 4:	To facilitate students for taking up and shaping a successful career in Zoology and its related subject.
PEO 5:	To gain experience investigating life science problems and to solve them

Programme Outcomes (POs) UG

On completion of the course the learner will be able to

PO 1:	To impart basic knowledge of various branches of Zoology and to understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance
PO 2:	To appreciate the complexities of biological organization and address scientifically controversial issues in a rational way.
PO 3:	To assess the scope of animal biology and select particular areas for further study
PO 4:	To inculcate transformational impact on the quality of education and to inspire the students to adopt scientific temper and live with scientific values.
PO 5:	To make the students aware of applications of Zoology and to highlight the potential of various branches to become an entrepreneur

Programme Specific Outcomes (PSO)

On completion of the course the learner will be able to

PSO 1:	Understand the nature and basic concepts of cell biology, Biochemistry, Taxonomy and ecology and analyze the relationships among animals , plants and microbes.(scientific knowledge).
PSO 2:	Perform procedures as per laboratory standards in the area of Biochemistry, Biostatistics, Taxonomy, Economic zoology and Ecology and understand the applications of biological sciences in Aquaculture, Pisciculture, Agriculture and Medicine.(Professional skill).
PSO 3:	The ability to learn about the scientific methods and how it facilitates the discovery of new knowledge in biology. This includes how to critically evaluate hypotheses and conclusions in science using verifiable data and how to clearly and effectively communicate the major concepts and hypotheses in biology in an appropriate style of presentation.(Design/development of Solutions).
PSO 4:	To acquire basic knowledge and skills in the observation and study of nature , biological techniques, experimental skills and scientific investigation and certain applied branches to enable them for self employment.(Problem-Solving Skills).
PSO 5:	To train academically sound future researchers and intellectual s in the area of general biology with emphasis in areas on the cutting edge of modern biology , e.g., Molecular biology, Biochemistry, Physiology, Genetics, Cytology and Environmental conservation.. (Successful Career and Entrepreneurship).

PG AND RESEARCH DEPARTMENT OF ZOOLOGY
COURSE STRUCTURE OF THE PG PROGRAMME-

M.Sc.,ZOOLOGY

Papers	No	Credit	Marks
Core Course	14	66	1400
Elective Course	5	20	500
Project	1	4	100
Total	**20**	**90**	**2000**

Marks /Papers	C.I.A	S.E
Theory Papers	25	75
Practical Papers	40	60

Passing Minimum

A candidate shall be declared to have passed in each course if she secures not less than 40% marks in the end semester examination and 40% marks in the continuous internal assessment and not less than 50% in the aggregate, taking continuous internal assessment and end semester examination marks together

M.Sc., Zoology- Course Structure under CBCS (90 Credits)

(applicable to the candidates admitted from the academic year **2021-2022** onwards)

Semester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Extn.	
I	Core Course – I (CC)	Animal Phylogeny and Biodiversity	6	5	3	25	75	100
	Core Course – II (CC)	Cell and Molecular Biology	6	5	3	25	75	100
	Core Course – III (CC)	Genetics	6	5	3	25	75	100
	Core Course – IV (CC)	Microbiology& Immunology	6	5	3	25	75	100
	Core Course – V (CC)	Practical I (CC I,II,III & IV)	6	4	3	40	60	100
		Total	30	24				500
II	Core Course – VI (CC)	Developmental Biology	6	5	3	25	75	100
	Core Course – VII (CC)	Biochemistry, Biophysics & Bio techniques	6	5	3	25	75	100
	Core Course – VIII (CC)	Applied Biotechnology	6	5	3	25	75	100
	Core Course – IX (CC)	Practical II (CC VI,VII & VIII)	6	4	3	40	60	100
	Elective – I	Fishery Biology and Fish Processing Technology/ Histology and Histochemistry	6	4	3	25	75	100
		Total	30	23				600
III	Core Course – X (CC)	Animal Physiology	6	5	3	25	75	100
	Core Course – XI (CC)	Research Methodology	6	5	3	25	75	100
	Core Course – XII (CC)	Practical III (CC X & XI)	6	4	3	40	60	100
	Elective - II	Bioinformatics and Computer Applications in Biology / Endocrinology	6	4	3	25	75	100
	Elective – III	Environmental Toxicology/ Wild life Biology	6	4	3	25	75	100
		Total	30	22				500
IV	Core Course – XIII (CC)	Environmental Biology& Evolution	6	5	3	25	75	100
	Core Course – XIV	Practical IV (CC XIII)	4	4	3	40	60	100
	Project Work	Dissertation	8	4	-	-	-	100
	Elective – IV	Economic Entomology/ Nutrition and clinical Biochemistry	6	4	3	25	75	100
	Elective-V	Coastal Aquaculture/ Comparative Animal physiology	6	4	3	25	75	100
		Total	30	21	-	-	-	500
		Grand Total	120	90	-	-	-	2000

PG & Research Department of Zoology

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The Department of Zoology will offer the following Major Elective Courses

1. Fishery Biology and Fish Processing Technology
2. Coastal Aquaculture
3. Bioinformatics
4. Economic Entomology
5. Research Methodology

Note:

Core Courses include Theory, Practical's& Project

No. of Courses	14
Credit per Course	4 - 5
Total Credits	70

Elective Courses

No. of Courses	5
Credit per Course	4
Total Credits	20

	Internal	External
Theory	25	75
Practical's	40	60

Project

Dissertation	80 Marks	[2 reviews – 20+20	=	40 marks
		Report Valuation	=	40 marks]
Viva	20 Marks			20 marks

Passing Minimum in a Subject

CIA	40%	Aggregate 50%
SE	40%	

Semester-I / Core Course-I	Animal Phylogeny and Biodiversity	Course Code: PGZA
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To give a thorough understanding in the origin of life in Invertebrate animals. • To acquire an in-depth knowledge on the paleontology in animal world. • To develop an holistic appreciation on the phylogeny, relationships and adaptations in animals • To understand theories of primate characteristic features, classification and affinities. • Learn the animal diversity which is an essential topic for biologists to know the distribution, and phylogeny of animal	
UNIT	**CONTENT**	**HOURS**
I	Phylogeny of Invertebrates: Biogenetic Law – Gastrea Theory – Origin of Matazova – Theories for the Origin of Metazova: Syncytial, colonial and Polyphyletic theory – Origin of Bilateria: Trochophore theory, syncytial, Planuloid theory, Ctenophore theory – Origin and Phylogeny of Annelida: Corn or Fission theory, Cyclomerism theory, Enterocoel theory, Gonocoel theory, Schozocoel theory, Trochophore Theory – Origin of Arthropoda – Onychophora – Trilobita – Eurypterida – Xiphosura.	**18**
II	Phylogeny of Invertebrates: Origin of Mollusca – Phylogeny of Mollusca : Neopilina , Nautiloids, Ammonoids and Belemnites. – Origin of Echinodermata: Coelenterate ancestry, Annelidan ancestry, Laphophorate ancestry, Hemichordate ancestry,	**18s**

	Dipleurula theory, and Pentactula theory. Phylogeny of Echinodermata. Echinoderm fossils.	
III	Phylogeny of Vertebrates: Origin of chordates – Theories of origin of Chordates. Ostracoderm: characteristic features, classification and affinities. Origin of vertebrates – Theories for the origin of vertebrates . Placoderms: characteristic features, classification and affinities. Holocephali : characteristic features, classification and affinities. Dipnoi: Affinities. Origin of Fishes: Origin of paired appendages, Apoda. Origin of Amphibia: Characteristics and affinities of Rhynchocephalia.	**18**
IV	Phylogeny of Vertebrates: Origin of Reptilia : connecting link between amphibian and reptilian, Evolution of reptilian, Golden Age of reptiles, Ratitae. Origin of Birds: Fossil bird- Archaeopteryx, Origin of flight in birds. Prototheria and Metatheria: characteristic features, classification and affinities. Origin of primates – adaptive radiation of lemuroids, Tarsius – new world monkeys, old world monkeys and apes, Australopithecus.	**18**
V	Biodiversity: definition – types – genetic, species and ecosystem diversity. Values and uses of biodiversity. Biodiversity measurements, Mega diversity centres. Loss of biodiversity. Conservation of biodiversity : in situ (afforestation, social forestry, agro forestry, Biosphere reserves, national parks and sanctuaries), ex situ (Cryopreservation, gene banks, sperm banks, DNA banks, tissue culture and biotechnological strategies). Biodiversity laws of India. Wild life protection Acts.	**18**
VI	Study biodiversity on different coastal type	

Text Book:

1. Barnes, R.D. (2006), Invertebrate Zoology, Cengage Publications.
2. Barrington, E.J.W. (2012), Invertebrate Structure and Functions, East west press Pvt (L)New Delhi.
3. Moore, R.C., Lolicker And Fischer, A.G. (2006), Invertebrate Paleontology, McGraw Hill Book Co., Inc., N.Y.
4. Simpson, G.G.1987, Principles of Animal Taxonomy, Oxford IBH Publishing Co., Pvt., New Delhi.
5. Devasahayan J.K., and N. Inbamani, 1887, Animal Phylogeny, R.V. Publications, Virudhunagar.
6. Agrawal K.C. 1996 Biodiversity, Agro Botanical Publishers, New Delhi
7. Waterman, A.J. (1971), Chordate Structure and Function, The Macmillan Company.

Reference Books:

1. Gupta, Rajiv.K, (2011), Advancements in Invertebrate Taxonomy and Biodiversity.
2. Highnam, K.C. and Hill, L. (1979), The Comparitive Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London.
3. Hyman, G.H., The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., N.Y
4. Jan, A.Pechenik,(2014), Biology of the Invertebrates. McGraw – Hill Publications.
5. Kotpal, R.L.,(2015), Minor Phyla, Rastogi Publication, Meerut.
6. Vasantika Kashyap (1997), Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.
7. Alessandro Minelli,(2009), Perspectives in Animal Phylogeny and Evolution, Oxford University Press.
8. Colbert, H. Edwin (2011), Evolution of the Vertebrates, Wiley Eastern Limited, New Delhi.

Web Resources:

1. https://opentextbc.ca/biology2eopenstax/chapter/animal-phylogeny/
2. https://www.annualreviews.org/doi/abs/10.1146/annurev-ecolsys-120213-091627

https://www.ibe.upf-csic.es/animal-biodiversity-and-evolution

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand and study of the Origin and phylogeny of Invertebrates and Chordates
CO 2:	Understand the primitive forms of invertebrates and vertebrates distribution
CO 3:	Understand the status and mode of living of different forms of animals.
CO 4:	Learn the animal phylogeny and its evolution
CO 5:	Students understand the biodiversity of Invertebrates and Chordates

Mapping of Cos with Pos & PSOs

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlated
M – Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Course-II	Cell and Molecular Biology	Course Code: PGZB
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand the cell structure in molecular level. • To provide the basic idea about cell cycle and regulation • To know the structure and importance of genetic material • To study the RNA synthesis in prokaryotes and eukaryotes • To understand the prokaryotes and eukaryotes gene expression and regulation	
UNIT	**CONTENT**	**HOURS**
I	**Cell membrane:** Molecular rganization- molecular models – cell permeability – cell surface differentiations and cell – cell communication – secretion and endocytic pathways. **Structure and functions of cells:** Cell organelles – Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes and Lysosomes.Peroxisome.structure & function of cytoskeleton and its role in motility. Methods of cell study : Micrometry – cell culture methods – cell fractionation technique – cytochemical staining methods – cytophotometry – immunochemistry and autoradiography .	**18**
II	**Nucleus:** Nucleoplasm and cytoplasmic relationship-Hammeling's experiment, isolation techniques; ultrastructure of nuclear envelop and nucleoplasm. **Chromosomes:**–Biochemistry – Organization of chromatin; Chromosomal types – polytene and lamp brush chromosome.**Cell**	**18**

	division: Cell cycle and mitosis- significance of mitosis; meiosis and reproductive cycle- regulation andsignificance of meiosis.cell cycle-(steps – regulation and control).	
III	**Nucleic acid:** DNA and DNA types, their topology and functions **DNA replication:** Types of replication- conservative, dispersive and semiconservative methods; Process of replication – Origin, replication fork, regulation in prokaryotes and eukaryotes; Role of enzymes and other protein factors in DNA synthesis. **DNA damage:** Sources and types of DNA damage; Nuclear versus mitochondrial DNA damage; Senescence and apoptosis; DNA damage and mutations. **DNA repairing mechanism:** Excision repair, SOS repair and mismatch repair.	**18**
IV	**RNA synthesis:** Process of transcription- preinitiation, initiation, promoter clearance, elongation and termination; role of enzymes and other protein factors; Measuring and detecting transcription; reverse transcription; synthesis of mRNA in prokaryotes and eukaryotes; synthesis of rRNA; synthesis of tRNA; RNA processing- capping and polyadenylation.RNA editing, Splicing.	**18**
V	**Genetic code:** Process of translation – initiation, elongation and termination and post translational process; role of enzymes and proteins in protein synthesis – Genetic code. **Gene regulation:** Lac operon- Structure, genetic nomenclature, lactose analogs, regulation in cyclic AMP and uses in molecular biology; Trp operon- repression and attenuation. **Protein transport:** Intracellular compartments and protein sorting; vesicular traffic in secretory and endocytic pathway, transport from ER through Golgi to lysosome and endosome. Control of gene expression at transcription level regulation of phages, virus. Prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.	**18**

VI	**Quantification of Nucleic acid in different biological sample**	

Text Book:

1. **Dipak** Ajoy Paul, (2011), Text Book of Cell and Molecular Biology, Books & Allied (P) Ltd., KolKata
2. **Kumar Kan, Soma Halder,** (2009), Cell biology, Genetics , Molecular Biology, New Central Book Agency , NewDelhi.
3. **Shukla** R.M.(2005)A Text Book of cell Biology , Dominant Phblishers and Distributers,
   New Delhi-110002.

Reference Books:

1. Bruce Alberts,(2017).Molecular Biology of the Cell,Garland Science Publishing Inc,New York.
2. DeRobertis, E.D.P. , F.A., Saez, and E.M.R. De Robertis Jr. 1975. Cell biology. W.B. Saunders Company, Philadelphia.
3. Du Praw, E.J. 1968. Cell and Molecular Biology. Academic Press New York.
4. Geoffrey, M.Cooper Robert E.Hausman(2013), The Cell, Publisher Sinauer Associates Inc
5. Gerald Karp,(2013). Cell Biology, Publisher Wiley.
6. Giese, A.C. 1962. Cell Physiology. W.B. Saunders Company, Philadelphia.
7. Freifelder D 1996. Molecular Biology, 2nd edition, Narosa Publishing house
8. Lewin, B. 2000. Genes VII Oxford university press.
9. Stryer, L. 1995. Biochemistry. W.H. Freeman and company.
10. Voet, D and Voet, J. 1995. Biochemistry, 2nd edition. John Wiley and Sons Inc.

Web Resources:

1. https://web.uri.edu/cmb/cell-and-molecular-biology/#:~:text=CMB%20is%20the%20study%20of,define%20their%20structure%20and%20function.
2. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology
3. https://www.nature.com/subjects/molecular-biology

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the cell structure in molecular level.
CO 2:	Understand basic idea of cell cycle and regulation to apply in research.
CO 3:	Job offers: Research Scientist in Cancer Research center, Adayar
CO 4:	Research Scientist in Tata Memorial Centre for Advanved Treatment in Cancer, Parel Mumbai
CO 5:	Technical officer in Centre for cellular and Molecular Biology(CCMB), TIFR at Hyderabad

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	M	S	M	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	M	S	S

S – Strongly Correlated
M – Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Course-III	Genetics	Course Code: PGZC

Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To give an in-depth understanding on the principles and mechanisms of inheritance • To help study the fine structure and molecular aspects of genetic material • To provide an opportunity to learn the importance of inheritance in Ma • To provide an understanding on the process and theories in evolutionary biology • To expose students to the basics and advances in Evolution	
UNIT	**CONTENT**	**HOURS**
I	Principles of Mendelian inheritance; Interaction of genes; Multiple alleles; Polygenic inheritance; Linkage and crossing over; Gene mapping in drosophila; Somatic crossing over in Drosophila. Sex determination in animals; Sex-linked inheritance in man and Drosophila	**18**
II	Eukaryotes –Fine structure of gene – Cistron, muton, recon, exon, intron, Mechanism of homologous recombination. Role of recombinase and chromosome mapping. Operon concept, regulatory mechanism in eukaryotes, attenuation and antitermination – Environmental regulation of gene expression Genes in populations – allelic and gene frequencies – implications of Hardy-Weinberg principle – Factors affecting	**18**

	Hardy-Weinberg equilibrium.	
III	Gene mutations – Chromosomal and point mutations, spontaneous and inducible mutations, reversible and suppressor mutations. Mutagens – Physical, chemical and biological. Teratogens and induced birth defects. Nuclear transplantation – Cell fusion : homokaryons and heterokaryons – Cytoplasts and karyoplasts Extra-chromosomal inheritance with reference to mitochondrial DNA, plastids,kappa particles, plasmids, episomes and chloroplasts.	**18**
IV	Inborn errors of metabolism: disorders of amino acid metabolism – PKU, alkaptonuria and albinism; disorders of purine metabolism – Lesh-Nhyan syndrome and ADA deficiency; disorders of carbohydrate metabolism – galactosemia and G_6PD deficiency; disorders of lipid metabolism – Tay Sach's diease and Gaucher's disease.Haemoglobin disorders – Sickle cell anemia and thalassemiaHuman Karyotype preparation and chromosomal syndromes in man – Down, Turner andKleinfelter syndromes	**18**
V	Genetic engineeringin Plant & Animal**,**Genetic counseling – Hereditary disorders :Aim- Purpose- Genetic Prognosis – Family history Preventive measures – High lights of genetic counseling. Pedigree analysis – Inbreeding and Outbreeding – significance, merits and demerits of inbreeding outbreeding.	**18**
VI	Study of mendelian inheritance in the society	

Text Book:

1. **S.Verma** and **V.K.Agrawal**, Genetics(2000),S.Chand and company Ltd.,
2. **N. Arumugam**, genetics and Evolution, Saras publication
3. **R.P. Meyyan**, genetics and Evolution, Saras publication
4. Girish Chopra, R.C. Gupta, Evolution & Genetics – R. Chand & Co 1998.
5. **R.M. Shukla** , Molecular genetics- Dominant Publishers & Distributors,2001.

Reference Books:

1. **Altenburg**, E. 1970. Genetics. Oxford and IBH Publishing Company, New Delhi.
2. **Burns, G.W.** 1969. The Science of Genetics. The Mac Millan Co. New York.
3. Eldon John Garden et al.,(2006) Principles of Genetics, Published by Pearson Education India
4. **Gardener, E.J.** 1972. Principles of Genetics. John Wiley & Sons. Inc. New York.
5. **Levine, R. P**. 1968. Genetics. Holt, Rinehart and Winston Inc. New York.
6. **Lewin, B.** 1986. Genes. Wiley Eastern Ltd. New Delhi.
7. **Rothwell,** N. V. 1978. Human Genetics. Printice Hall of India.
8. **Sinnott, E.W. L.C. Dunn** and **T. Dobzhansky**. 1959. Principles of Genetics. Tata McGraw Hill, New Delhi.
9. William.S, Klug et al.,(2016) Genetics, Published by Pearson Education India
10. **Winchester, A.M**. 1967. Genetics, Oxford and IBH Pub. Co., New Delhi.

Web Resources:

https://www.pdfdrive.com/principles-of-genetics-d185210607.html

https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Student will test and deepen their mastery of genetics by applying this knowledge in a variety of problem solving situations
CO 2:	Student learn the basic principles if inheritance at molecular level
CO 3:	Job offer: Technician in Karyotyping in Medical Research Centre
CO 4:	Research scientist in ICMR institutes
CO 5:	Research Assistant in Institute of Forest Genetics and Tree Breeding, Coimbatore

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-I / Core Course- IV	Microbiology and Immunology	Course Code: PGZD
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To provide an over view of the microbial world, its structure and function • To give students an intensive and in-depth learning in culture techniques • To familiarize the learner with the applied aspects of microbiology • To know the immunity and immune system of human • To study the immunodeficiency diseases and its diagnostic techniques	
UNIT	**CONTENT**	**HOURS**
I	History and Scope of microbiology - Outline classification of microorganisms – Bacteria, fungi, algae, and virus. Bacterial growth and nutrition requirements, Culture techniques - media preparation -types of culture media , isolation and Identification methods. Peservation of pure culture, Aerobic and anaerobic culture techniques.	**18**
II	Microbes in food - Role of microbes in food production; Dairy and non-dairy products -fermented foods and alcoholic beverages. Microbes of milk, food contamination , poisoning and spoilage – sources, symptoms and prevention of food borne infections – Bacterial and fungal toxins – methods of detection and detoxification – food sanitation in food manufacture. Microbes in fermentation – production of ethanol, lactic acid, vinegar, vitamins, microbial enzymes, fuels andPharmaceuticals(antibiotics	**18**

	vaccines).	
III	Causative agents, modes of transmission, symptoms, diagnosis and control of the following diseases in Man : Bacterial Disease : Pneumonia, Diphtheria, Rheumatic fever, Whooping cough, Tuberculosis, Meningitis, Botulism, Typhoid, Cholera, Gonorrhea, Plague and leprosy. Viral diseases – Influenza, Measles, Mumps, Chicken pox, hepatitis, Poliomyelitis, Rabies, Japanese encephalitis, Yellow fever and HIV infection (AIDS).	**18**
IV	Immunity – Humoral and cell mediated immunity. Lymphoid organs in Man – primary lymphoid organs, secondary lymphoid organs; Cells of the immune systems ; Haemopoiesis – Antigens, Haptens, Epitopes and Paratopes; Immunoglobulins – structure and classes of immunoglobulins; Complement - Classic pathway – Alternate pathway – Biological functions of complement – complement fixation tests; Hypersensitivity.	**18**
V	Immunodeficiency diseases – primary and secondary immunodeficiency – AIDS – Life cycle – Transmission of HIV – Symptoms – Diagnosis, treatment for AIDS ; Immunization - Active and passive immunization – Monoclonal& Polyclonal antibodies; Immunological techniques – precipitation – VDRL test – Immunodiffusion – Immunoelectrophoresis – Agglutination – Blood typing – Widal test – Coomb's test – passive agglutionation – Immunofluorescence – ELISA – HLA typing -RIA .	**18**
VI	Observation of microbial diseases in aquatic organism	

Text Book:

1. **PELCZER, M.J.,REID, R.D**. and **CHAN, E.C.S**. (1996), Microbiology, V Ed., Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. **ANANTHANARAYANAN, T** and **JAYARAM PANIKER, C.K**. (2000), Text Book of Microbiology, VI Ed., Orient Longman Ltd., Madras.

3. **Ananthanarayanan, T** and **Jayaram paniker, C.K**.and Arti Kapil (2013), Text Book of Microbiology, 9th Edi.Publi: University press(India) Pvt. Ltd., ISBN-13:978-8173718892.

Reference Books:

1. **Michael,J. Pelzer, J.R,ECS. Chan**,(2001) Microbiology. McGraw Hill Publishing Company Ltd., New Delhi.
2. **Purohit, S.S,**(2006)Microbiology, Fundamentals and Applications (Agro botanical Publications)
3. **Patel, A.H.(2015),** Industrial Microbiology. Laxmi Publications New Delhi.
4. **Ross, F.C**., Introductory Microbiology (Bell and Howell Company, London)
5. **Dubey, R.C**.(2013) Microbiology, S.chand Co., New Delhi.
6. **Anil K.Sharma . (2019) Immunology: An IntroductoryTextbook. 1st Edition. Jenny Stanford Publishing. ISBN: 9789814774512**
7. **David P**. Stites, Abba I. Terr, Basic & Clinical immunology 8th edition, a Lange medical book publishers
8. **Ivan Roitt**,2011. Essential immunology. 8th edition Wiley-Blackwell science Ltd.
9. MARK Peakman and **Diego vergani**(2009) Basic and clinical immunology.**Publisher Churchill Livingstone.**
10. **Nasora,** 2006. Immunology. 2nd edition Narosa publishing house Ltd.

Web Resources:

https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html
https://www.pdfdrive.com/molecular-cell-biology-molecular-cell-biology-d7302545.html
https://www.pdfdrive.com/cell-biology-d33458612.html
https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand an overview of the microbial world, its structure and function
CO 2:	Students have intensive and in-depth learning in culture techniques and familiarize the learner with the applied aspects of microbiology
CO 3:	Student will be able to identify the cellular and molecular basis of immune responsiveness
CO 4:	Learners understand immunology is the branch of biomedical science that deal with immune system in both health and diseases
CO 5:	Job offer: Epidemiologist, Pathology Assistant, Teacher, Veterinarian Associate, Medical and clinical Laboratory Technologists.

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	S	S	S	S	S	S	S	M	S

S- Strongly Correlated

M-Moderately Correlated

W-Weakly Correlated

N-No Correlation

Semester-I / Core Course-V	Practical I (CC I,II,III and IV)	Course Code: PGZEY

Instruction Hours: 6	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks- 60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To familiar with identification of invertebrates and chordates animals • Understand the mounting technique. • To get hands on training in culturing of animals. • Understand the alternate digital dissection by vedio clippings • To know the mendelian characters and its significance.	
UNIT	**CONTENT**	**HOURS**
I	**A. INVERTEBRATES and CHORDATS** **1. Taxonomy** **TAXONOMY OF INVERTEBRATES** **1. Taxonomy**. **Phylum: Protozoa** Euglena, Amoeba , Plasmodium **Phylum:Porifera** Sycon, .Spongilla **Phylum:Coelentrata** Physalia, Aurelia, Sea anemone **Phylum:Platyhelminthes** Planaria, Fasciola, Taenia **Phylum:Aschelminthes** Ascais **Phylum:Annelida** Nereis, Earthworm, Leech **Phylum:Arthropoda** Penaeus, Scolopendra, Scorpion, Peripatus **Phylum:Mollusca** Chiton, Dentalium, Aplysia, Mytilus, Sepia **Phylum:Echinodermata**	**18**

	Antedon, Cucumaria, Echinus **TAXONOMY OF CHORDATES** **SUB PHYLUM: PROTOCHORDATA** Amphioxus, Balanoglossus, Ascidian, Petromyzon **Pisces:** Shark , Echenein, Ophiocepalus, Anguilla, Exocoetus, Syngnathus , **Amphibia:** Ichthyophis, Salamandra, Bufo, Chelone, Sphenodon, Naja, Crocodylus, **Aves :** Parrot , Owl, Sparrow **Mammals:** Bat, Rabbit, Rattus	
II	**2. Mounting** Nereis – Parapodium Lepas – Mouthparts Prawn - Appendages Sea urchin – Pedicellaria , Aristotle's lantern Teleost – Scales Honeybee – Sting **3. Spotters** Invertebrate larval forms. Invertebrate fossils – Ammonoids, Belemnoids, Nautiloids and Echinoclem fossils. Minor Phyla – Chaetognatha, Rotifera, Phoronida and Sipunculida. **4. Dissections** Video clipping of dissection of shark, frog, calotes and r can be shown to the students. A student can make use of material available in any search web site for online dissection of shark, frog, calotes, rat using Apple quick time software.	**18**
III	**5. Culturing of Animals** A visit to atleast any 2 of following: Vermiculture, apiculture, sericulture, ornamental fish culture, poultry or dairy farm or Biofertilizer or Biopesticide Industry in order to evoke interest in self employement.	**18**
IV	**B. CELL AND MOLECULAR BIOLOGY** Micrometry Camera Lucida Drawings Human Buccal Smear Blood Smear – Cockroach, Man. Cytochemical detection of Carbohydrates, Proteins, Lipids, DNA and RNA. **C .GENETICS** Drosophila culture – Identifications of Normal, mutants &	**18**

	sexes Blood groups ABO & Rh their genetic significance. Pedigree analysis. Human karyotyping & Chromosomal abnormalities. Hardy Weinberg law & Calculation of gene frequencies for dominant, recessive & co-dominant traits and Multiple alleles.	
V	**D.. MICROBIOLOGY& IMMUNOLOGY** Culture techniques – culture of bacteria. Bacterial growth curve –Counting and Antibiotics usceptibility test .Measurement of bacteria – Preparation of smears and simple staining. Specific staining – negative staining &Gram staining. **Immunology** Identification of lymphoid organs in rat / mouse. Determination of human blood group by haemagglutination test and assessment of specificity of antigen – antibody reactions. Detection of the specific reactivity of precipitating antibody (Igg) with fractionated antigens by immunoelectrophoresis, Vidal- test.	**18**

Text Book:

1. **Barnes, R.D** Invertebrate Zoology, Cengage Publications. . (2006),
2. **Barrington, E.J.W.** Invertebrate Structure and Functions, East west press Pvt (L)New Delhi. (2012),
3. **Waterman, A.J.** Chordate Structure and Function, The Macmillan Company. (1971),
4. **Dipak** Ajoy Paul, Text Book of Cell and Molecular Biology, Books & Allied (P) Ltd., KolKata. (2011)
5. **S.Verma** and **V.K.Agrawal**, GeneticsS.Chand and company Ltd, (2000).
6. **Ananthanarayanan, T** and **Jayaram paniker, C.K**.and Arti Kapil Text Book of Microbiology, 9th Edi. Publi: University press(India) Pvt. Ltd., ISBN-13:978-8173718892, (2013).
7. Dr. A.Amsath, 2007. Practical Manual for M.Sc zoology, MMA Publication, Pattukottai

Reference Books:

1. Gupta, Rajiv.K, Advancements in Invertebrate Taxonomy and Biodiversity. (2011)
2. Highnam, K.C. and Hill, L. The Comparitive Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London. (1979).
3. Alessandro MinelliPerspectives in Animal Phylogeny and Evolution, Oxford University Press. ,(2009)

4. Colbert, H. Edwin Evolution of the Vertebrates, Wiley Eastern Limited, New Delhi. (2011)
5. Bruce Alberts Molecular Biology of the Cell,Garland Science Publishing Inc,New York. ,(2017).
6. William.S, Klug et al Genetics, Published by Pearson Education India.,(2016)
7. **Patel, A.H.** Industrial Microbiology. Laxmi Publications New Delhi, **(2015)**.
8. MARK Peakman and **Diego vergani** Basic and clinical immunology. **Publisher Churchill Livingstone,** (2009)**.**

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Obtain thorough knowledge in the identification of vertebrate and chordate animals
CO 2:	Familiar with mounting techniques
CO 3:	Know to culture economically important animals
CO 4:	Able to do microbial culture technique
CO 5:	Understand the mendelian traits.

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	M	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	M	S	M	M	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	M	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Course-VI	Developmental Biology	Course Code: PGZF
Instruction Hours: 6	Credits: 5	Exam Hours: 3

Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To introduce the concepts and process in developmental biology • To understand the genetic mechanisms and the unfolding of the same during development • To expose the learner to the new developments in embryology and its relevance to Man. • To study the cell differentiation and tissue interactions in organ development • To know the health care and advanced technology in fertilization	
UNIT	**CONTENT**	**HOURS**
I	Gametogenesis – Spermatogenesis – Cells in seminiferous tubules, spermiogenesis, structure and types of sperm Egg**:** Origin of egg - growth of oocyte - synthesis and accumulation of macromolecules in the oocyte – vitellogenesis - nuclear activities during oocytes growth. Hormonal and nervous control of ovulation Egg as a developmental system**:** Organization of egg, cytoplasm before and after fertilization - polarity and symmetry of egg. Egg cortex**:** Nature and role in amphibian development.	18
II	Fertilization:Bio-chemical aspects of egg activation - molecular events during fertilization. Polyspermy. Fertilization : Events of fertilization- acrosome reactio in sperm – cortical reaction in egg - recognition of egg and sperm, physiological changes infertilization, theories of fertilization.	**18**
III	Cleavage :Plan and Patterns - Chemical changes - role of nucleus and cytoplasm in cleavage - totipotency - Nuclear transplantation – nuclear clones.Mechanisms and significance of Blastulation and Gastrulation, Morphogenetic movements**:** selective affinity of	**18**

	cells - metabolism and gene activity during gastrulation.formation of germ layers in animals; embryogenesis.	
IV	Organizer concept:Primary and secondary organizers - nature of induction - mechanism - gradients in the determination. Tissue interactions: Lens development.Cell differentiation **:** Chemical and cellular factors- differential gene activity.Ageing and alteration in developmental potentials**:** Gene regulation of aging.Scenescence.	**18**
V	Precaution and health care during pregnancy and gestation. Impotency: Causes of Impotency and sterility male and infertility in female – Concept of test-tube baby - Artificial Insemination in humans - In Vitro Fertilization (IVF) and Gamete-Intra-Fallopian Transfer (GIFT) – Advantages and disadvantages. Teratogenesis-Developmental mechanism of teratogenesis. Contributions of teratology to developmental biology. Teratogens and induced birth defects.	**18**
VI	To study different stages of chick embryo development	

Text Book:

1. Verma and Agarwal (2006) Developmental Biology
2. Veera Bala Rastogi, M.S.Jayaraj – Developmental Biology – Kedar Nath, Ram Nath

Reference Books:

1. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
2. Beril, N.J. 1974. Developmental Biology. Tata McGraw –Hill Publishing Company Ltd. New Delhi.
3. Ebert, J.D., 1966. Interacting systems in Development. Holt, Rinehart and Winston, New York.
4. McEwen, R.S. 1969. Vertebrate Embryology. Oxford & IBH Publishing Co., New Delhi.
5. Nelson, O.E. 1953. Comparative Embryology of the Vertebrates. The Blackston Company, New York.
6. Patten, B..M. 1958. Foundations of Embryology. McGraw – Hill Book Company Inc., New York.
7. Waddington, C.H. Principles of Development and Differentiation. The Mac Millan Company, New York.
8.. Twyman,R.M.-Developmental Biology – Viva Books pvt., New Delhi, Chennai,Mumbai.

Web – Resources:

https://www.khanacademy.org/science/biology/developmental-biology

https://plato.stanford.edu/entries/biology-developmental/
https://www.ncbi.nlm.nih.gov/books/NBK9983/
https://biology.duke.edu/research/developmental-biology

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the concepts and process in developmental biology
CO 2:	Understand the genetic mechanisms and the unfolding of the same during development
CO 3:	Expose the learner to the new developments in embryology and its relevance to Man
CO 4:	Job offer: IVF laboratory, Embryologists in O&G department in Medical College and Research
CO 5:	Centre, Research Assistant in Veterinari College and Research centre. Animal care taker

Mapping of Cos with Pos & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	M	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlated
M – Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-II / Core Course-VII	Biochemistry, Biophysics and Bio techniques	Course Code: PGZG
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand the chemical nature of life and life process • To provide an idea on structure and functioning of bio molecules • To generate an interest in the subject and help students explore the new developments in biochemistry • To learn the biophysical properties and functioning of life processes • To introduce the tools and techniques available for studying biochemical and biophysical nature of life • To equip the learner to use the tools and techniques for project work/ research in biology	
UNIT	**CONTENT**	**HOURS**
I	Water and minerals – functions and hormonal regulation of mineral metabolism – pH – buffers, Structure, properties and classification of carbohydrates, proteins and lipids. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). – their metabolism, hormonal regulation. Classification of enzymes , enzyme kinetics – Mechanism of enzyme action – regulation of enzymatic activity – Co-enzymes – Isoenzymes – functions of enzymes – Energy rich compounds and their roles, Fat- Soluble and water soluble Vitamins. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes Metabolism of amino acids nucleotides and vitamins	**18**

II	Visible spectrum – Beer Lambert's law and its application – Electromagnetic radiation – Uses of X-rays. UV rays and radio waves; Lasers and their uses in biology – Principles and applications of Colorimetry and Spectrophotometry – Laws and application of thermodynamics. Radioactivity – natural and artificial – half life – Measurement of Radioactivity: Geiger-Muller counter and Scintillation counter – Principles and applications.	**18**
III	Microscopy – Magnification, Resolution and Numerical aperture. Compound, Phase contrast and Electron microscopes (SEM & TEM), Confocal. Camera lucida, Micrometry – Principle and their applications. Microtomy – types of microtomes – fixation, embedding, sectioning, staining and mounting procedures.	**18**
IV	pH – pH meter and electrodes – buffers – acid base balance – Handerson Hasselbach equation. Homogenization – Centrifugation – types of centrifuges: Clinical, High speed and Ultra Centrifuges. Principle and applications of colorimetry and spectrophotometry. Spectroscopy : Flame emission spectroscopy, Atomic absorption spectroscopy, Nuclear Magnetic resonance spectroscopy (NMR), Circular dichroism spectroscopy, ESR spectroscopy, Mass spectroscopy.	**18**
V	Chromatography – paper, thin layer, column, gas and liquid chromatograpy – Principles and application. Electrophoresis – Paper, gel (horizontal & vertical) , Agarose gel and SDS – PAGE – Immunoelectrophoresis – moledif: Principles and applications.	**18**
VI	To Prepare histology slide of different organs of fish	

Text Book:

1.Sathiyanarayana. U, Chakrapani (2017) Biochemistry, Publisher Elsevier India.

2.Subramanian, M.A., 2005. Biophysics principles and techniques, MJP Publishers.

3.Berry, A.K. 1988. A text book biophysical chemistry, EMKAY Publication, New Delhi.

Reference Books:

1. Deb,A.C.,(2011), Concepts of Biochemistry. Publisher – Books & Allied (P) Ltd.,Kolkata
2. Donald Voet, Judith, G. Voet, et al.,(2018) Principles of Biochemistry, Wiley Global Edition.
3. Hoar, S.W., (1983), General and Comparactive Physiology, Prentice Hall, London, New York.
4. Raghunath Narvekar – 2008, Hand book of Biochemistry-Adhyayan publishers & Distributors.
5. .Sharma Dushyant Kumar – 2010, Biochemistry – Narosa publishing house
6. Ackerman, E. (2018). Biophysical science, Publisher - Arkose Press.
7. Annie – 2010, Biochemistry & Biotechniques – Saras Publications
8. Casey, E.J. (2018). Biophysics: Concepts and mechanics, Sagwan Press.
9. Daniel, M. 1989. Basic Biophysics for Biologists. Agro Botanical Publishers (India), Bikaner.
10. Kumarasamy.V -2012,Biophysics & Bioinstrumentation- Saras Publication
11. Pattabhi(Vasantha) and Gautham, (2010), Biochemistry - Narosa Publishing house.

Web Resources:

1. https://pubs.acs.org/journal/bichaw
2. https://courses.lumenlearning.com/boundless-biology/chapter/connections-of-carbohydrate-protein-and-lipid-metabolic-pathways/
3. https://www.cambridge.org/core/books/part-1-mrcog-revision-notes-and-sample-sbas/carbohydrate-protein-and-lipid-metabolism/C51D6667B0DDE2433B6FC3CE31A1EB2A
4. https://www.biophysics.org/what-is-biophysics
5. https://biotechnique.com/

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the chemical nature of life and life process
CO 2:	Understand the structure of bio-molecules and its function in life.
CO 3:	Learn the biophysical properties and functioning of life processes.
CO 4:	Learn the advanced tools and techniques available for studying biochemical and biophysical nature of life.
CO 5:	Job offer: Instrumentation and Lab technician, Research Assistant in Clinical Laboratory, Technician/Research Assistant in TIFR, CCMB, ICFRE, ICMRE, ICAR, AIMS Research Institute. Institute .

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	M	S	S	S	S	S	S

S - Strongly Correlated
M - Moderately Correlated
W-Weakly Correlated
N – No Correlation

Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To give an intensive and in-depth learning in the field of biotechnology • To understand the modern biotechnology practices and approaches with an emphasis in • technology application, medical, industrial, environmental and agricultural areas • To familiarize the students with public policy, biosafety, and intellectual property rights issues • To understand the commercial protection of organic compound using microbes. • To learn the process of bioremediation.	
UNIT	**CONTENT**	**HOURS**
I	Hybridoma technology: Production and Application of monoclonal and polyclonal antibodies – Gene Therapy — Cell bank – Animal bioreactor and molecular pharming. Transgenic animals – transgenic animal model development – Transgenic mouse – embryonic stem cell method and pronucleus method – Transgenic fish and sheep. Bioethics in animal genetic engineering.	**18**
II	Agricultural Biotechnology: Genetically Modified Microorganisms – Phytoremediation. Bacterial Biofertilizers –Rhizobium, Acetobacter inoculants –Nitrogen fixing,Phosphate solubilizing, Mobilizing- VAM manuring – Cyanobacterial inoculants –Azolla, Anabaena. Benefits of biofe Biopesticides in pest management.	**18**
III	Industrial and Microbial Biotechnology – Fermentation technology: Fermentors, Selection of microbes, Fermentation medium –	18

	Production of Penicillin, Vitamin B^{12}, Amino acids and Proteases – Production of organic compounds by microbial fermentation – Ethanol and acetone production - Antibiotics – microbes used – commercial production o antibiotics – Single Cell Protein (SCP) production and their advantages- Spirulina.	
IV	Medical Biotechnology – Applications of r-DNA technology in human heal Recombinant DNA proteins and their uses: i) Interferon, ii) Interleukin, iii) Factor VIII, iv) Urokinase and v) Tissue plasminogen activator – Recombinant vaccines: Hepatitis-B, Rabbies and FMD Vaccine – Commercial production of penicillin – DNA finger printing and its use in Forensic science .	**18**
V	Environmental Biotechnology – Bioremediation – *In-situ*, and *Ex-situ.* Bioremediation of Xenobiotics- dyes, havy metals, coal waste through VAM fungi, Effluent treatment using genetically modified microbes. Intellectual Property Rights–copy right, trade marks, patents, industrial design rights and trade secrets.	**18**
VI	Preparation of Biofertilizer	

Text Book:

1. Abbasi (SA) Ramasami E(1999), Biotechnology methods of pollution control.
2. Bahadur (Bir),ED , Essential of biology & biotechnology
3. Dubey, R.C (2014) A text book of biotechnology. S. Chand and Company, New Delhi.
4. Ignacimuthu .s (1995) , Basics Biotechnolgy - Tata Mcgraw Hill.
5. Jogand s.v (1993), Advances in Biotechnology -Himalaya.
6. Kumar H.D (1991) A text book of biotechnology – Affiliated East west
7. Lohar(Prakash.s)(2004) Biotechnology.
8. Purohit S.S Mathur S.K - Biotechnology: Fundamental and application –Agrobios goel
9. Rana S.V.S (1990) Recent trends in Biotechnology & Biosciences society of Bioscience.
10. Sathyanarayana, U (2005) Biotechnology. Books and Allied P.Ltd. Kolkata.
11. Sohal (Harvinder s) ; Srivastava (Asok.k) (1994), Ashish Pulishing House.
12. Trehan (keshav) (1990), Biotechnology –Wiley Eastern Ltd.

Reference Books:

1. .Bains, W. (1998). Biotechnolgy from A to Z. Oxford University Press, Oxford.
2. 2.Dubey, R.C. (2014). Text book of Biotechnology, S.Chand & Company Ltd. Ram agar, New Delhi
3. Lydell Norris,(2016),Text Book of Biotechnology. Publisher – Syrawood Publishing
4. 4.Ranga, M.M. (1999). Animal Biotechnolgy. Agrobios (India) Jodhpur.
5. 5.Sathyanarayana.U,Chakrapani.U,(2008), Biotechnology. Publisher – Books & Allied (P) Ltd.,
6. 6.Trevan, M.D, Boffery, S. Goulding, K.H. &Stanbury, P. (1984). Biotechnology:
7. The BiologicalPrinciples. Tata McGraw Hill Publishing company Limited, New Delhi.
8. 7.Wiley,(2017), A Text Book of Biotechnology. Editor H.K.Das.

Web Resources:

https://appliedbiotechnology.wisconsin.edu/what-is-applied-biotechnology/
https://iubmb.onlinelibrary.wiley.com/journal/14708744
https://fbns.ncsu.edu//extension_program/documents/biotech_applications.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand advance technique and its application in the field of biotechnology
CO 2:	Understand the modern biotechnology practices and approaches with an emphasis in
CO 3:	technology application, medical, industrial, environmental and agricultural areas
CO 4:	Familiarize the students with public policy, biosafety, and intellectual property rights issues
CO 5:	Job offer: BCG vaccine Laboratory Chennai. Pasteur Institute Ooty, Clinical laboratory, Medical Research Centre, IVF laboratory, Research Assistant/ JRF/SRF/ in the Research Institute of ICAR, ICMRE, VCRC, TIFR, CCMB, Fisheries University and Research centre

Mapping of Cos with Pos & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlated

M – Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-I / Core Course-IX	Practical II (CC VI,VII and VIII)	Course Code: PDZIY
Instruction Hours: 6	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand the study of reproductive cells and its motility. • To know the estimation techniques of biological samples. • Understand the principles and mechanisms of bioinstruments. • Know the purpose of microtechnique. • Understand the isolation and separation of nucleic acid by advanced biotechnique.	
UNIT	**CONTENT**	**HOURS**
I	**A. Developmental Biology** 1. Preparation of sperm suspension in frog/bull and observation of the spermatozoa. 2. Observation of live spermatozoa and study of rate of motility of sperm in frog /bull semen. 3. Vaginal smear preparation in rat / mouse to study the stages of oestrous cycle.	**18**
II	**B. Biochemistry** 1. Estimation of total protein in biological sample. 2. Estimation of total carbohydrate in biological sample. 3. Estimation of Amino acids in muscle & liver tissue of chick 4. Buffer preparation – determination of pH using pH meter.	**18**
III	**C.Biophysics** *1.* Colorimeter–Determination of Optical Density of samples using	

	Standards. 2. Centrifuge-Preparation of samples using low and high speed centrifuges. a. Chromatography- 3. Separation of free sugars in different samples (Paper). 4. Separation of neutral lipids (TLC). 5. Electrophoresis-Separation of human serum proteins (Demonstration only).	
IV	**D.Biotechniques :** Micrometry- Microtechnique ,fixation, embedding, serial sections, cytological staining, mounting of tissues, organs and embryos**.**	**18**
V	**E.Biotechnology** 1. Isolation of genomic DNA 2. Plasmid isolation 3. Agarose gel electrophoresis of DNA 4. DNA fragmentation using restriction enzymes (Demonstration) 5. Blotting technique (southern and western) Demonstration only.	**18**

Text Book:

1. Verma and Agarwal Developmental Biology, (2006)
2. Veera Bala Rastogi, M.S.Jayaraj – Developmental Biology – Kedar Nath, Ram Nath.
3. Subramanian, M.A., 2005. Biophysics principles and techniques, MJP Publishers.
4. Ackerman, E. Biophysical science, Publisher – Arkose Press, (2018).
5. Sathiyanarayana. U, Chakrapani Biochemistry, Publisher Elsevier India, (2017)
6. Dubey, R.C (2014) A text book of biotechnology. S. Chand and Company, New Delhi

Reference Books:

1. Verma and Agarwal Developmental Biology, (2006)
2. Veera Bala Rastogi, M.S.Jayaraj – Developmental Biology – Kedar Nath, Ram Nath.
3. Deb,A.C. Concepts of Biochemistry. Publisher – Books & Allied (P) Ltd.,Kolkata,(2011).
4. Wiley A Text Book of Biotechnology. Editor H.K.Das,(2017).

Web Resources:

https://microbenotes.com/category/developmental-biology/
http://www.mednotes.net/notes/biophysics/

Course Outcomes:
On completion of the course the learner will be able

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CO 1:	Hands on training in observation of live cells.
CO 2:	Ability to quantify the biological samples
CO 3:	Able to understand the basic mechanisms and operating of bioinstruments
CO 4:	Understand the microtechnique for slide preparation..
CO 5:	Know the application of advanced biotechniques.

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	M	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlated

M – Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Elective Course-I	Fishery Biology and Fish Processing Technology	Course Code: PGZE1
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To Learn the fish techniques of different fishes. • To learn the management strategy. • To know the fish processing technique. • To learn the induce breeding technique and fish pathology. • To study the fish population, growth and stock assessment	
UNIT	**CONTENT**	**HOURS**
I	World and Indian Fisheries – Prosepects and Problems – Plans, Polices and Current Status of Indian Fisheries. Marine fisheries ; Sardines, Mackerels, Sciaenids, Ribbonfish, Silver bellies, Pomfrets, Carangids, Sharks, Shrimps, Prawns, Crabs, Lobsters, Mussels and Clams Inland fisheries ; Freshwater – riverine, reservoir, pond and cold water fisheries- Spawning and breeding habits of fishes. Estuarine and brackish water fisheries and their economics.	18
II	Culture fisheries : Integrated fish farming technology – rice – cum – brackish water fisheries, rice-cum-common carp culture,	18

	fish –cum-duck culture, Sewage – fed fisheries – monosex culture – polyculture. Ornamental fish culture and its economics.	
III	Fish Gears and Crafts used in South Indian Fisheires. Fish endocrinology – Induced breeding – technicques – examples. Fish Pathology : Parasites – Protozoan, fungal, bacterial, worms and arthropods.	18
IV	Assessment of fish stocks : Marking and recapture method, area sampling method, biostatistical method, egg count method, hydroacoustic method, remote sensing. Age and Growth : Scale method, otolith method, other skeletal parts as age indicators, length – frequency method, length – weight relationship and condition factor. Population studies : estimation of population size, marking, tagging, population dynamics, population models.	18
V	Fish Processing and Preservation technology Salting, Icing, Sundrying, Smoking, Canning, Tinning, and Freezing techniques, Cold Storage, Brine water, brief account on transport and marketing. Lay out of Processing Plant – Factory Hygiene and Sanitation, Fish products and by products .	18

Text Books:

1. Khanna, S.S. and Singh, H.R. (3rd Edition, 2015). A Text book of Fish Biology and Fisheries. Narendra Publishing House. ISBN:9789384337117.
2. Handbook of Fisheries and Aquaculture (2017). Publisher:ICAR. ISBN-10-9788171641062; ISBN-13:978-8171641062.
3. Arumugam,N (2014). Aquaculture and Fisheries. Saras Publication.ISBN-10:9382459995; ISBN-13:978-9382459996
4. BISWAS, S.P., (1993) Manual of Methods in Fish Biology, International Book Co., Absecon

Highlands, New Jersey.
5. JHINGRAN, V.G., (1991) Fish and Fisheries of India. Hindustan Publishing Copr., New
Delhi.
6. PILLAI, T.V.R. (1993) Aquaculture : Principles and Practices. Fishing News Agency, London.
7. AGARWAL, S.C. 2006. History of Indian Fisheries. Daya publication.
8. SRIVASTAVA, C.B.L. A Text Book of Fishery science and Indian Fisheries. Kitab Mahal Publishers.

Reference Books :

1. Bhardwaj,K.D. (2011)Modern Technique in Fish Handling and Processing. Cyber Tech Publications. ISBN-108178846896 ; ISBN-13 :978-8178846897.
2. Krishnaveni,G. and Veerabhdra Rao,N. and Veeranjaneyulu, K.(2016) Récent Technologies in Fish and Fisheries. Rigi publication. ISBN-10 :9384314587 ; ISBN-13 :978-9384314583.
3. Bernard A. Megrey. (2nd Edition,2009) Computers in Fisheries Research. Publisher : Springer. ISBN-10 :1402086350 ; ISBN-13 :978-1402086359.
4. Sen,D.P.(2005) Advances in Fish Processing Technology. Allied Publisher Pvt. Ltd. ISBN-10 :8177646559 ; ISBN-13 :978-8177646559.
5. Faridi,A.Z.,(2014) Text Book of Fish Processing Technology.Neha Publishers pvt. Ltd., ISBN-10 :9350301792 ; ISBN-10 :978-3550301791.
6. Daniela Borda, Anca I Nicolau, Peter Rasper. (2017) Trends in Fish Processing Technologies.CRC Press Taylor & Francis Group. ISBN : 9781498729178.
7. Bose, A.N., Yang, C.T., And Mishra, A. (1991) Coastal Aquaculture Engineering. Oxford and IBH Publishing Co., PVt. Ltd., New Delhi.
8. Chakrabarti N.M., (1994) Diseases of Cultivable Freshwater Fishes and Their Control. International Books and Periodicals Supply service, New Delhi.
9. Day, F., (1986) The Fishes of India, Vols., I & II. Today and Tomorrow's Book Agency, New Delhi.
10. Govindan, T.K. (1992) Fish processing Technology, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
11. MPEDA Hand book of Aquafarming (1992) Freshwater Fishes, Marine Products Export Development Agency, Kochi.
12. New, M.B., Tacon., A.G.J., and CSAVAS., I. (1993) Farm – made – Aqua feeds. Food and Agrilculture Organization of United nations, Rome.
13. Santhanam, R., (1990) Fisheries Science, Daya Publishing House, New Delhi.
14. Seghal, K.K. (1992) Recent Researches in Cold Water Fisheries, Today and Tomorrow's Pbulishers and Printers, New Delhi.
15. Sinha, V.R.P. (1993) A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford and IBH Publishing Co., Pvt., Ltd., New Delhi.
16. Subbha Rao (1986) Economics of Fisheries, Daya Publishing House, New Delhi.
17. Trivedi, K.K. (186) Fisheries Development: 2000 A.D. Association of Indian Fishery Industries and Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
18. Uma Sharma., & Grover, S.P., (1982), An Introduction to Indian Fisheries, Bishen Singh Mahendra Pal Singh, Dehra Dun. Prediction
19. Rajagopalasamy, C.B.T & Velayutham, P. 1999. Quality control of Fish and Fishery products.

Web - Resources:

https://krishi.icar.gov.in/jspui/bitstream/123456789/20805/1/2_fish%20processing%20and%20preservation.pdf
http://iifpt.edu.in/olapp/pmfme/upload/mt_handbook_fish.pdf
http://ledhyane.lecture.ub.ac.id/files/2015/09/HartReynolds_2002-HandbookOfFishBiologyAndFisheriesVol1.pdf
https://www.notesonzoology.com/india/fishery/fishery-meaning-types-and-economic-zones/646

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the fish techniques of different fishes.
CO 2:	Understand and familiarized with construction of pond and its management strategy
CO 3:	Hands on training in fish processing technique
CO 4:	Familiarize with Induced breeding
CO 5:	Job offer: Self employment, Entrepreneur, Executive in fish products, Aquarist, Research Assistant in Fisheries university and Research centre, MPEDA, RGCA, CIBA, CMFRI

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	M	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	M	S	M	M	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Elective Course-I	Histology and Histochemistry	Course Code: PGZE1

Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• The student will be able to identify the basic structure of cells, tissues and organs. • Describe cells contribution to normal function. • The student will be able to interpret light- and electron-microscopic histologic images • Understand and identify the tissue source and structures. • Hands on training provided to histology techniques**.**	
UNIT	**CONTENT**	**HOURS**
I	Histology :Histochemistry and Histopathology : Objectives and applications . Tissue fixation : Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods-:freezing and microwave fixation; choice of fixatives, fixation artifacts. Dyes. –Natural and Synthetic, Classification.	18
II	Functional Morphology (mammalian) : Histological organization of GI tract- stomach and intestine, lungs, kidney, spleen, thymus, Bone and bone marrow .	18
III	Histochemistry: Principles and methods of application and utility of classical histochemical. Techniques : for localization of glycoproteins (PAS), nucleic acids(Feulgen) and steroid	18

	dehydrogenase activity.	
IV	Immunohistochemistry: Principles, method of application of Imunohistochemistry and mmunofluorescence techniques for localization of proteins in endocrine cells (Pituitary cell types or islet of Langherhans). In situ hybridization of nucleic acids.	18
V	Histopathology: Tumors- malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors.	18

Text Books:

1. Textbook of Histology, Leslie P. Gartner, published by Elsevier November 2015, ISBN: 9780323672740.
2. Histology:The Big picture, by David A. Morton and John F. Ash, 2012.

References:

1.Boyd,W. 1976:A text book of Pathology. Structure and function in ddisease, 4th edition. Lea and Fibiger, Philadephia.

2.Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied ,J & A,Churchill Ltd., London.

3.Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.

4.Telford, I.R. and Bridgman,C.F.(1990). Introduction to Functional Histology, Harper and Row, NY.

Web Resources:

1. http://www.rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Histo/Introduction.pdf
2. https://www.hh.um.es/pdf/Supplements/Suppl%201,%202011.pdf
3. https://www.slideshare.net/sstss/histochemistry
4. http://www.auburn.edu/academic/classes/zy/hist0509/html/Lec02notes-microsc&histoch.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Able to outline the services provided by a hospital histology laboratory
CO 2:	Outline the processes involved in the preparation of tissue sections and explain the purpose of each of these processes.
CO 3:	Able to identify a number of basic tissue-types from their microscopic appearance.
CO 4:	Understand why histology is essential for accurate diagnosis and monitoring of disease progression.
CO 5:	Knowledge of the structure and function of the major organ systems, including the molecular, biochemical and cellular mechanisms for maintaining homeostasis.

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	S	S	S	M	M	S	S	S	M	M

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III/ Core Course-X	Animal Physiology	Course Code: PGZJ
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

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Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To understand the basics in physiology • To know the physiology of different organs • To gain knowledge about hormones and their feedback mechanism • Learn role of receptors in man • Understand the biological rhythm and biological clock	
UNIT	**CONTENT**	**HOURS**
I	Homeostatic mechanism - Osmo and lonic regulations in Fishes; Temperature and pH regulations in animals; Acclimatization to high altitudes; Hydrostatic pressure; Buoyancy, Nutrition – Nutritional requirements, types, essential, aminoacids, and fatty acids – vitamins and their role. Respiration – Respiratory pigments and their functions. Exchange of gases – transport of O2 and CO2 – regulatory mechanisms; Haemoglobin – Chemistry – structure – Respiratory quotient-neural and chemical regulation of respiration.	18
II	Circulation – Heart,-Functions of Heart, heart beat, cardiac rhythm and regulation; Blood coagulation; Types of transport mechanisms, blood pressure, ECG; Excretion – Excretion in relation to different habitats – Detoxification pathways of Ammonia, Urea, and Uric acid formation, Vertebrate Nephron – Mechanisms of urine formation and Acid base	18

	balance. Nervous system - Neurons,- Nerve impulse action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.	
III	Chemistry of muscular contraction, Photoreceptor – Vertebrate eye, photo chemistry, visual information and adaptations of eye. Phonoreceptor – Vertebrate ear, physiology of hearing; Electric organs, Bioluminescence – chemistry and control; Chronobiology – Biological rhythm and biological clock.	18
IV	Endocrine glands in vertebrates and feedback system in endocrine regulation of vertebrates. Pituitary gland (Adenohypophysis , Pars Intermedia and Neurohypophysis) - Characteristics, structural organization , biosynthesis, regulation and functions of hormones .Hypothalamic regulation for release of pituitary hormones. Pineal gland -hormones and their role in photoperiodic response in vertebrates Thyroid gland -- characteristics, structural organization,synthesis and functions of hormones. Parathyroid gland- structure, synthesis and functions of hormones.	18
V	Pancreas -Structure ,hormones and their functions. Adrenal gland- Structural organizations, biosynthesis and functions of cortical and medullary hormones Gonadial gland-Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrous and menstrual cycle - hormones of pregnancy - parturition - hormonal control of lactation.	18
VI	Preparation of diet chart for diabetes	

Text Book:

1.Arumurugam, N., Animal Physiology, Saras Publication-kanyakumari.

2.Verma, P.S., Tyagi, B.S, and Agarwal, Animal physiology, Saras Publication, S.Chand and Co., New Delhi.

Reference Books:

1. Prosser C.L, Brown, F.A. 1965. Comparative Animal physiology W.B.SandersCompany London.
2. 2.Nagabhushnam. R, Kodarkar. M.S., and Sarojini,R. 1983. Text book of Animal Physiology, Oxford& IBH publishing co. New Delhi.
3. 3.Bykov . K.M., 1960. Text book of physiology . Foreign languages publishing house , Moscow.
4. Hurkat, P.., Mathur. C., A book of Animal physiology. S.Chand & co (PVT) Ltd., Ram Nagar New Delhi
5. Hoar, S.W., 1978. General and Comparactive Physiology, Prentice Hall, London, New York.
6. Malcolm.S.Gordon – Animal Physiology – principles and Adaptations- Macmillan Publishing co.
7. Inc _ Newyork..
8. Haris, G.W. and B.T. Donovan. 1968. The Pituitory Gland. S. Chand and Co.,
9. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
10. Mac Hadley. 1992. Endocrinology, 3rd Edition. Prentice – Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
11. Ingleton, P.M. and J.T. Bangara. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers
12. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders International Student edition. Toppan Company Limited. Tokyo.
13. Prakash S Lohar Endocrinology, Hormones and Human Health.
14. Ashoke Kumar Boral – Mammalian endocrinology – New central Book Agency(P) ltd – London.
15. Rao.C.V. A Text book of Immunology Narosa Publishing house – Chennai.
16. Peter Wood – Understanding Immunology – Pearson Education ltd – Chennai.

Web Resources:

.https://nptel.ac.in/courses/102/104/102104042/

http://unaab.edu.ng/funaab-ocw/index.php/animal-physiology-67467/lecture-notes-73565

http://www.sci.utah.edu/~macleod/bioen/be6000/notes/L01-intro.pdf

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Have enhanced knowledge of mammalian physiology
CO 2:	Understand the function of physiological systems such as respiratory, circulatory and metabolic system.
CO 3:	Understand the physiological response to that environment.
CO 4:	Able to analyze and report on experiments in physiology
CO 5:	Understand the endocrine organs structure and functions.

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	M	M
CO5	S	S	S	M	M	S	S	S	M	M

S – Strongly Correlated

M – Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XI	Research Methodology	Course Code: PGZK
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• This study is being undertaken within a framework of a set of approaches and uses procedures, methods and techniques that have been tested for their validity and reliability. • Biostatistics provides a clear specification of the hypothesis to be tested. • Know the basic concept of biostatistics • Understand the applications of statistic in biological data • Obtain in depth knowledge in data collection	
UNIT	**CONTENT**	**HOURS**
I	**Concepts of Research and Research Formulation** Basic concepts of research – Meaning, Objectives, Motivation and Approaches. Types of Research – Descriptive / Analytical, Applied/ Fundamentals, Quantitative/Quantitative, Conceptual/Empirical. Research Methods versus Methodology, Research and scientific method. Research process. Observation and facts, Prediction and Explanation, Induction, Deduction. Defining and Formulating the research problem. Selecting the problem and necessity of defining the problem.	**18**
II	**Data Collection and Analysis** Collection of data , Methods of data collection, Data Analysis with Statistical Packages. Computer aided searches, Search engines – Google, Yahoo.	**18**

	Research publication and ethics, UGC CARE listed journals. Plagiarism,Impact factor,Citation index.	
III	**Literature review and Thesis Writing** Source , Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review. Hypothesis – Null and Alternate Hypothesis and testing of hypothesis. Components of a thesis writing – Introduction, material and methods, presenting the results, writing the discussion, citing the references, tables and figures, bibliography.	**18**
IV	**Research and Documentation** – Abstracts and research papers – Preparation and submission of research paper for peer reviewed journals- citation index – h-index – impact factors – creation and usage of Google scholar account – Project Proposal writing, Research articles, Oral Communications.	**18**
V	Definition – development of Biostatistics, data in Biostatistics – samplesand population, variables, accuracy and precision, derived variables, frequency distribution, handling of data..Descriptive Statistics: arithmetic mean, other means, median, mode, range, standard deviation, Student's t, confidence limit, analysis of variance, single classification, two way analysis of variance, assumptions, regression, correlation, analysis of frequencies. Multivariate analysis – Definition and derivation of Principal components,	**18**
VI	Primary and secondary data collection	

Text Book:

1.GURUMANI,N.2007.Research Methodology for Biological Sciences.MJP Pub.Chennai.

2.P.RAMADASS & A.WILLSON ARUNI,2009. Research and writing. MJP Pub.Chennai.

Reference Books:

1. ANDERSON,J.,DURSTON,B.,POOLE,M.1991.Thesis and Assignment writing. New Age International Pvt .Ltd., New Delhi.
2. .Conference of Biological Editors.1972. Style Manual for Biological Journals,American Institute of BIOLOGICAL Science, Washington,D.C.
3. KOTHARI,C.R.2006. Research Methodology & Research Techniques .New Age Int.Pub.
4. .JAWAHAR,P.2000. The preservation of Zoological specimen.Government Museum,Chennai.
5. GILES,R.H.JR.(Ed) 1984.Wildlife Management Techniques 3rdedition.The Wildlife Society,Washington.D.C.Nataraj Publishers,Dehradun.India.
6. .PAUL OLIVER.2005.Writting Your Thesis. Vistaar Publications.New Delhi.
7. SUNDAR RAO,P.S.S & J.RICHARD.2006.Introduction to Biostatistics and Research Methods(4th) .Prentice Hall,New Delhi.
8. BAILEY, N.T.J. (1997), Statistical Methods in Biology, III Ed., Cam. University Press, N.Y.
9. SOKAL, R. and JAMES, F. (1973), Introduction to Biostatistics, W.H. Freeman and Company Ltd., Tokyo, Japan.

Web Resources:

https://www.cusb.ac.in/images/cusb-files/2020/el/cbs/MCCOM2003C04%20(Business%20Research%20Methods)Research_Methodology_C_R_Kothari.pdf

https://prog.lmu.edu.ng/colleges_CMS/document/books/EIE%20510%20LECTURE%20NOTES%20first.pdf

https://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_Judu_illavarasusvyasa_univ
https://faculty.franklin.uga.edu/dhall/sites/faculty.franklin.uga.edu.dhall/files/lec1.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the basic concept of research
CO 2:	Learn the importance and sources of literature and hypothesis testing concept..
CO 3:	Efficient in document preparation, research article writing and project proposal writing
CO 4:	Learn data collection and descriptive statistics
CO 5:	Ability to use the applications of biostatistics to conduct research in the area of biology

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XII	Practical III (CC X and XI)	Course Code: PGZLY
Instruction Hours: 6	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• Animal physiology associated practical allow student to explore particular systems in detail and to develop relevant lab skills through the study of examples. • Research methodology uses procedures, methods and techniques that have been tested for their validity and reliability. • Biostatistics encompasses the design of biological experiments and analysis of data. • Familiar with histology slide preparation • Understand the different data collections	
UNIT	**CONTENT**	**HOURS**
I	1. Quantitative estimation of amylase activity. 2. Effect of substrate concentration on salivary amylase activity 3. Effect of enzyme concentration on the activity of salivary amylase. 4. Effect of pH concentration on the activity of salivary amylase.	18
II	5. Quantitative estimate of Protein by Biurette/ Lowry method 6. Study of oxygen consumption in fish. 7. Effect of Thyroxin on the respiratory metabolism of fish.	18
III	Demonstration of endocrine organs in vertebrates(any one) 2. Demonstration of reproductive system in vertebrate (Rat/Mouse) 3.Histological study of Pituitary, Adrenal, Testis, Ovary, corpus luteum , Intestine,Pancreas and Thyroid gland. A record of laboratory work and twenty slides containing serial	18

	sections (20 slides) shall be submitted at the time of practical examination.	
IV	**RESEARCH METHODOLOGY** Primary data collection and submission Secondary data collection and submission Document preparation and submission (topic selection is own interest)	18
V	**BIOSTATISTICS** *Problems related to* Chi-square test Student's t – test Correlation Regression	18

Text Book:

1.ARUMURUGAM, N., Animal Physiology, Saras Publication-kanyakumari.

2.VERMA, P.S., TYAGI, B.S, AND AGARWAL, Animal physiology, Saras Publication, S.Chand and Co., New Delhi.

3.GURUMANI,N.2007.Research Methodology for Biological Sciences.MJP Pub.Chennai.

4.SOKAL, R. AND JAMES, F. (1973), Introduction to Biostatistics, W.H. Freeman and Company Ltd., Tokyo Japan.

Reference Books:

1. 1.HURKAT, P., MATHUR. C., A book of Animal physiology. S.Chand & co (PVT) Ltd. Ram Nagar, New Delhi

2. KOTHARI,C.R.2006. Research Methodology & Research Techniques .New Age Int.Pub. SUNDAR RAO,P.S.S & J.RICHARD.2006.Introduction to Biostatistics and Research Methods(4th) .Prentice Hall,New Delhi.
3. 4..BAILEY, N.T.J. (1997), Statistical Methods in Biology, III Ed., Cam. University Press, N.Y.

Web Resources:

.https://nptel.ac.in/courses/102/104/102104042/
http://unaab.edu.ng/funaab-ocw/index.php/animal-physiology-67467/lecture-notes-73565
http://www.sci.utah.edu/~macleod/bioen/be6000/notes/L01-intro.pdf
https://www.cusb.ac.in/images/cusb-files/2020/el/cbs/MCCOM2003C04%20(Business%20Research%20Methods)Research_Methodology_C_R_Kothari.pdf
https://prog.lmu.edu.ng/colleges_CMS/document/books/EIE%20510%20LECTURE%20NOTES%20first.pdf
https://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_Judu_illavarasusvyasa_univ
https://faculty.franklin.uga.edu/dhall/sites/faculty.franklin.uga.edu.dhall/files/lec1.pdf

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the concept and principle of quantitative analysis of physiological enzymes.
CO 2:	Learn the estimation method of protein and metabolic activity of fish
CO 3:	Hands on training in preparation of histological slide.
CO 4:	Develop skill in problem solving related to biological sample data
CO 5:	Efficient with big data analysis software package-SPSS.

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand the importance of bioinformatics in biology • To familiar with application of bioinformatics tool • To know the concept of biostatistics • To understand the applications of biostatistics in biology • To obtain in depth knowledge in computer and its application	
UNIT	**CONTENT**	**HOURS**
I	**BIOINFORMATICS** Objectives of Bioinformatics, kinds of data used, Data integration, Data analysis, Carriers in Bioinformatics, Scope of bioinformatics – Useful bioinformatics sites – Bioinformatics in Pharmaceutical industry – Bioinformatics orientation in IT industry. Biological databases –Tools for Searching biological databases – Sequence and Structural databases – Nucleotide Sequence Databases - NCBI, GENE BANK, EMBL DDBJ. Protein Sequence databases – Swissprot, PIR – Structural database (PDB, CATH, and SCOP).	**18**
II	Sequence alignment – Methods of pair wise alignment – Algorithms– Needleman &wunch algorithm – Smith waterman algorithm – Amino acid substitution matrices – PAM – BLOSUM-Multiple sequence alignment (MSA) – Clustal W. Phylogenetic analysis: Concept of trees, Methods of Phylogenetic analysis - Distance matrix methods, Characters based methods-	**18**

	Steps on Constructing alignments and phylogenies.	
III	Conceptual models of protein structure – Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure - the relationship of protein three – didimension structure to protein function.	**18**
IV	**COMPUTER APPLICATION IN BIOLOGY** Introduction to computer**:** History of computer – components of a computer – block diagram – input devices – output devices- classification of computer – computer virus.Computer Programming concepts**:** Algorithms, Flowchart. Computer operating system**:** DOS and WINDOWS	**18**
V	MS office application**:** i) Word Processor : MS - Word ii)Data Processor : MS - Excel iii)Presentation : MS Power point Computer application**:** Office automation: E-mail and Internet. Applications of statistical packages: SPSS.	**18**

Text Book:

1. S.P.GUPTA – Statistical Methoda, Suldan chand & son, Educational Publishers- News Delhi.
2. Pillai, R.S.N. and Bagavathi. 2009. Statistics. S. Chand, New Delhi.
3. Gurumani, N. 2002. An introduction to Biostatistics. MJP Publishers, Chennai.
4. Gopi, 2011.Evolution Biostatistics & computer application. Saras publication.
5. Arumugam, N. 2010. Biostatistics ComputerAapplication, Bioinformatics instrumentation. Saras publication.

Reference Books:

1. Sokal, R.R. and F.J. Rohif. 1981. Biometry. W.K. Freeman. San Francisco.
2. Taxali. R.K. 1997. PC Software made simple. Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Bailey, N.T.J.(1997) , Statistical Methods in Biology, III Ed., Cam.University Press, N.Y.
4. Palanichamy.D. and Manoharn, M.Statistical Methods for biologist (Palani Paramount Publications). Gupta R.K.,S.P.Test Book of statistic.
5. Zar,J.H., 1996 .Biostatistical Analysis,
6. SOKAL,R. and JAMES, F.(1973), Introduction to Biostatistics, W.H. Freeman and Company Ltd., Tokyo, Japan.
7. P.N.Elhance. Fundamentals of Stsstics, Kitab Mahal, Allahabad.

Web Resources:

https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf
https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes
https://www.freebookcentre.net/biology-books-download/Lecture-Notes-ioinformatics.html

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the Biological databases and its scope
CO 2:	Learn sequence alignment to construct phylogenetic tree using of bioinformatic tools..
CO 3:	Skill to predict protein structure using RASMol package.
CO 4:	Understand the concept of computer programming which make it necessary to integrate informatics when solving biological problems.
CO 5:	Understand it has become an important focus for industry, particularly in the post-genomic era.

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	M	S	S	M	S
CO2	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Elective Course-II	Endocrinology	Course Code: PGZE2
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• Understand the hormones and its classification • Learn hormone synthesis, secretion, regulation, transport and metabolic fate • Understand the biological effects of catecholamineas • Learn the reproductive hormones and reproduction • Understand the fundamental concept of hormone signal transduction	
UNIT	**CONTENT**	**HOURS**
I	Hypothalamic and pituitary hormones: Hormones – classification, biosynthesis, circulation in blood, modification and degradation. Hormone receptors – structure and regulation. Mechanism of hormone action. Hypothalamic and pituitary hormones. Hypothalamic releasing factors. Anterior pituitary hormones: biological actions, regulation and disorders of growth hormones, ACTH, gonadotropine and prolactin. Leptin. Posterior pituitary hormones – biological actions and regulation of vasopressin. Diabetes insipidus and SIADH secretion. Oxytocin, Hypopituitarism	18
II	Thyroid and parathyroid hormones: Thyroid hormones – synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroid agents. Thyroid functions tests. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of PTH, calcitonin and	18

	calcitriol. Hypercalcemia and hypocalcemia Rickets and osteomalacia.	
III	Adrenal hormones: Adrenal cortical hormones.Synthesis, regulation, transport, metabolism and biological effects. Adrenal function tests. Cushing's syndrome, aldosteronism, congenial adrenal hyperplasia, adrenal cortical insufficiency. Adrenal medullary hormones – synthesis, secretion, metabolism, regulation and biological effects of catecholamines. Phaeochromocytoma.	18
IV	Gonadal, G.I. and pancreatic hormones: Gonadal hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. The menstrual cycle. Pregnancy – diagnostic tests and biochemical changes. Foetal monitoring. Amenorrhea. Pancreatic hormones – synthesis, regulation, biological effects and mechanism of action of glucagons, somatostatin and insulin. Insulin receptor. Brief account of gastrointestinal	18
V	Signal transduction: Fundamental concepts and definitions of signals, ligands and receptors, endocrine, paracrine and autocrine signaling. Receptors and signaling pathways – cell surface receptors, ion channels, G-protein coupled receptors, receptor kinases (tyr, ser/thr).Signal transduction through cytoplasmic and nuclear receptors. The Ras-raf MAP kinase cascade, second messengers – cyclic nucleotides, lipids and calcium ions. Crosstalk in signaling pathways.	18

Text Books:

1.Williams Textbook of Endocrinology – Wilson and Foster 13th ed. 2015.

2.Mechanisms of hormone action – Autind and Short, 1980.

Reference Books

1. Harper's Biochemistry – Murray et al. 26th ed. McGraw Hill, 2003.
2. Principles of Biochemistry – Mammalian Biochemistry, Smith et al. McGraw Hill, 1983.
3. Williams et al, Textbook of Endocrinology, 2015.

Web Resources:

1.https://my.clevelandclinic.org/ccf/media/files/Endocrinology/12-END-382-Endocrine-Notes_fnl.pdf

2.https://www.uc.edu/content/dam/uc/ce/docs/OLLI/Page%20Content/The%20Endocrine%20System.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the classification and biosynthesis of hormones.
CO 2:	Learn about hormonal regulation and biological actions.
CO 3:	Understand adrenal hormones and syndromes..
CO 4:	Understand gonadal hormones and its importance.
CO 5:	Understand concept of signal transduction and signaling pathways.

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	M	S	S	M	S
CO2	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	M	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Elective Course - III	Environmental Toxicology	Course Code: PGZE3
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand the concept of Environmental biology • To obtain in depth knowledge in solid waste management • To study the toxicants, effects, causes and management • Learn the classification of toxics substances • To understand the bio transformation and bio indicators	
UNIT	**CONTENT**	**HOURS**
I	Concepts of ecology: Limiting factors- Liebig's law of minimum-Shelford''s law of tolerance Population ecology: Attributes, estimates, density, diversity indices; Factors influencing population fluctuations Community ecology: community structure, dominance, stratification, succession and niche concept.	18
II	Habitat Ecology- lake, marine, rocky, muddy and sandy shore, estuary, terrestrial-grassland,forest,desert. Biodiversity –basic concepts, types, values, threats , methods of conservation- sustainable development and biodiversity indices. Wildlife conservation-Wildlife sanctuaries and National Parks-Biosphere Reserves. Pollution – sources, effects, and control of air, water, organic pollutants, BOD, COD, pesticides, heavy metals, thermal, radiation, oil, land and noise pollution – industrial pollution – with reference to Distilleries, paper mills and Tanneries.	18

III	Solid Waste Management: Types of solid wastes – degradable and non-degradable wastes; Collection, segregation, transportation and disposal of solid wasts (integrated waste management, Landfill, incineration, recycling, biological reprocessing, energy recovery, avoidance and reduction). Biomedical waste management-Components of biomedical wastes, waste management and protection from biomedical wastes.Status of solid waste management in India.	18
IV	Elements of Toxicology**:** Definitions – Scope – Classification. Toxic substances(Environmental Toxi-cants):Pesticides(Insecticide-Organochlorine, Organophasphate, carbamates) – Herbicides, Fungicides – Automobile emission – Heavy metals – Radioactive substances. Effects of Toxic substance: Elementary account on reversible and irreversible toxic effects. Evaluation of toxicity : acute, chronic toxicity. Determination of toxicity: LC50, LD50 and EC50. Route of Entry of Toxicants: Food, Water, Air, Skin and Laboratory animals –Absorption and Distribution of toxicants; (storage depots , kinds of storage deports).	18
V	Excretion of toxicants**:** important routes (Renal, biliary, pulmonary) Less important routes (feacal, salivary, placental,milk and egg) – Kinetics of excretion. Bio – Transformation – Phase I reaction and phase II reaction. Safety Evaluation of Toxicants**:** Risk management and monitoring – Environmental hazard and risk assessment – Criteria for safety evaluation – Upper and lower confidence limits – Cumulative toxicity – Evaluation of combined toxicity – Role of Lc50 or LD50 values in safety evaluation of toxicants – Behavior of Toxicants in the environment **–** Bio indicators.	18

Text Book:

1.BISWARUP MUKERJEE – Fundamentals of Environmental Biology –Silverline Publications – Allahabad.

2.AGARWAL – Environmental Biology – AgroBotanical Publishers (India)-New Delhi.

Reference Books:

1.ODUM, E.P. (1996) Fundamentals of Ecology (III Edn), Nataraj Publishers, Dehradun.

2.SHARMA, B.K. and KAUR, H. (1997) Environmental Chemistry, Goel Publishing House, Meerut.

3.TACCONI, L. (2000) Biodiversity and Ecological Economics : Participation, Values and Resource Management. Earthscan Publications Ltd., London.

4.CASTRI, F.D. and YOUNES, T. (1996). Biodiversity : Science and Development. CAB Int., Wallingford, U.K.

5.CHAPMAN, J.L., and REISS, M.J. (1997). Ecology – Principles and Applications, CAMBRIDGE University Press, U.K.

6.CLARKE, G.L. (1963). Elements of Ecology, John Wiley and Sons, Inc., New York.

7.GHOSH, G.K. (1992). Environmental Pollution, Ashish Publishing house, New Delhi.

8.SHARMA, B.K. and KAUR, H. (1997). An Introduction to Environmental pollution, Goel Publishing House Meerut.

9.SINHA, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.

10.MUNN, R.E. (1975) Environment Impact Assessment, Principles and Procedures, John Wiley and Sons, Toronto.

11.AHMAD, Y.J and SAMMY, G.K. (1985). Guidelines to Environmental Impact Assessment in Developing Countries. Hodder and Stoughton, London.

12.KANNAN. K. (1991) Fundamentals of Environmental pollution. S.Chand & Co., Ltd., New Delhi

Web Resources:

https://www.atsdr.cdc.gov/training/toxmanual/modules/1/lecturenotes.html

http://pustaka.unp.ac.id/file/abstrak_kki/EBOOKS/Environmental%20Toxicology%203rd%20edition.pdf

http://envirotox.hu/wp-content/uploads/2017/10/Environmental-toxicology_lecture-notes_part1.pdf

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the concept of population and community ecology.
CO 2:	Learn pollution sources, effect, control methods.
CO 3:	Learn Solid waste management and its status in India.
CO 4:	Understand toxic substances, effect, evaluation, toxicity determination an routeof entry.
CO 5:	Understand excretion of toxicants and biotransformation

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	M	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Elective Course- III	Wildlife Biology	Course Code: PGZE3
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To study about wildlife biologists and zoologists. • To understand research & development, carry out in wildlife management. • To know the conservation plans that combat these threats, and protect our natural resources. • Understand the importance of wildlife censes • Know the wild life protection Act And its importance	
UNIT	**CONTENT**	**HOURS**
I	Definition of wildlife: Causes of wildlife depletion- need for wildlife conservation – IUCN Categories – endangered species of birds and mammals in India.	18
II	Wildlife sanctuaries, National park and Biosphere reserves – Definition and importance.Sanctuaries: vedanthangal Bird sanctuary – Mudumalai wildlife sanctuary – point calimere wildlife sanctuary.National parks: Corbett national park, guindy national park, Biosphere reserves – Gulf of Mannar	18
III	Importance of Wildlife Censes – Censes Techniques: Direct methods –Line Transect Method –Block count method. Indirect Method: Pugmark techniques and pellet methods.	18

IV	Zoos and their importance – types of enclosures – food and feeding of zoo animals – veterinary care of zoo animals – zoo education. Case study of Aringar Anna Zoological Park.	18
V	Wildlife (Protection) Act 1972: Introduction – Schedule – Declaration of Wildlife Sanctuary and National parks. Human wildlife conflicts with reference to Elephant.	18

Text Book:

1. **Saharia.V.B** 1982 Wildlife in India, Nataraj Publishers, Dehradum.
2. **Goutam Kumar Saha and Subhendu Mazumdar**- Wildlife Biology: An Indian Perspective
3. **Ashok Shantilal Kothari and Boman Framji Chhapgar**; Wildlife of the Himalayas and the Terai Region (Bombay Natural History Society)"
4. **Raymond F Dasmann-** Wildlife Biology

Reference Books:

1. **Dasman.R.F** 1964 Wildlife Biology, Jhon and Wildy and sons New York. Pp231
2. **Giles R.H.J** (Ed) 1984 Wildlife Management Techniques 3rd Edition. The Wildlife Society, Washington, D.C. Natraj Publishers, Dehradum, India.
3. **Sesharri.B** 1986 India's Wildlife reserves, Sterling Pup'rs pvt Ltd,. New Delhi.
4. A. R. E. Sinclair, Graeme James Caughley, and John M. Fryxell
5. John M. Fryxell, A. R. E. Sinclair and Graeme James Caughley
6. **Anthony R.E.. Sinclair, John M. Fryxell, Graeme Caughley**. – 2nd ed. p. cm. Rev. ed

Web Resources:

http://www.jnkvv.org/PDF/06042020101735WILDLIFE%20BIOLOGY.pdf

https://www.slideshare.net/Bikramsingh106/conservation-biology-note-pdf

https://rajusbiology.com/biodiversity-and-conservation-notes-pdf/

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the need of wildlife conservation and categories of IUCN.
CO 2:	Know wildlife sanctuaries and National parks.
CO 3:	Learn wildlife census techniques and methods..
CO 4:	Understand the importance of Zoo's and case study.
CO 5:	Know wildlife protection Act's

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	M	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-VI / Core Course-XIII	Environmental Biology and Evolution	Course Code: PGZM
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To learn the limiting factors of the environment • Understand the basic concept of biodiversity and its indices • Learn the advanced technique of remote sensing and satellite image analysis • Understand the modern concept of origin of life • Learn the advanced evolutionary process at the molecular level	
UNIT	**CONTENT**	**HOURS**
I	Concepts of ecology: Limiting factors- Liebig's law of minimum- Shelford's law of tolerance Population ecology: Attributes, estimates, density, diversity indices; Factors influencing population fluctuations Community ecology: community structure, dominance, stratification, succession and niche concept Solid Waste Management: Types of solid wastes – degradable and non-degradable wastes; Collection, segregation, transportation and disposal of solid wasts (integrated waste management, Landfill, incineration, recycling, biological reprocessing, energy recovery, avoidance and reduction). Biomedical waste management-Components of biomedical	18

	wastes, waste management and protection from biomedical wastes. Status of solid waste management in India.	
II	Habitat Ecology- lake, marine, rocky, muddy and sandy shore, estuary, terrestrial-grassland,forest,desert Biodiversity –basic concepts, types, values, threats , methods of conservation- sustainable development and biodiversity indices. Wildlife conservation-Wildlife sanctuaries and National Parks-Biosphere Reserves Pollution – sources, effects, and control of air, water, organic pollutants, BOD, COD, pesticides, heavy metals, thermal, radiation, oil, land and noise pollution – industrial pollution – with reference to Distilleries, paper mills, Tanneries, indicator organisms – bioaccumulation – biomagnification and biomonitoring of pollutants. Environmental impact assessment (EIA) – definition, steps in EIA, method of EIA, problems involved in EIA, reporting (EIS).	18
III	Remote sensing – aerial photography – satellite images – thermal, infra – red, radar images, ecological applications – resources exploration, understanding environmental factors, predicting natural hazards.GIS and its application, Space ecology – Exobiology – hazards of space travel. Environmental Protection Act 1986, 1990, 1997 and Environmental Protection Act –Air quality 2010.	18
IV	Origin and Evolution of Life-theories of origin of life- modern concept of origin of life -origin of basic biological molecules, abiotic synthesis of organic monomers and polymers- origin of Prokaryotes- origin of eukaryotic cells Present status of the concept of natural selection – genetical theory of natural selection – evidences for the role of natural	18

	selection Neo – Lamarckism – present concept of recapitulation – genetic and non-genetic variations – origin and evolutionary significance. Polymorphism and selection – definitions, transient polymorphism, balanced polymorphism, genetic polymorphism, enzyme polymorphism and selection advantages. Fossils-fossilization and its significance. Geological time scale - eras, periods and epochs.	
V	Polyploidy and evolution – genetic assimilation – genetic speciation – species concept – evolutionary trends – canalization of selection – orthoselection. Molecular evolution – gene evolution, evolution of gene families, molecular drive, assessment of molecular variation, punctuated equilibria and neutrality theory. Evolution of population – from races to species, adaptation pattern, behavioural adaptations and strategies, sexual competition and selection, isolating mechanisms, mode of speciation and evolutionary rate. Adaptation - Nature and types of adaptation – Adaptive trends - Quantifying adaptation - Batesian and Mullerian mimicry and evolution. Evolution of human brain ,communication,speech and language. Evolution of culture.	18
VI	Analysis of Marine/ Freshwater Plankton	

Text Book:

1. Biswarup Mukerjee – Fundamentals of Environmental Biology –Silverline Publications – Allahabad.
2. Agarwal – Environmental Biology – AgroBotanical Publishers (India)-New Delhi.

Reference Books:

1. ODUM, E.P. (1996) Fundamentals of Ecology (III Edn), Nataraj Publishers, Dehradun.
2. SHARMA, B.K. and KAUR, H. (1997). Environmental Chemistry, Goel Publishing House, Meerut.
3. TACCONI, L. (2000) . Biodiversity and Ecological Economics : Participation, Values and Resource Management. Earthscan Publications Ltd., London.
4. CASTRI, F.D. and YOUNES, T. (1996). Biodiversity : Science and Development. CCA Int., Wallingford, U.K.
5. CHAPMAN, J.L., and REISS, M.J. (1997). Ecology – Principles and Applications, CAMBRIDGE University Press, U.K.
6. CLARKE, G.L. (1963). Elements of Ecology, John Wiley and Sons, Inc., New York.
7. GHOSH, G.K. (1992). Environmental Pollution, Ashish Publishing house, New Delhi.
8. SHARMA, B.K. and KAUR, H. (1997). An Introduction to Environmental pollution, Goel Publishing House Meerut.
9. SINHA, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.
10. MUNN, R.E. (1975) . Environment Impact Assessment, Principles and Procedures, John Wiley and Sons, Toronto.
11. AHMAD, Y.J and SAMMY, G.K. (1985). Guidelines to Environmental Impact Assessment in Developing Countries. Hodder and Stoughton, London.
12 .KANNAN. K. (1991) . Fundamentals of Environmental pollution. S.Chand & Co., Ltd., New Delhi
13 .KRISHANAN, N.T. (1994). Environmental Biology. JJ Publication, Madurai.
14 .VERMA, S.R. , SHARMA, R.S. and RANI, G. (1988). Ecology and Animal behaviour. Jaiprakash Nath & Co., Meerut.

Web Resources:

.http://www.uilis.unsyiah.ac.id/oer/files/original/1c18821adec76287db06550e04d69314.pdf
https://gurukpo.com/Content/B.SC/Ecology%20Environmental%20Science%28Zoology-2%29%28B.Sc%29.pdf

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand Scope of Ecology with sub divisions
CO 2:	Know the components of ecosystem and animal relationship.
CO 3:	Understand Biogeochemical cycles
CO 4:	Understand the importance and conservation of Biodiversity
CO 5:	Learn origin of life and theories of evolution

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV / Core Course-XIV	Practical IV (CC XIII)	Course Code: PGZNY
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To learn the community structure and its functions • Understand the habited ecology in different eco system • Learn the advanced technical remote sensing and radar image analysis • Understand the basic and modern concept of origin of life • Understand the evolution process of population at molecular level	
UNIT	**CONTENT**	**HOURS**
I	Report on ecological collection representing different habitats and their adaptations – sandy, muddy, rocky shores, Deep sea.	12
II	Hydrological studies of water samples with special reference to pollution	12
III	Water quality index (WQI) calculation using 9 parameters such as pH, Temperature, Turbidity, Conductivity, Total solids, Dissolved Oxygen, BOD, Nitrate and Phosphate.	12
IV	Qualitative estimation of Marine & Freshwater plankton and Quantitative estimation of Marine & Freshwater plankton.	12
V	Spotters: stick insect, leaf insect, fossil records, Archaeopteryx, Mimicry and colouration. Student activity: observation on the locomotion of earthworm in different places and has to submit a case study report .	12

Text Book:

1.BISWARUP MUKERJEE – Fundamentals of Environmental Biology –Silverline Publications – Allahabad.

2.AGARWAL – Environmental Biology – AgroBotanical Publishers (India)-New Delhi.

Reference Books:

1. ODUM, E.P. (1996) Fundamentals of Ecology (III Edn), Nataraj Publishers, Dehradun.

2. SHARMA, B.K. and KAUR, H. (1997). Environmental Chemistry, Goel Publishing House, Meerut..

3. TACCONI, L. (2000) . Biodiversity and Ecological Economics : Participation, Valuesand Resource Management. Earthscan Publications Ltd., London..

4. CASTRI, F.D. and YOUNES, T. (1996). Biodiversity : Science and Development. CAB Int., Wallingford, U.K.

5. CHAPMAN, J.L., and REISS, M.J. (1997). Ecology – Principles and Applications, CAMBRIDGE University Press, U.K.

6. CLARKE, G.L. (1963). Elements of Ecology, John Wiley and Sons, Inc., New York.

7. GHOSH, G.K. (1992). Environmental Pollution, Ashish Publishing house, New Delhi.

8. SHARMA, B.K. and KAUR, H. (1997). An Introduction to Environmental pollution, Goel Publishing House Meerut.

9. SINHA, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.

10. MUNN, R.E. (1975) . Environment Impact Assessment, Principles and Procedures, John Wiley and Sons, Toronto.

11. AHMAD, Y.J and SAMMY, G.K. (1985). Guidelines to Environmental Impact Assessment in Developing Countries. Hodder and Stoughton, London.

12 .KANNAN. K. (1991) . Fundamentals of Environmental pollution. S.Chand & Co., Ltd., New Delhi

13 .KRISHANAN, N.T. (1994). Environmental Biology. JJ Publication, Madurai.

14 .VERMA, S.R. , SHARMA, R.S. and RANI, G. (1988). Ecology and Animal behaviour. Jaiprakash Nath & Co., Meeru

Web Resources:

1.https://www.hzu.edu.in/bed/E%20V%20S.pdf

2.https://www.ikbooks.com/books/book/earth-environmental-sciences/textbookenvironmental-biology/9788188237876/

Course Outcomes:

On completion of the course the learner will be able

..

CO 1:	Able to demonstrate broad based knowledge of the fundamentals of environmental biology and evolution
CO 2:	Ability to demonstrate skills in the observation and experimental study of organisms using both field based and laboratory based approach..
CO 3:	Have preparation of case study report and the scientific document preparation
CO 4:	Understand in identifying analyzing, hypotheses, interpreting results and conclusions, and evaluating quality through critique..
CO 5:	Hands on training in identification of plankton .

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV/ Elective Course-IV	Economic Entomology	Course Code: PGZE4
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To study the insect pests and their control measures. • To study the economic importance of insects as pollinators, predators and insect pests (vector borne diseases) and their control. • To study the basic concepts of pesticides and integrated pest control. • Familiar with culturing of economically important beneficial insect • To know the life cycle of harmful insect test	
UNIT	**CONTENT**	**HOURS**
I	Scope, An outline classification of insects ; Life cycle of a Hemipteran, Coleopteran and Lepidopteran pest (Two examples with mouth parts of insects-useful and harmful insects) And their interrelations with environments, Insects as pollinators, Parasitoids, Scavengers and weed killers.	18
II	Beneficial insects: Sericulture – Types of silkworm. Life cycle and rearing of mulberry silkworm, Bombyx mori- Life cycle and rearing of non mulberry silkworm (Tasa - Antheraeamylitta); Cocoon processing for silk fabric – cocoon boiling, reeling, re reeling, winding, doubling, twisting and weaving. Apiculture – Types of honeybees. Life cycle, culture, movable frame hive, bee products and its economic importance Lac culture : lac insect,-lacciferlacca – Life cycle, Lac processing, Lac products and Economic importance.	18

III	Harmful insects – Pest of stored grains, Rice, Coconut, Cotton, Sugarcane, Pulse crops, Cereal crops, Oilseed crops and pest of Fruits and Vegetables. Household pests of medical importance – Mosquito, Housefly, Cockroach, Ticks, Mites, Louse, Bed bug, Plasmodium, Filarial worm, Loa loa, Dust Mite.	18
IV	Principles and methods of pest management – Principles of Insect control – Prophylactic measures – Conventional, Mechanical, Physical methods – Genetic control and Quarantine. Biological control : Parasites, Predators and Microbial agents. Chemical methods : Pesticides – general classification – classification based on mode of action, mode of entry and bio pesticides.	18
V	Recent trends in pest control – Pheromones, Attractants, Repellants and Chemosterilants. Integrated pest management and its importance & applications. Assesment to pest population, Estimation of pest damage – Pest outbreak – Pest survelliance.	18

Text Book:

1.VASANTHARAJ DAVID. B and V.V. RAMAMURTHY (2011). Elements of Economic Entomology, Namrutha publications, Chennai 600 116.

2.TEMPHARE. D.B (2009) Modern Entomology, Himalaya publishing Mumbai.

3.AMBROSE, DUNSTON P., (2004) The insects: Structure, function and Biodiversity, Kalyani.

Reference Books:

1.CHAPMAN, R.F (2002) The insect structure and functions. English Languages Book Society, Hooder Strongon.

2.MIKE, W., SEVICE (1999) Medical Entomology for student, Cambridge press.

3.NAYER, K.K., ANANTHAKRISHNAN T.N and DAVID B.V General and Applied Entomology. M.Grow Hill Publications, Newdelhi.

4.RATHNASWAMY G.K (1986). A handbook of medical Entomology and Elementry Parasitology S. Viswanathasn printers & Publishers Pvt.Ltd.

5.SRINIVASTAVA, K.P (1993) A Text book of applied Entomology. Vol I & II Kalyani Publishers, New Delhi.

6.P.G FENEMORE, ALLAPRAKASH, (1992). Applied Entomology : Wiley Eastern Ltd., Delhi.

7.ULLAL., S. R and M.N NARASIMHANNA (1987). Hand book of Practical sericulture, Central silk board (Ministry of textiles – Government of India), United Mansion, 39, Mahatma Gandhi road, Bangalore.

8.P.G. FENEMORE Manual. Silkworm Rearing. FAO Agricultural Service Bulletin, Rome

9.WIGGLES WORTH J.B., 1994. Insect physiology, Chapman and hall, London.

10.TEMPHARE D.B., 1984. A text book of insects Morphology, Physiology and Endocrinology.S. Chand and Co., New Delhi.

Web Resources:

https://www.researchgate.net/publication/327282644_A_Text-book_of_Economic_Entomology_M_Dayib

https://www.helpforag.app/2018/03/entomology-notes.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Study the classification of insects
CO 2:	Understand the beneficial insect in detail
CO 3:	Learn how pest become harmful insect.
CO 4:	Learn integrated pest management methods
CO 5:	Understand the pest control measures and methods

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	M	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	M	S	M	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV / Elective Course-IV	Nutrition and Clinical Biochemistry	Course Code:PGZE4
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To learn the nutritional requirement • Understand the basal metabolic and energy balance • Hands on training in clinical biochemistry • Learn the advanced biochemical analysis • Understand the criteria for selecting a method for biochemical analysis	
UNIT	**CONTENT**	**HOURS**
I	Nutritional requirements :Basic concepts, scope and methodology; Principal food components; Vitamins: structure and function; Food nutrients: recommended allowances and their modifications under stress conditions; Deficiency and excess of principal nutritional components; Formula diets and c.	18
II	Nutrition in health and diseases: Protein energy malnutrition; Energy balance and requirements: basal metabolic rate (BMR); Factors affecting BMR and its measurement; Resting metabolic rate; Specific dynamic action of food; Dietary fat and heart disease and cancer; Atherosclerosis: risk factors and protective measures; Nutritional management of diabetes and obesity; Weight management; Anthropometric measurements; Nutrition and infection; Basics of nutrigenomics.	18

III	Clinical biochemistry and quality assurance: Clinical chemistry/biochemistry: concept, definition and scope; Biological samples: types, collection, processing, stability and storage; Phlebotomy tubes; Serum and serum separator devices; Chemical composition of biological fluids: blood, urine and cerebrospinal fluid; Reference range.	18 s
IV	Quality assurance: Accuracy and precision; Factors influencing the accuracy of results; Levy-Jennings' chart; Reliability of laboratory methods; Interferents; Responsibilities of a clinical biochemist. Biochemical tests in clinical practice, Biochemical tests in clinical practice: uses of a chemical/biochemical analysis; Criteria for selecting a method for biochemical analysis.	88
V	Biochemical tests in clinical practice: Biochemical tests in clinical practice: uses of a chemical/biochemical analysis; Criteria for selecting a method for biochemical analysis; Enzymes as diagnostic tool; Advantages and disadvantages of enzyme assays; Isoenzymes and their diagnostic importance; Methods for the detection of isoenzymes; Organ function tests: clinical presentation and diagnosis of the diseases of the liver and kidney; Bilirubin metabolism and hyperbilirubinaemia; Acid base disorders.	18

Text Book:

1.VENKATRAMAN SHREEMATHY, 2015.Nutrition and Biochemistry for Nurses 2nd Edition. Elsevier

2.SATYANARAYANAN. 2017. Biochemistry 5th Edition, Elsevier

Reference Books:

1. SHARMA, DC., 2017.Nutritional Biochemistry by, CBS PUBLICATION

2.RAMNIK SOOD,2019. Textbook of Clinical Biochemistry, Atithi Medical Book Publisher

Web Resources:

https://www.siirt.edu.tr/dosya/personel/beslenme-biyokimyasi-ders-kitabi-siirt-2018221143328398.pdf

https://www.researchgate.net/publication/311555830_Clinical_biochemistry_of_nutrition

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the basic concept of nutritional requirement and its methods
CO 2:	Know the nutrition in health and diseases and basic of nutrigenomics
CO 3:	Learn the clinical test sample collection, preservation and storage for further testing..
CO 4:	Understand the quality assurance by criteria selection for biochemical analysis.
CO 5:	Getting hands on training in biochemical laboratory test methods

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	M	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV / Elective Course-V	Coastal Aquaculture	Course Code: PGZE5
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To know the shore-based aquaculture in India and world • Familiar with the major cultivable species • Hands on training in aquaculture system. • Understand the fish nutrition and feed management. • To know the marketing channels,legal issues and government policies	
UNIT	**CONTENT**	**HOURS**
I	**Cultivable brackish water finfish and shellfish species**: Traits of important cultivable fish and shellfishes (sea bass, mullet, milkfish, grouper, cobia, snappers, tiger shrimp, white shrimp, mud crab, mussel, clam, oysters (both edible and pearl), lobsters, seaweeds. Seed resources: seed collection from natural and artificial and collection of hatchlings.	**18**
II	**Cultivable brackish water finfish and shellfish species**: Traits of important cultivable fish and shellfishes (sea bass, mullet, milkfish, grouper, cobia, snappers, tiger shrimp, white shrimp, mud crab, mussel, clam, oysters (both edible and pearl), lobsters, seaweeds. Seed resources: seed collection from natural and artificial and collection of hatchlings.	**18**

III	**Shore based aquaculture system**: Traditional (pokkali, bheries, gazanis, khazans), semiintensive, intensive aquaculture practice of commercially important species of fish (*Mugil cephalus, Chanos chanos, Elops machnata, Megalops cyprinoibes and Lates calcarifer*) and shellfishes (Shrimp, Mussel, Edible and pearl Oyster culture).	**18**
IV	**Fundamentals of fish nutrition and feed management**: Growth in fish; Principal nutrients and nutritional requirements of cultivable fish and shellfishes. Classification of feed : Live and Artificial. Principles of feed formulation. Composition of an ideal fish feed. Qualities of good artificial feed. Food conversion ratio. Feeding schedule and methods.	**18**
V	**Marketing of Fin and shell fishes**: Marketing channels – Fresh and preserved fin and shell fishes marketing. Risk of fish marketing. Organization involvement in fish marketing. Role of Research and Devevelopment institutions in Coastal zone management – Legal empowerment and licensing of farms.– Government policies – Aquaculture Authority of India.	**18**

Text Book:

1. Santhanam, R., Ranganathan, N. and Jagathesan, G.1990. Coastal Aquaculture in India. CBS Publisher & Distributors, New Delhi.
2. Arumugam,N.2016. Aquaculture. Saras publications.
3. V.B.SAKHARE . Reservoir fisheries and Ecology – Mangalam Publications,L-21/1.St.No.5,Shivaji margnear Kali Mandir,Delhi-53.
4. A.C.LORG.Fish feeding and Integrated fish farming,Cyber Tech Publications,New Delhi

Reference Books:

1.BARDACH, J.E., J.H.RYTHER & W.O. MCLARNEY- Aquaculture, Wiley-Inter Science, 1972.

2. HUET, M & J. TIMMERMANS: Text Book of fish culture: Breeding and cultivation of fish, 2nd ed., fishing News Book Ltd., 1986.

3. PILLAY T.V.R. Aquaculture Principles and Practices, Fishing News Books, 1981.
4. ROBERT, R.STICKNEY. Principles of Aquaculture, John wiley & Sons Inc. 1984.
5. SANTANAM R, N. RAMANATHAM & G. JAGATHESAN. Coastal Aquaculture, CBS Publishers and Distributors, 1990
6. IMAI T. Aquaculture in shallow seas, Amerind Pub. Co.,1977.
7. JHINGRAN V.G . Fish and Fisheries of India,Hindustan Pub. corp., 1982.
8. MILNE P.H. Fish & Shellfish farming in Coastal waters, FNB Ltd., 1972.
9.SRIVASTA.C.B. Fisheries Science And Indian Fishery- Kital Mahal 22A- Sangai Nadu, Allahabad.
10.VENKATARAMANUJAM,N.RAMANATHAN . Introduction to Fishery Science- Janshi Publications 11-A. Palayamkottai Road.Tuticorin – 628 008.
11.SHAMMI.Q.J. BHATINAGAR.A.S. Applied fisheries – Updesh Purohit for Agrobios (Indian), Jodhpur.
12.YADAV.B.N. Fish and Fisheries – Daya Publishing house
13. ROUNSEFELL .G.A.HAMYEVERHART . Fishery Science. Method & Application – International Books & Periodicals supply services.
14. KURIAN.C.V. SEBATIAN.V.O. Prawns and Prawn fisheries of India. Hindustan Publishing corporation – Delhi.
15. SHAILENDRA GHOSH . Fisheries and aquaculture management – Adhyayan publication & Distributors.

Web Resources:

http://www.fao.org
http://www.caa.gov.in

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand different shore-based aquaculture in India and world
CO 2:	Identify the major cultivable species
CO 3:	Hands on training in fin and shell fish system
CO 4:	Learn fish nutrition and feed management
CO 5:	Become an entrepreneur in fish marketing

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	M	S	S	S	M	S
CO4	S	S	S	S	S	S	M	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV / Elective Course- V	Comparative Animal physiology	Course Code: PGZE5
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	• To understand and compare the early vertebrate developmental stages • Able to compare skeleton of vertebrate animals • Able to compare exoskeleton vertebrate animals • To compare and contrast internal organs of vertebrate • Able to compare endocrine system of vertebrate	
UNIT	**CONTENT**	**HOURS**
I	Early vertebrate morphogenesis- fertilization cleavage and blastula, formation of neural tube and notochord, mesoderm formation, fate of ectoderm, endoderm and embryonic membrane. Skin and pigment of fish's , cyclostomes, amphibian, reptiles and mammals.	18
II	ntroduction to Skelton and heterotopic bones and cartilage. Vertebrate ribs and sternum of fishes and tetrapods. Te vertebrate skull of bony fishes , amphibian reptiles and birds.	18
III	Muscles of bony fishes and tetrapods. Appendicular muscle and integumentary muscle and electric organs. Comparative digestive system of fishes, amphibian reptiles and birds.	18
IV	Comparative circulatory and nervous system of fishes, amphibian reptiles and birds. Comparative cstudy of sense organs.	18
V	Comparative study of endocrine glands and urinogenital system of fishes, amphibian reptiles, birds and mammals.	18

Text Book:

1. Moyes, CD and Schulte, PM. Principles of Animal Physiology. Benjamin Cummings, New York, 1st Edition.

2. Randall, Burggren and French. Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York, 5th Edition, 2002.

3. Willmer, Stone and Johnston. Environmental Physiology of Animals. Blackwell Science Ltd. 2000. (QP82. W48 2000).

4. Schmidt-Nielsen. Animal Physiology: Adaptation and environment. Cambridge University Press.

Reference Books:

1. Hill, Wyse, and Anderson 2008 . Animal Physiology Second Edition, Sinauer
2. Comparative Animal Physiology" by Philip C Withers
3. "Comparative Animal Physiology" by C Ladd Prosser
4. Comparative Physiology: Primitive Mammals" by Knut Schmidt-Nielsen and Liana Bolis
5. "Advances in Comparative and Environmental Physiology: Animal Adaptation to Cold" by J A Boulant and R J Brooks
6. Comparative Animal Physiology: Environmental and Metabolic Animal Physiology" by C Ladd Prosser
7. Principles of Zoology – Touching the Structure, Development, Distribution, and Natural Arrangement of the Races of Animals, Living and Extinct" by Louis Agassiz
8. "Advances in Comparative and Environmental Physiology" by J Machin and S H Wright.
9. "Comparative Physiology: Animals-Hormones and Regulation; Evolution of Physiological Mechanisms" by Open University
10. "Comparative Physiology of Animals: Environmental Approach" by Richard W Hill
11. . The Comparative Physiology of the Pancreatic Islets (Zoophysiology)" by August Epple and Jack E Brinn

Web Resources:

https://coek.info/pdf-comparative-animal-physiology-c-ladd-prosser-frank-a-brown-jr-w-b-saunders-co-we.html
https://www.researchgate.net/publication/286456096_DrPBReddy's_TEXT_BOOK_OF_ANIMAL_PHYSIOLOGY

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand the early vertebrate morphogenesis
CO 2:	Understand and learn to compare endoskeleton of vertebrates
CO 3:	Understand and know to compare exoskeleton of vertebrates
CO 4:	Ability to compare and understand circulatory and nervous system of vertebrates
CO 5:	Skill to compare endocrine system and urinogenital system of vertebrates

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	M	S	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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