

Sadakathullah Appa College

(Autonomous)

(Reaccredited by NAAC at an 'A' Grade. An ISO 9001:2015 Certified Institution)

Rahmath Nagar, Tirunelveli- 11.

Tamil Nadu.

PG DEPARTMENT OF ZOOLOGY



CBCS SYLLABUS

Learning Outcomes-based Curriculum Framework for

ZOOLOGY (M.Sc.)

(Applicable for the students admitted from June 2021 as per
the Resolutions of the Academic Council Meeting held on 20.03.2021)

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POSTGRADUATE DEPARTMENT OF ZOOLOGY
CBCS SYLLABUS
M.Sc. Zoology (2021-2024)
COURSE STRUCTURE

I SEMESTER			II SEMESTER		
COURSE	H/W	C	COURSE	H/W	C
DSC –I	5	4	DSC –IV	5	4
DSC – II	5	4	DSC –V	5	4
DSC –III	5	4	DSC –VI	5	4
DSE-I	4	4	DSE-III	4	4
Practical-I	4	2	Practical – III	4	2
Practical-II	4	2	Practical - IV	4	2
IDC – I	2	2	SEC	2	2
Library Hour	1		Library Hour	1	
TOTAL	30	22	TOTAL	30	22
III SEMESTER			IV SEMESTER		
DSC-VII	5	4	DSC –X	5	4
DSC –VIII	5	4	DSC –XI	5	4
DSC –IX	5	4	Project	8	8
DSE –III	4	4	DSE -IV	4	4
Practical-V	4	2	Practical-VII	4	2
Practical-VI	4	2	Practical-VIII	4	2
IDC -II	2	2			
Library Hour	1				
TOTAL	30	22	TOTAL	30	24

DISTRIBUTION OF HOURS, CREDITS, NO. OF PAPERS & MARKS				
SUBJECT	HOURS	CREDITS	NO. OF PAPERS	MARKS
DSC+Project	63	52	12	1250
Practical	32	16	8	400
DSE	16	16	4	400
IDC	4	4	2	100
SEC-SWAYAM-NPTEL Course	2	2	1	50
Library Hour	3			
TOTAL	120	90	27	2200

POSTGRADUATE DEPARTMENT OF ZOOLOGY
M.Sc. Zoology (2021-2024)
COURSE STRUCTURE

SEM	Course	Title of the Courses	Sub. Code	H/W	L*	T*	P*	C	Marks		
									I	E	T
I	DSC-I	Biology of Invertebrates and Chordates	21PCZO11	5	3	2	-	4	40	60	100
	DSC-II	Biochemistry	21PCZO12	5	3	2	-	4	40	60	100
	DSC-III	Cell and Molecular Biology	21PCZO13	5	3	2	-	4	40	60	100
	DSE-I	A) Apiculture	21PEZO11A	4	3	1	-	4	40	60	100
		B) Systematics and Animal Diversity	21PEZO11B	4	3	1	-	4	40	60	100
		C) Endocrinology	21PEZO11C	4	3	1	-	4	40	60	100
	P - I	Biology of Invertebrates and Chordates Practicals	21PCZO1P1	4	1	-	3	2	40	60	100/2
	P - II	Biochemistry & Cell and Molecular Biology Practicals	21PCZO1P2	4	1	-	3	2	40	60	100/2
	IDC-I	Ornamental fish culture	21PIZO11	2	1	1	-	2	40	60	100/2
		Library Hour		1	-	-	-	-	-	-	-
II	DSC IV	Developmental Biology	21PCZO21	5	3	2	-	4	40	60	100
	DSC V	Genetics and Evolution	21PCZO22	5	3	2	-	4	40	60	100
	DSC VI	Animal Biotechnology	21PCZO23	5	3	2	-	4	40	60	100
	DSE-II	A) Vermiculture	21PEZO21A	4	3	1	-	4	40	60	100
		B) Environmental Biology	21PEZO21B								
		C) Nanobiotechnology	21PEZO21C								
	P - III	Developmental Biology Practicals	21PCZO2P1	4	1	-	3	2	40	60	100/2
	P - IV	Genetics and Evolution & Animal Biotechnology Practicals	21PCZO2P2	4	1	-	3	2	40	60	100/2
	SEC	SWAYAM-NPTEL Course	21PSZO21	2	1	1	-	2	25	75	100/2
		Library Reading Hour		1	-	-	-	-	-	-	-
III	DSC VII	Animal Physiology	21PCZO31	5	3	2	-	4	40	60	100
	DSC VIII	Biostatistics and Bioinformatics	21PCZO32	5	3	2	-	4	40	60	100
	DSC IX	Research Methodology	21PCZO33	5	3	2	-	4	40	60	100

	DSE-III	A) Microbiology	21PEZO31A	4	3	1	-	4	40	60	100
		B) Fisheries and Aquaculture	21PEZO31B								
		C) Parasitology	21PEZO31C								
	P -V	Animal Physiology Practicals	21PCZO3P1	4	1	-	3	2	40	60	100/2
	P -VI	Biostatistics and Bioinformatics & Research Methodology Practicals	21PCZO3P2	4	1	-	3	2	40	60	100/2
	IDC-II	Applied Zoology	21PIZO31	2	1	1	-	2	40	60	100/2
		Library Reading Hour		1	-	-	-	-	-	-	-
IV	DSC X	Immunology	21PCZO41	5	3	2	-	4	40	60	100
	DSC XI	Entomology	21PCZO42	5	3	2	-	4	40	60	100
	Project	Project	21PPZO41	8	2	-	6	8	-	-	150
	DSE-IV	A) Sericulture	21PEZO41A	4	3	1	-	4	40	60	100
		B) Poultry and Dairy Science	21PEZO41B	4	3	1	-	4	40	60	100
		C) Animal Feed Technology	21PEZO41C	4	3	1	-	4	40	60	100
	P - VII	Immunology Practicals	21PCZO4P1	4	1	-	3	2	40	60	100/2
	P - VIII	Entomology Practicals	21PCZO4P2	4	1	-	3	2	40	60	100/2
			Total	120				90			2200

*** L-Lecture Hours * T-Tutorial Hours * P-Practical Hours**

M.Sc. Zoology

Programme Learning Outcomes

PLO	Upon completion of M.Sc. Degree Programme, the graduates will be able to:
PLO 1	Disciplinary Knowledge Acquire in-depth scientific knowledge in the core areas of study.
PLO 2	Creative Thinking and Practical Skills / Problem Solving Skills <ul style="list-style-type: none"> • Enrich skills of observation to draw logical inferences from scientific experiments/ programming and skills of creative thinking to develop novel ideas. • Hone problem solving skills in theoretical, experimental and computational areas and to apply them in real life situations.
PLO 3	Sense of inquiry and Skilled Communicator / Research, Innovation and Entrepreneurship <ul style="list-style-type: none"> • Develop the capability for raising appropriate questions relating to the current/emerging issues encountered in the scientific field and to plan, execute and express the results of experiments / investigations through technical writings as well as through oral presentations. • Design innovations for exploring the unexplored areas in diverse fields to accomplish socially relevant and economically beneficial innovative research projects. • Become a skilled entrepreneur for launching start-up / business ventures to improve the economy of the nation.
PLO 4	Ethical Awareness / Team Work / Environmental Conservation and Sustainability <ul style="list-style-type: none"> • Equip them for conducting work as an individual / as a member, or as a leader in diverse teams upholding values such as honesty and precision, and thus preventing unethical behaviors such as fabrication, falsification, misrepresentation of data, plagiarism etc., to ensure academic integrity. • Realise that environment and humans are dependent on one another and to know about the responsible management of our ecosystem for survival, and for the well-being of the future generation as well.
PLO 5	Digital Literacy/Self-Directed Learning/Usage of ICT/Lifelong Learning <ul style="list-style-type: none"> • Get access to digital resources, to use them judiciously for updation of knowledge and also to engage in remote/independent learning. • Inculcate the habit of learning continuously through the effective adoption of ICT to update knowledge in the emerging areas in Sciences for inventions/discoveries so that the knowledge transferred from laboratory to land would yield fruitful results for the betterment of global society.

Programme Specific Outcomes (PSO)

PSO.NO.	Upon completion of M.Sc. Zoology Degree Programme, the graduates will be able to:	PLOs Matched
PSO - 1	Understand the basic concepts in Invertebrates, Chordates and their morphological features, adaptations and classifications, Cell Biology, Biochemistry, Developmental Biology, Genetics, Evolution, Microbiology, Immunology, Research Methodology, Statistics, Physiology, Bioinformatics, Taxonomy, and Ecology.	PLO-1, 5
PSO – 2	Acquire the practical skills in the fields of Biotechnology, Entomology, Immunology, Fisheries and Aquaculture and Bioinformatics to solve real-time problems.	PLO-1,2,3
PSO – 3	Generate innovative ideas for performing experiments and researches in the areas of Biological Sciences, Aquaculture, Apiculture, Vermiculture, Mushroom Culture, Sericulture, Ornamental Fish Culture and Poultry and Dairy Science by developing the required skills for generating a source of income to become entrepreneurs.	PLO-2,3,4
PSO – 4	Analyze the relationships among plants, animals, microbes and deal with the local, national and global environmental issues on matters of sustainability by realizing the responsibilities, ethical values and concern of an individual and society as a whole.	PLO-1,4
PSO – 5	Develop experimental procedures, tools and techniques to deliver relevant applications in the fields of Biostatistics, Biotechnology and Bioinformatics through self-directed learning with effective adaptation of ICT.	PLO-1,2,5

SEMESTER I

Course Title	BIOLOGY OF INVERTEBRATES AND CHORDATES
Total Hours	75
Hours/Week	5
Subject Code	21PCZO11
Course Type	DSC-I
Credits	4
Marks	100

GENERAL OBJECTIVE:

To comprehend the functional morphology, mode of life including the affinities of invertebrates and chordates.

COURSE OBJECTIVES:

CO No.	The learners will be able to
CO-1	Understand the functional morphology of Protozoa, Porifera, Coelenterata and Ctenophora
CO-2	Illustrate the functional morphology, adaptation of Platyhelminthes, Aschelminthes and Annelida.
CO-3	Explain the special morphological features and physiological functions of Arthropoda, Mollusca and Echinodermata.
CO-4	Classify the origin, evolution and functional morphology of Protochordates, Fish and Amphibia.
CO-5	Compile the origin, evolution and functional morphology of Reptiles and Birds.

Unit I: PROTOZOA, PORIFERA, COELENTERATA AND CTENOPHORA

Phylogeny of Invertebrates: **Protozoa**-Respiration – locomotion – nutrition-reproduction, Phylogenetic origin and evolution of **Metazoa**; **Porifera**-Cellular organization-skeleton-reproduction; **Coelenterata and Ctenophora**-Polymorphism-colony formation-Corals- polyp, skeleton, types of corals-General organization and affinities of Ctenophora.

Unit II: PLATYHELMINTHES, ASCHELMINTHES AND ANNELIDA

Platyhelminthes and Aschelminthes (*Fasciola hepatica* and *Ascaris lumbricoids*)- Nutrition and reproduction- Morphological and physiological adaptations- Larval stages of Trematodes and Cestodes, **Annelida** - Archiannelida, morphological features, filter feeding- Adaptive radiation in Polychaetes - coelom and metamerism.

Unit III: ARTHROPODA, MOLLUSCA AND ECHINODERMATA

Arthropoda-Larval forms of Crustacea- Parasitism in Crustacea-respiration in Arthropods; **Mollusca**-(*Pila* - respiratory and nervous system)- foot in Mollusca, torsion and detorsion in Gastropods. **Echinodermata** - Phylogeny and evolution – (*Asterias* coelom - nervous system- larval forms)

Unit IV: PROTOCHORDATES, FISH AND AMPHIBIA

General organization and affinities of **Protochordates**- Origin of Chordates and Tetrapods **Fish** (*Labeo rohita*) **and Amphibia** (*Rana tigrina*) - integument in Fish and Amphibia - digestive system in Fish and Amphibia -circulation in Fish and Amphibia - respiratory system in Fish and Amphibia- urinogenital system in Fish and Amphibia.

Unit V: REPTILES, BIRDS AND MAMMALS

Origin and evolution of Reptiles- origin of Birds-origin of Mammals, circulation in Reptiles (*Calotes versicolor*), Birds (*Columba livia*) and Mammals (*Oryctolagus cuniculus*)- respiration in Reptiles (*Calotes versicolor*), Birds (*Columba livia*) and Mammals (*Oryctolagus cuniculus*) -urino-genital system in Reptiles (*Calotes versicolor*), Birds(*Columba livia*) and Mammals (*Oryctolagus cuniculus*).

Text books:

1. Kotpal R.L (2019) Modern Text Book of Zoology, Invertebrates (12th Edition). Rastogi Publications, Meerut.
2. Kotpal RL (2019) Modern Text Book of Zoology Vertebrates. 12th Edition, Rastogi Publications, Meerut.

Reference Books:

1. Jordan EL and PS Verma (2006) Invertebrate Zoology, S. Chand & Co Ltd, New Delhi.
2. Agarwal VK (2000) Invertebrate Zoology, 1st Edition, S. Chand and Co, Ltd. New Delhi. 2661
3. R.S.K. Barnes, P. Calow, P.J.W. Olive, D.W. Golding & J.J. Spicer (2013). The Invertebrates A Synthesis. 3rd Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
4. Jan A. Dechenik. Biology of Invertebrates 7th Edition. (2015). Published by Mc Graw Hill Education (India) Private Limited.

5. F. Harvey Pough, Christine M. Janis, John B. Heiser (2012), Vertebrate Life (9th Edition) Pearson Publisher
6. Ekambaranatha Ayyar, M. and Ananthakrishnan, T.N. (2003). A Manual of Zoology, Part-II (Chordata), Viswanathan Printers and Publishers, Chennai
7. Jordan, E.L. and Verma, P.S. (2013). Chordate Zoology. 14th Edition, S. Chand & Company, New Delhi.

Course Outcome

CO No	Upon completion of the course, the students will be able to	PSO's addressed	Cognitive Level
CO-1	Identify the Phylogenetic origin and evolution of Protozoa, Porifera, Coelenterata and Ctenophora.	1	Understanding
CO-2	Explain the Nutrition and reproduction, Morphological and physiological adaptations of Platyhelminthes and Aschelminthes.	1,2	Applying
CO-3	Analyze the Anatomy and Physiology of Arthropoda, Mollusca and Echinodermata	1,3	Analyzing
CO-4	Distinguish between the digestive, respiratory and urinogenital systems of Fish and Amphibia.	1,4	Evaluating
CO-5	Justify the circulatory, respiratory and reproductive system of Reptiles, Birds and mammals.	1,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
I	21PCZO11	BIOLOGY OF INVERTEBRATES AND CHORDATES					75	4		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓				
CO-2	✓	✓	✓	✓	✓	✓	✓			
CO-3	✓	✓	✓	✓	✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓			✓	
CO-5	✓	✓	✓	✓	✓	✓				✓
	Number of matches (✓) = 34 Relationship = Low/Medium/ High									

SEMESTER-I

Course Title	BIOCHEMISTRY
Total Hrs	75
Hrs / Week	5
Sub. Code	21PCZO12
Course Type	DSC-II
Credits	4
Marks	100

General objective:

To impart knowledge on metabolism of biomolecules and to understand the classification, structure and function of carbohydrate and lipids.

Course objectives:

CO. No	The learners will be able to
CO -1	Describe the structure of atoms and chemical bonds.
CO -2	Explain the primary role of carbohydrates in the body and their properties and functions.
CO -3	Compare the key differences between Acidosis and alkalosis.
CO -4	Evaluate the structures, functions and properties of proteins.
CO -5	Develop the structure and the key biological functions of lipids.

UNIT I: STRUCTURE OF ATOM AND BIOENERGETICS

Structure of an atom and molecule - chemical bonds, covalent bonds – characteristic geometrics, non-covalent bonds, properties of hydrogen bonds, Vander Waals interaction - pH and acid base balance, Henderson – Hasselbach equation, metabolic acidosis and alkaloids, chemical equilibrium and biological fluids, Bioenergetics and thermodynamics - oxidation and reduction reaction - redox potential.

UNIT II: CARBOHYDRATES

Structure, classification -mono and polysaccharides- properties and functions – Metabolism of carbohydrates – Glycolysis, Citric acid cycle - oxidative phosphorylation - electron transport system - Glycogenesis, Glycogenolysis and Gluconeogenesis. Hexose Mono Phosphate Shunt.

UNIT III: PROTEINS

Aminoacid – Structure, classification, properties – Physical, chemical properties and functions- Metabolism of individual aminoacids – phenylalanine, tyrosine and tryptophan – Kynurenine and serotonin pathway –transamination and deamination. Metabolism of ribonucleotides -Biosynthesis and degradation of purines and pyrimidines - Protein – Hierarchical structure, properties (folding, modification, degradation), Classification –simple, conjugated and derived proteins and functions.

UNIT IV: LIPIDS

Lipid - structure, Classification – simple, compound and derived lipids - properties and functions - Biosynthesis of fatty acids and Acylglycerol - phospholipids - metabolism of fatty acids – β oxidations, ketogenesis and Cholesterol.

UNIT V: Enzymes, Vitamins and Hormones

Enzymes – nomenclature, classification and functions, Enzyme kinetics – Michael's Menten equation, Coenzymes – activators and inhibitors, Vitamins – composition, structure and functions - Hormones – classification and functions.

Textbooks

1. Amita Saxena. 2006, Text book of Biochemistry, Discovery Publishing House, New Delhi – 110002.
2. U.Satyanarayana, Biochemistry. 2017. Books & Allied (P) LTD-Kolkata. ISBN: 9788131248850

Reference Books

1. A.Shanmugam, 2005. Fundamentals of biochemistry for Medical students. Navabharat Printers and Traders, Madras-86.
2. Stryer, L., W. H., 2005. Biochemistry. Freeman and Company, San Francisco.
3. Lehninger, A. L., 2006. Principles of biochemistry. CBS Publishers and Distributors, New Delhi-32.
4. Kuchel P. W. and G. B. Ralston, 2003. Schaum's outlines of biochemistry (2nd edition). Tata McGraw-Hill Edition.
5. Jeremy M. Berg and John L. Tymoczko, Lubert Stryer 2015, Biochemistry W. H. Freeman, 7th edition.

Course outcomes

CO.NO	Upon completion of the course, the students will be able to	PSO's addressed	COGNITIVE LEVEL
CO-1	Enumerate the bioenergetics thermodynamics law and redox potential.	1,2,3	Remembering
CO-2	Differentiate and explain the processes of glycogenesis with the pathway of the citric acid cycle.	1,2,3	Understanding
CO-3	Interpret the factors that are to be involved in the control of carbohydrate metabolism of glycogenolysis and gluconeogenesis.	1,2,3	Applying
CO-4	Explain the metabolism of individual amino acids, purine metabolism and pyrimidine metabolism.	1,3,4	Analyzing
CO-5	Assess the different lipid metabolism of β oxidation, ketogenesis and cholesterol.	1, 3, 5	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
I	21PCZO12		BIOCHEMISTRY			75		4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓	✓		
CO-2	✓	✓	✓			✓	✓	✓		
CO-3	✓	✓	✓			✓	✓	✓		
CO-4	✓	✓	✓			✓		✓	✓	
CO-5	✓	✓	✓			✓		✓		✓
	Number of matches (✓) = ...31.... Relationship = Low/ Medium /High									

SEMESTER - I

Course Title	CELL AND MOLECULAR BIOLOGY
Total Hrs	75
Hrs / Week	5
Sub. Code	21PCZO13
Course Type	DSC-III
Credits	4
Marks	100

General objective:

To understand the fundamental unit of life with specific insight into the organization of prokaryotes and eukaryotes.

Course objectives:

CO. No	The learners will be able to
CO -1	Differentiate the division between the prokaryotic and eukaryotic organism.
CO -2	Describe the structure and the functions of mitochondria.
CO -3	Explain the composition and the structure of Deoxyribonucleic acids.
CO -4	Compare the mechanics of transcription, translation and termination of plasmid replication.
CO -5	Justify on the role of apoptosis and its significance.

UNIT I: STRUCTURE AND FUNCTION OF CELL ORGANELLES

Structure and function of Eukaryotes and Prokaryotes –. Structure and function of plasma membrane – models, membrane transport - structure and function of lysosomes, Golgi bodies and mitochondria .

UNIT II: RIBOSOMES AND PROTEIN SYNTHESIS

Ribosome – Types and biogenesis of ribosomes - membrane protein and secretory protein – Protein synthesis –mechanism, protein targeting, domains, Motif and Folds - Endoplasmic reticulum - insertion in to Endoplasmic reticulum membrane. Post transitional modifications of proteins both in the RER and SER - Protein glycosylation in endoplasmic reticulum.

UNIT III: NUCLEIC ACIDS

Nucleic acids – DNA – structure and functions – DNA replication – unit of replication, enzymes involved, replication origin and replication fork, plasmid replication (Initiation, elongation and termination). RNA – structure, types, RNA polymerases - RNA predating, edition and transport, Reverse transcription - structure and function of reverse transcriptase - DNA repair mechanism.

UNIT IV: GENE EXPRESSION

Structure of chromatin and chromosomes - heterochromatin - euchromatin and transposons - Regulatory mechanism of gene expression in eukaryotes - regulation at transcriptional and translational levels - Control of regulatory mechanism of gene expression in prokaryotic organism - Operon concept, *lac* operon, *ara* operon and *trp* operon.

UNIT V: CANCER AND APOPTOSIS

Characteristics of cancer cells - Oncogenes and antioncogenes - P53 gene, cancer cell cycle, Distinction between cancer cells and normal cells, Molecular designing of cancer treatment - Biology of aging and senescence – Significance of apoptosis –apoptosis in *Coenorhabditis elegans* and mammals.

Textbooks :

1. C.B.Powar, 2017. Cell biology, Himalaya publishing house pvt.ltd, Mumbai.
2. P.S.Verma and Agarwal, 2013, Cell biology, Genetics, Molecular biology, Evolution and Ecology.

Reference Books:

1. Ajay paul, 2007. Text book of Cell and Molecular Biology.
2. Rastogi, S.C. 2006 Cell and Molecular Biology 2nd Edition. New Age International Publishers, New Delhi.
3. Gerald Karp, Janet Iwasa, Wallace Marshall. 2016, Cell and Molecular Biology. Concepts and Experiments, John Wiley and Sons, Inc., New York.
4. Gerald Karp, Janet Iwasa, Wallace Marshall, 2015,Karp's Cell and Molecular Biology, 8th Edition, John Wiley and Sons, Inc., New York
5. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. 2000, Molecular Cell Biology, 4th edition New York.

Course Outcomes

CO.No	Upon completion of the course, the students will be able to	PSO's addressed	Cognitive Level
CO-1	Summarize on the structure and functions of cell organelles.	1,2,3	Understanding
CO-2	Examine the post transitional modifications and protein glycosylation in cytoskeleton of the cell.	1,2,3	Applying
CO-3	Classify the major role played by the replication enzymes and replication fork.	1,3	Analyzing
CO-4	Discriminate the types of RNA and their structure.	1,2,3,4	Evaluating
CO-5	Develop the factors associated with the detail of cancer cell cycle and treatment for cancer.	1,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours	Credits			
I	21PCZO13		CELL AND MOLECULAR BIOLOGY			75	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓	✓	✓	✓	
CO-2	✓	✓	✓		✓	✓	✓	✓		
CO-3	✓	✓	✓			✓		✓		
CO-4	✓	✓				✓	✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓				✓
	Number of matches (✓) = ...33.... Relationship = Low/ Medium /High									

SEMESTER -I

COURSE TITLE	APICULTURE
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO11A
COURSE TYPE	DSE-IA
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

To inculcate the innovative techniques in rearing of honeybee and to develop entrepreneurial skill among students.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the different types of bees and their morphology.
CO-2	Develop the techniques in the process of rearing honey bees.
CO-3	Categorize the various byproducts of honey bees and its uses.
CO-4	Classify the various diseases and enemies in a bee colony.
CO-5	Discuss on the importance of the queen bee in a colony.

UNIT I: MORPHOLOGY AND ANATOMY OF HONEY BEE

Definition, scope, honey bee- classification of bees- rock bee, Indian bee, little bee and dammer bee – their identification and habits – choice of species in apiculture. Bee colony – distinctive features and identification of queen, drones and workers, functions of the members. - Anatomy and organ system of honey bee. - Development of honey bee – egg, larva and pupa – time taken for the development of queen, drone and worker, life history of *Apis cerana indica*.

UNIT II: TECHNIQUES OF REARING AND BEE KEEPING EQUIPMENT

Apiculture techniques, arranging an apiary position – space, acquiring bees – care of newly captured colonies – handling the bees; bee keeping – primitive methods – modern methods; The bee hive– different kinds of cells – burr comb - different types of hives – artificial hives and their advantages – parts of artificial hive – other appliances used in apiaries.

UNIT III: BY PRODUCTS OF HONEY BEE

Honey bee products - honey – extraction of honey – preservation and storage of honey – properties, chemical composition, nutritive value, medicinal values – honey as daily food; Bee wax – production – method of extraction – characteristics and uses; Bee venom – methods of extraction of venom – composition of venom – curative value.

UNIT IV: FAMILIARIZATION WITH DISEASES AND ENEMIES OF BEES

Enemies of bees – greater wax moth, lesser wax moth, ants, wasps, lice, beetles and birds and their control. Diseases of bees: adult and brood diseases – prevention and control measures.

UNIT V: QUEEN BEE REARING AND MISCELLANEOUS MANAGEMENT

Queen rearing and introduction - Supersedure - foraging - swarming – prevention and control; robbing and fighting – prevention and control; uniting stocks – different methods - inter- relationship of plants and bees.

TEXT BOOKS

1. Gupta, J.K., Belavadi V.V. and Sh. Mohinder Singh. 2016. Apiculture ICAR Book.
2. Belsare D.K., Rakesh Kumar Singh, Shashikala and Ravindra @ Raviraj, 2019. Text Book of Apiculture, Indian Books and Periodicals ISBN: 9789352991983.

REFERENCE BOOKS

1. Gupta, J.K., Sharma, H K and Thakur, R K.2009. Practical Manual on Beekeeping. Department of Entomology and Apiculture, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, p 83.
2. Gupta, J K.2010. Spring Management of honey bee colonies. In “OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, School of Agriculture, New Delhi, UNIT-I, pp 5-14, p 105.
3. Gatoria, G.S., Gupta, J. K., Thakur, R.K. and Singh, J.2011. Mass queen bee rearing and multiplication of honey bee colonies. All India Co-ordinated project on honey bees and pollinators, ICAR, HAU, Hisar, p70.
4. Diana, S. 2011. The Bee keepers hand book. Comstock publishing.

Course Outcomes

CO. NO.	Upon completion of the course, the students will be able to	PSO's addressed	COGNITIVE LEVEL
CO-1	Understand the morphology and anatomy of honey bees.	1,2	Understanding
CO-2	Examine the various bee keeping equipment.	1,3	Applying
CO-3	Analyze the various by products of honey bees.	3,4	Analyzing
CO-4	Evaluate on the various diseases and enemies of bees.	3,4	Evaluating
CO-5	Develop the skill of uniting different stocks and analyse the inter relationship of plants and bees.	2,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
I	21PEZO11A		APICULTURE			60		4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓		✓		
CO-3	✓				✓			✓	✓	
CO-4		✓	✓	✓	✓				✓	✓
CO-5	✓	✓	✓	✓	✓		✓			✓
	Number of matches (✓) = ...30.... Relationship = Low/ Medium /High									

SEMESTER -I

COURSE TITLE	SYSTEMATICS AND ANIMAL DIVERSITY
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO11B
COURSE TYPE	DSE – IB
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

- ❖ To build on the concepts of biodiversity and to enlighten the taxonomic classification of animals.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the concepts of biosystematics and its importance.
CO-2	Develop the methods of collection and preservation techniques in taxonomy.
CO-3	Analyze the application of the important rules of zoological nomenclature.
CO-4	Compare the various structures and functions of eco systems in India.
CO-5	Create knowledge on the importance of diversity of the marine and mangrove eco systems.

UNIT I: INTRODUCTION TO SYSTEMATICS

Concept of biosystematics, terms used in systematic biology, importance of taxonomy, stages in taxonomy – morphological, embryological, cytological, biochemical and differential systematics, tasks of taxonomists.

UNIT II: TAXONOMIC COLLECTION, PRESERVATION AND IDENTIFICATION

Taxonomic Collection – scope of collection, collection methods, preservation of data, curating, storing and cataloging, methods of identification, description of taxonomic characters, taxonomic keys, taxonomic publication.

UNIT III: CLASSIFICATION AND APPLICATION OF ZOOLOGICAL NOMENCLATURE

Classification –components and types of classification, Linnaean hierarchy, Species concepts, Kinds of species, Origin of code, International rules of nomenclature, ICZN, Zoological records, digitization of taxonomic data.

UNIT IV: BIODIVERSITY – TERRESTRIAL AND FRESHWATER ECOSYSTEMS

Concepts on biodiversity, Species and genetic diversity-ecosystem of India–Wetlands, reserve forests, rain forests and desert plains in India and their faunal resources, animals of lotic and lentic ecosystems, threats to wetlands and conservation, Biotechnological tools for conservation of biodiversity.

UNIT V: DIVERSITY OF MARINE AND MANGROVE ECOSYSTEMS

Coastal, coral reef, mangrove, sea grass and seaweed ecosystems and their faunal resources, threats to marine biodiversity, animals of lagoons and estuaries; Pelagic and benthic animals of the sea, marine productivity.

TEXT BOOKS

1. Larry S.Roberts, Cleveland P., Hickman, David J.Eisenhour, Allan L and Susan L. Keen. 2014. Animal Diversity. Dewey Edition. Mc Graw Hill Education.
2. Narendran T.C. 2009. An introduction to taxonomy. AICOPTAX, Zoological Survey of India, Kolkata, India. ISBN: 9788181712189.

REFERENCE BOOKS

1. Agarwal and M.U.Gupta, 2004. Animal Taxonomy, S.Chand, New Delhi. 86pp.
2. John Milton M C, 2008.(Ed) Training Manual on GIS and Marine Biodiversity, 320pp.
3. Kapoor V.C.1998.Theory and practice of animal taxonomy, Oxford and IBH, New Delhi, 247pp;
4. Singh B.K 2004.Biodiversity:Conservation and Management, Mangal Deep Publication, 586pp.

COURSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSOs Addressed	COGNITIVE LEVEL
CO-1	Compare the stages in taxonomy and the importance of taxonomy.	1,4	Understanding
CO-2	Implement the taxonomic method of identifying an organism to its species level.	1,4	Applying
CO-3	Distinguish the various kinds of species.	2,3	Analyzing
CO-4	Assess the different types of ecosystems in India.	3,4	Evaluating
CO-5	Create the patterns involved in marine productivity.	4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
I	21PEZO11B	SYSTEMATICS AND ANIMAL DIVERSITY				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓			✓	
CO-2	✓	✓	✓	✓	✓	✓			✓	
CO-3	✓	✓		✓	✓		✓	✓		
CO-4	✓	✓	✓	✓				✓	✓	
CO-5		✓	✓	✓	✓				✓	✓
	Number of matches (✓) = ...32.... Relationship = Low/ Medium /High									

SEMESTER – I

COURSE TITLE	ENDOCRINOLOGY
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO11C
COURSE TYPE	DSE-IC
CREDITS	4
MARKS	100

GENERAL OBJECTIVE

To make the students to learn the objectives and scope of comparative endocrinology, anatomy, morphology and histology of endocrine tissues of vertebrates, crustacean and insect endocrine organs and their functions.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the endocrine system and the mechanism of hormone action
CO-2	Explain the structure of Pituitary and Thyroid glands
CO-3	Enumerate the Pancreatic hormones and their functions
CO-4	Explain the Reproductive Endocrinology
CO-5	Illustrate the Neuroendocrineendocrine systems in crustaceans

UNIT I INTRODUCTION TO ENDOCRINOLOGY

Introduction, objectives and scope of endocrinology - endocrine glands in insects (silk moth) and vertebrates (kangaroo) - Mechanism of hormone action- - Cell surface receptors and intracellular signalling - general classes of chemical messengers.

UNIT II INSECTS AND CRUSTACEAN ENDOCRINOLOGY

Neuroendocrine systems in crustaceans – endocrine control in moulting and metamorphosis-Neuroendocrine system in insects - endocrine control in moulting – metamorphosis and reproduction.

UNIT III PITUITARY AND THYROID GLANDS

Adenohypophyseal and Neurohypophyseal hormones in human- Hypothalamic control of hypophyseal hormones- Structure and endocrinology of Pituitary- Phylogeny,

structure and functioning of Thyroid gland-Endocrinology of Parathyroid and Calcium regulation in body.

UNIT IV PANCREAS AND ADRENAL GLANDS

Structure of human pancreas-Pancreatic hormones and their functions- Structural organizations of adrenal gland - Functions of cortical and medullary hormones - Hormones in homeostasis; Disorders of endocrine glands.

UNIT V REPRODUCTIVE ENDOCRINOLOGY

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.

TEXT BOOKS

1. Williams, R. H. (2011), Textbook of Endocrinology, (13th ed.): Elsevier
- Nussey, S. & Whitehead, S. (2001).
2. Yadav, P. R. (2009), Textbook of Endocrinology, (12th ed.): Elsevier. New Delhi: Sonali Publications, Discovery Publishing House Pvt. Ltd.

REFERENCE BOOKS

1. Goswami, M.P. (2013). Endocrinology and Molecular Cell Biology. Delhi: Gaurav book centre Pvt Ltd. Griffing, G & Padilla, M. (Eds.). (2015).
2. Melmed, S., Polonsky, K., Larsen, R.P., Kronenberg, H. (2015), Endocrinology: Specialty Review and Self- Assessment, Stat Pearls Publishing, (3rd ed.). USA: Stat Pearls Publishing LLC.
3. Victor W. Rodwell., David A. Bender., Kathkeen, M., Kennelly, P., Antony, Weil. (2018), Endocrinology - An Integrated Approach. Oxford: BIOS Scientific Publishers. Harper's Illustrated Biochemistry (31th ed.): McGraw Education.

Course Outcomes

CO. NO.	Upon completion of the course, the students will be able to	PSO's addressed	COGNITIVE LEVEL
CO-1	Understand the endocrine glands in crustaceans, insects and vertebrates	1	Understanding
CO-2	Describe the hypothalamic control of hypophyseal hormones	1,3,4	Applying
CO-3	Compare the Structural organizations of adrenal gland and pancreatic gland	1,4,5	Analyzing
CO-4	Discuss the role of hormones in pregnancy	1,2,4,5	Analyzing
CO-5	Assess the Neuroendocrine system in insects	1,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
I	21PEZO11C	ENDOCRINOLOGY				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓		✓	✓	
CO-3	✓				✓				✓	✓
CO-4		✓	✓	✓	✓		✓		✓	✓
CO-5	✓	✓	✓	✓	✓				✓	✓
	Number of matches (✓) = ...32.... Relationship = Low/ Medium /High									

SEMESTER – I

Course Title	BIOLOGY OF INVERTEBRATES AND CHORDATES PRACTICALS
Total Hours	60
Hours/Week	4
Subject Code	21PCZO1P1
Course Type	Practical -I
Credits	2
Marks	100/2

General Objective:

To comprehend the functional morphology of Invertebrates and Chordates.

Course Objectives:

Co.No.	The learners will be able to
CO-1	Remember the anatomy of Earthworm.
CO-2	Examine the anatomy of the Cockroach.
CO-3	Explain the digestive system of the Pila.
CO-4	Evaluate the Invertebrate and Vertebrate animals.
CO-5	Explain the circulatory system of the frog.

1. Dissection of Earthworm digestive system.
2. Dissection of Earthworm Reproductive system.
3. Dissection of Cockroach nervous system.
4. Dissection of Cockroach digestive system.
5. Virtual Dissection of Pila digestive system
6. Isolation of body setae of earthworm
7. Isolation of Prawn appendages
8. Isolation of placoid scales of Shark.
9. Virtual Dissection of Frog circulatory system (Venous system of frog).
10. Virtual Dissection of Rat urinogenital system.

Biology of Invertebrates and Chordates- Spotters

- 1) Euplectella 2) Euspongia 3) Fungia 4) *Fasciola hepatica* 5) Penaeus 6) Bonellia
- 7) Pila 8) Chameleon 9) Pigeon 10) Bat.

Field study: Sea shore visit and collection of animals and classify.

Course Outcomes

CO. No.	Upon completion of the course, the students will be able to	PSO's addressed	Cognitive Level
CO-1	Examine the morphology and anatomy of earthworm.	1,3	Understanding
CO-2	Identify the nervous and digestive system of the Cockroach.	1,2	Applying
CO-3	Analyze and isolate the placoid scales of the Shark.	1,2,3,4	Analyzing
CO-4	Explain the appendages of the Prawn.	1,4,5	Evaluating
CO-5	Discuss the circulatory system of the Frog.	1,2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
I	21PCZO1P1	BIOLOGY OF INVERTEBRATES AND CHORDATES PRACTICALS				60	2			
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓		✓		
CO-2	✓	✓	✓		✓	✓	✓			
CO-3	✓	✓	✓			✓	✓	✓	✓	
CO-4	✓	✓				✓			✓	✓
CO-5	✓	✓	✓		✓	✓	✓	✓		✓
	Number of matches (✓) = 31 Relationship = Low/ Medium /High									

SEMESTER - I

Course Title	BIOCHEMISTRY & CELL AND MOLECULAR BIOLOGY PRACTICALS
Total Hrs	60 / Semester
Hrs / Week	4
Sub. Code	21PCZO1P2
Course Type	Practical - II
Credits	2
Marks	100/2

General objective:

To impart knowledge on estimation methods and preparation of different types of cells

Course objectives:

CO. No	The learners will be able to
CO -1	Define the effect of Salivary amylase activity on enzyme concentration.
CO -2	Examine the separation of amino acids by paper chromatography method.
CO -3	Construct and observe squamous epithelial cells in human beings.
CO -4	Explain the mitotic cell division in onion root tip.
CO -5	Develop the columnar and ciliated epithelial cells.

1. Effect of Salivary amylase activity on substrate concentration.
2. Effect of Salivary amylase activity in relation to enzyme concentration.
3. Separation of aminoacids by paper Chromatography method.
4. Quantitative estimation of Carbohydrate in tissue sample.
5. Quantitative estimation of protein in muscle.
6. Mounting and observation of mitotic stages of onion root tip.
7. Study of giant chromosomes in chironomous larva.
8. Preparation of squamous epithelial cells of human buccal cavity.
9. Preparation of blood smear (fish, human)
10. Observation of columnar and ciliated epithelial cells

Biochemistry spotters

- 1) Spectrophotometer
- 2) pH meter
- 3) Paper Chromatography
- 4) Centrifuge.

Cell and Molecular Biology spotters

- 1) Oncogene
- 2) Apoptosis
- 3) Fine structure of Mitochondria
- 4) Structure of DNA
- 5) Structure of mRNA, tRNA and rRNA

Course outcomes

CO.No	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive level
CO-1	Classify the salivary amylase activity in relation to enzyme concentration.	1,2,3	Understanding
CO-2	Develop the quantitative estimation of the carbohydrates.	2,4	Applying
CO-3	Examine the quantitative estimation of protein in muscles.	2,3,4	Analyzing
CO-4	Assess the preparation of blood smear from the human blood.	1,4	Evaluating
CO-5	Design the giant chromosome in chironomous larva.	1,2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
I	21PCZO1P2	BIOCHEMISTRY & CELL AND MOLECULAR BIOLOGY PRACTICALS					4	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO3	PLO4	PLO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓		✓			✓	✓	✓		
CO-2	✓		✓				✓		✓	
CO-3	✓		✓				✓	✓	✓	
CO-4	✓	✓				✓			✓	
CO-5	✓	✓	✓		✓	✓	✓		✓	
	Number of matches (✓) = ...25.... Relationship = Low/ Medium /High									

SEMESTER - I

Course Title	ORNAMENTAL FISH CULTURE
Total Hours	30
Hours/Week	2
Subject Code	21PIZO11
Course Type	IDC-I
Credits	2
Marks	100/2

General Objective:

To understand the various aspects of Ornamental fish culture and to adopt and encourage the students become an entrepreneur.

Course Objectives:

CO.No.	The learners will be able to
CO-1	Classify the popular ornamental fish.
CO-2	Construct an Aquarium.
CO-3	Categorize the fish feed.
CO-4	Assess the breeding techniques.
CO-5	Examine the various diseases.

Unit I: INTRODUCTION TO ORNAMENTAL FISH CULTURE

World trade of ornamental fish and export potential, different varieties of exotic and indigenous fish; Ornamental fisheries: A new dimensions in aquaculture entrepreneurship - popular ornamental fish- egg laying Fish-live bearing Fish.

Unit II: CONSTRUCTION OF AQUARIUM

Design and construction of fish tanks- setting up of fish tanks-accessories for fish tanks – ornamental plants – floating plant – submerged plant – lace plant – Bacopa – Hornwort – Hydrilla – Water Sprite – Indian fern – Hidden club – Amazon sword plant – Needle grass – Ribbon grass.

Unit III: FOOD AND FEEDING OF ORNAMENTAL FISH

Types of feed -natural feed and artificial feed-culture of live food organism – Infusorians, Zooplankton, Rotifers, Copepods, Cladocerans, Brine shrimp, Blood worm and Tubificid- preparation of artificial feed- feeding- balanced diets for aquarium fish.

Unit IV: BREEDING OF AQUARIUM FISH

Breeding of ornamental fish: live bearer species-Guppies, Mollys, Sword tail fish and Platy fish, egg layer species-Siamese fighter, Zebra danio, Gold fish, Koi carp and Neon tetra.

Unit V: FISH DISEASES AND TREATMENT / TRANSPORT OF FISH

Protozoan diseases - Fungal diseases - Bacterial diseases -Viral diseases; transport of fish, oxygen packing, anaesthetics used in fish transport, methods of sedation.

Textbooks:

1. Jameson J.D. and Santhanam R, (1996) Manual of Ornamental fish and farming technologies, FCRI-Tuticorin.
2. Ahilan, B., Felix, N., Santham, R., (2008) A text book of Aquariculture, Daya Publishing House, India
3. M. S. Reddy. (2004), A Text Book of Aquaculture, Discovery Publishing Pvt.Ltd, New Delhi.

Reference Books:

1. Saxena, A. (2011) Fisheries Economics, Daya Publishing House, New Delhi
2. Zaidi, S.G.S (2002) Ornamental fish culture Manual, CIFE, Mumbai
3. Mahapatra, B.K., Dutta S., Pailan, G.H. (2015) Ornamental Fish Breeding, Culture and Trade Manual Kolkata Centre ICAR-Central Institute of Fisheries Education- Kolkata.
4. Dholakia A.D. (2010) Ornamental Fish culture and Aquarium Management, Daya Publishing House, New Delhi
5. Srivastava, C.B.L (2006) A textbook of fishery science and Indian fisheries, Kitab Mahal, New Delhi.

Course Outcome

CO.No.	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Compare the different types of ornamental fish.	1,2,3	Understanding
CO-2	Apply knowledge in setting up of fish tanks.	1,2,3,4	Applying
CO-3	Differentiate the live feed and artificial feed preparation.	1,2,4	Analyzing
CO-4	Evaluate the process of breeding ornamental fish.	1,4	Evaluating
CO-5	Analyse the methods of sedation and Anaesthetics used in fish transport.	1,3,4,5	Analyzing

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
I	21PIZO11	ORNAMENTAL FISH CULTURE				2	2			
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓	✓	✓		
CO-2	✓	✓	✓		✓	✓	✓	✓	✓	
CO-3	✓	✓	✓		✓	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓			✓	
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Number of matches (✓) =38 Relationship = Low/Medium/ High									

SEMESTER II

Course Title	DEVELOPMENTAL BIOLOGY
Total Hrs	75
Hrs / Week	5
Sub. Code	21PCZO21
Course Type	DSC-IV
Credits	4
Marks	100

General objective:

- ❖ To acquire knowledge on gametogenesis and learn the role of hormones on metamorphological changes of organisms.

Course objectives:

CO. No	The learners will be able to
CO -1	Explain the structure of sperm and eggs.
CO -2	Construct the cleavage patterns and cleavage rules.
CO -3	Analyze the process of organogenesis.
CO -4	Evaluate the types and physiology of placenta.
CO -5	Construct Induced ovulation in humans.

UNIT I: GAMETOGENESIS AND FERTILIZATION

Gametogenesis: Spermatogenesis –morphology and types of spermatozoan, process of spermatogenesis; oogenesis: structure of egg and types of eggs and egg membranes; Process of oogenesis- vitellogenesis- organization and polarity of eggs; Fertilization: mechanism of fertilization, significance of fertilization; Parthenogenesis – types and significance of parthenogenesis.

UNIT II: CLEAVAGE AND FATE MAPS

Cleavage: characteristics, plane of cleavage, patterns of yolk on cleavage, laws of cleavage and physiology of cleavage; germ layers: cell lineage study- methods and outcome of cell lineage; Cleavage in Amphioxus, Frog, Chick and Man; Fate maps –construction of fate map, fate maps of Frog, Chick, Ascidian and Man.

UNIT III: GASTRULATION AND ORGANOGENESIS

Gastrulation: morphogenetic movements, gastrulation in Amphioxus, Frog, Chick and Mammal; Organogenesis: Development of brain and heart in Chick, development of brain in Frog; gradient theory, cellular differentiation and nuclear transplantation; Teratogenesis-genetic and environmental teratogenesis.

UNIT IV: PLACENTATION AND METAMORPHOSIS

Development, types and physiology of extra embryonic membrane; Placenta- types, morphological classification and functions of placenta, post embryonic development; Organizer: Concept, inductive tissue interactions – Spemann's classical experiment; Metamorphosis – types of metamorphosis in Amphibians and Insects - hormonal regulation of metamorphosis; Regeneration – patterns and mechanism of regeneration in Planaria and Amphibian- Wolffian regeneration.

UNIT V: ADVANCED MODERN TECHNIQUES

Induced ovulation in humans- multiple ovulation and embryo transfer in cattle- embryo splitting – invitro fertilization – Gamete Intra Fallopian Transfer techniques (GIFT) - cryopreservation of gametes - prenatal diagnosis, human cloning and its ethical implications, embryo transfer - Artificial insemination in human and cattle.

TEXTBOOKS

1. Scott F.Gilbert and Susan R. Singer 2011. Developmental Biology Vol. 1 Inc. Publishers, The University of Michigan.
2. Subramanian, M.A. 2011. Developmental Biology Oscar Publications, India

REFERENCE BOOKS

1. Arora, M.P., 2007. Embryology, Himalaya Publishing House, Ramdrot, Dr.Balerao Mass, Gurgaon - Mumbai.
2. Verma, P.S. and Agarwal, V.K.,2014. Chordate embryology, S Chand and Company Limited, New Delhi.
3. Subramoniam, T., 2013. Molecular Developmental Biology, Narosa Publishing House Private Limited, Chennai.
4. Gilbert, S.F. 2011. Developmental Biology, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Balinsky, B.I. 2012. Introduction to Embryology, Holt Saunders International, (5th Edn),Philadelphia.
6. Todd Streelman, J. 2013. Advances in Evolutionary Developmental Biology. Wiley Blackwell Publishers

Course outcomes

CO.NO	Upon completion of the course, the students will be able to	PSOs Addressed	COGNITIVE LEVEL
CO-1	Summarize the spermatogenesis, Oogenesis and fertilization mechanism.	1,2	Understanding
CO-2	Construct the cleavage and fate map in frog, chick and man.	1,2,3	Applying
CO-3	Compare the different concepts of parthenogenesis and teratogenesis.	1,4	Analyzing
CO-4	Explain the different types of metamorphosis.	1,4	Evaluating
CO-5	Discuss the various methods for artificial insemination in humans and cattle.	4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
II	21PCZO21	DEVELOPMENTAL BIOLOGY				75	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓			✓	✓	✓		
CO-3	✓	✓	✓			✓			✓	
CO-4	✓	✓	✓			✓			✓	
CO-5	✓	✓	✓						✓	✓
	Number of matches (✓) = ...27.... Relationship = Low/ Medium /High									

SEMESTER - II

Course Title	GENETICS AND EVOLUTION
Total Hours	75
Hours/Week	5
Subject Code	21PCZO22
Course Type	DSC-V
Credits	4
Marks	100

General Objective:

To facilitate the students to understand the genetic basis of inheritance and the basic concepts of evolution

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the Mendelian principle.
CO-2	Develop the inherited genetic disorder and inborn errors.
CO-3	Identify the chromosomal disorders.
CO-4	Evaluate the causes of phylogenetic gradualism and punctuated equilibrium.
CO-5	Originate micro and macro evolution.

UNIT I: MENDELIAN PRINCIPLES

Law of Segregation – Law of independent assortment of genes- multiple alleles and genetics of ABO, Rh blood groups in man-Linkage and crossing over-localization of DNA in chromosome and gene mapping- extra nuclear DNA: DNA in mitochondria and plastid-maternal effects and cytoplasmic inheritance.

UNIT II: CONCEPT OF GENE

DNA as the genetic material-regulation of gene expression in prokaryotes and eukaryotes- inherited genetic disorder in man-syndromes- sex linked inheritance, colour blindness, haemophilia -inborn errors of metabolism- sickle cell anaemia, albinism and phenylketonuria.

UNIT III: GENETIC DISORDERS

Mutation: Mutation types and mutagens - genetic disorder – Huntington's chorea – cystic fibrosis – thalassemia – muscular dystrophy and Tay Sac's disease –screening for genetic disorders – amniocentesis – chorionic villus sampling – fetoscopy – gene therapy.

UNIT IV: TRADITIONAL EVOLUTION

Origin and evolution of prokaryotes and eukaryotes – phylogenetic gradualism and punctuated equilibrium; major trends in the origin of higher categories – micro- and macroevolution.

UNIT V: MOLECULAR EVOLUTION

Construction of phylogenetic trees – quantifying genetics – variability –genetic structure of natural population – phenotypic variation – pattern of genetic variation – Founder's effect and bottle necks – models explaining changes in genetic structures of population.

Textbook:

1. Daniel L.Harti (2009), Genetics: Analysis of Genes & Genomes: 8th Edition.
2. Verma and Agarwal (2014), Genetics and Evolution.

Reference Books:

1. M. W. Strickberger. 2005. Genetics.3rd Edition, Prentice-Hall, India.
2. Benjamin Lewin. 2000. Genes VII. Oxford University Press.
3. Robert J. Brooker,2012. Genetics – Analysis and Principles,4th Edition,(International Edition), NY McGraw Hill, New York..
4. Paul Amos Moody. 2011. Introduction to evolution, Nabu Press, United States.
5. Douglas J. Rutuyma. 2013. Evolution, 3rd edition, Sinauer Associates.inc.

COURSE OUTCOME

CO.No.	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Explain the Law of Segregation.	1,2,3	Understanding
CO-2	Experiment with colour blindness, hemophilia - inborn errors of metabolism- sickle cell anemia, albinism. phenylketonuria.	1,2,3,4	Applying
CO-3	Examine the Genetical Disorders.	1,2,3,5	Analyzing
CO-4	Justify the Traditional Evolution.	1,3,4	Evaluating
CO-5	Develop the Molecular Evolution.	1,3,5	Creating

Relationship Matrix

Semester	Course Code			Title of the Course				Hours	Credits	
II	21PCZO22			GENETICS AND EVOLUTION				75	4	
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓	✓	✓		
CO-2	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓		✓	✓	✓	✓		✓
CO-4	✓		✓		✓	✓		✓	✓	
CO-5	✓		✓		✓	✓		✓		✓
	Number of matches (✓) = 37 Relationship = Low/Medium/ High									

SEMESTER - II

Course Title	ANIMAL BIOTECHNOLOGY
Total Hours	75
Hours/Week	5
Subject Code	21PCZO23
Course Type	DSC-VI
Credits	4
Marks	100

General Objective:

To gain knowledge on recombinant DNA technology, gene transfer and transgenicity and its applications

Course Objectives :

CO.NO.	The learners will be able to
CO-1	Remember the basic principle of animal biotechnology.
CO-2	Explain the recombinant DNA technology.
CO-3	Classify the various type of cloning vectors.
CO-4	Evaluate the organ culture of the animal biotechnology.
CO-5	Develop the process of industrial based biotechnology.

UNIT I: BASICS OF ANIMAL BIOTECHNOLOGY

Scope of Animal Biotechnology-Current status and future applications of Animal Biotechnology- scope of animal cell culture- types of cell culture- laboratory facilities for animal cell culture-culture media- cell culture products; stem cells: types of stem cells-stem cell therapy – Somatic cell fusion and hybridoma technology.

UNIT II: RECOMBINANT DNA TECHNOLOGY

Principles and methods of recombinant DNA technology - types of restriction enzymes - ligase linkers and adaptors - c DNA library - transformation - selection of recombinants-hybridization techniques, DNA sequences -gene probe - DNA finger printing-DNA chip technology-Restriction Fragment length polymorphism(RFLP), Randomly

amplified polymorphic DNA (RAPD) - PCR technique - genomic library; Blotting techniques - Southern blotting - Northern blotting - Western blotting.

UNIT III: CLONING VECTORS AND DNA TECHNIQUES

Plasmids: E. coli, pBR 322, Ti plasmid, bacteriophage, cosmids, phasmids, shuttle vectors, yeast and bacterial chromosome, mammalian cells - Simian virus 40 - Gene cloning -Gene transfer technologies- Human genome project – biosensors and their applications.

UNIT IV: GENETIC ENGINEERING FOR HUMAN WELFARE

Organ culture - whole embryo culture - embryo transfer in human; transgenic animal, in vitro fertilization (IVF) technology – Dolly- human gene therapy, monoclonal antibodies production and application, cryobiology-Bioethics in animal genetic engineering.

UNIT V: BIOTECHNOLOGY AND INDUSTRY

Fermentation - bioreactor - microbial products - primary and secondary metabolites - enzymes technology -antibiotic synthesis- single cell protein (SCP)- Biopolymers, Biopesticides and Biofertilizers.

TEXTBOOKS:

1. Dubey R.C. Text book of biotechnology, 2012. S.Chand & company Limited, New Delhi.
2. Das, H.K. 2004. Text Book of Biotechnology. Wiley Dreamtech India Pvt.Ltd., New Delhi.
3. Prakash S Logar 2005. Biotechnology. MJP Publishers, Chennai.
4. P. Ramadoss 2008. Animal Biotechnology, MJP Publishers Chennai
5. LP Rema 2006. Applied Biotechnology.

REFERENCE BOOKS

1. Gupta .P.K. Biotechnology and Genomics.2013. Rastogi Publications, Meerut.
2. Singh.B.D. Genetic Engineering and Animal Biotechnology, 2005,KalyaniPublishers, Chennai – 17.
3. M. W. Strickberger. 2005. Genetics.3rd Edition, Prentice-Hall, India
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell.5th Edition,2007. Garland Science.

COURSE OUTCOME

CO.NO.	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Define the Scope of Animal Biotechnology.	1,2,4	Remembering
CO-2	Apply the Knowledge on molecular finger printing (DNA finger printing) - RFLP - the PCR techniques.	1,2,3,5	Applying
CO-3	Distinguish the various type of cloning vectors - Bacterial, Viral and yeast.	1,2,3,4	Analyzing
CO-4	Summarize the Organ culture.	1,2,5	Evaluating
CO-5	Develop single cell protein (SCP)- Biopolymers.	1,2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
II	21PCZO23	ANIMAL BIOTECHNOLOGY				75	4			
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓		✓	✓	✓		✓
CO-3	✓			✓	✓	✓	✓	✓	✓	
CO-4	✓	✓		✓	✓	✓	✓			✓
CO-5	✓	✓			✓	✓	✓	✓		✓
	Number of matches (✓) = 36 Relationship = Low/Medium/ High									

SEMESTER - II

COURSE TITLE	VERMICULTURE
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO21A
COURSE TYPE	DSE–IIA
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

To acquaint with the techniques of vermiculture and to create knowledge on Self - employment opportunity.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand vermiculture and different species required for rearing.
CO-2	Identify the various culture methods.
CO-3	Examine the various techniques in vermiculture.
CO-4	Evaluate the skill of marketing.
CO-5	Develop the future scope in the area of vermicompost.

UNIT I: INTRODUCTION TO VERMICULTURE

Vermiculture – scope and importance, common species for culture, environmental requirements; Earthworms– taxonomic position and diversity, types – morphological and ecological grouping – epigeic species, endogeic species and Anecic species, ecological roles and economic importance of earthworms – need for earthworm culture.

UNIT II: CULTURE METHODS

Culture methods – wormery – breeding techniques: indoor and outdoor cultures - monoculture and polyculture – relative merits and demerits; Windows method-process – advantages.

UNIT III: VERMICULTURE TECHNIQUES

Vermiculture techniques, advantages of vermiculture, vermicomposting technology, methods of vermicomposting, large scale manufacture of vermicompost, worm casts, vermicompost, vermiwash - production techniques, role of earthworms in soil fertility, use of for crop production, in land improvement and reclamation.

UNIT IV: MARKETING STRATEGIES

Marketing the products of vermiculture, quality control, market research, marketing techniques, creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing, financial support by governments and NGOs for vermiculture.

UNIT V: FUTURE PERSPECTIVES

Effect of vermicompost application on soil and plant growth, vermicompost as an organic manure, a good substitute of fertilizers, influence of pests and microbes on vermiculture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries, forest regeneration, potentials and constraints for vermiculture in India.

TEXT BOOK

1. Eri board , 2015, Hand book of Biofertilizers and Vermiculture.
2. Keshav S. 2014. Text Book of vermicompost: Vermiwash and Biopesticides. Published by Biotech books.

REFERENCE BOOKS

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India..
2. Dash, M.C., 2012 Charles Darwin's Plough Tool for vermitechnology, I.K. International Publishing House Private Limited, New Delhi.
3. Lekshmy M.S., Santhi R, 2012 Vermitechnology Sara Publications, New Delhi.
4. National Institute of Industrial Research,2010.The complete Technology book on vermiculture and vermicompost, Published by National Institute of Industrial Research, Delhi.

COURSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Understand the morphological and ecological characters of earthworm.	1,3	Understanding
CO-2	Carry out the various breeding techniques in vermiculture.	1,2,3	Applying
CO-3	Demonstrate vermiculture biotechnology.	2,3	Analyzing
CO-4	Select marketing techniques in vermiculture.	3,4	Evaluating
CO-5	Find the potentials and constraints for vermiculture in India.	3,4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits			
II	21PEZO21A		VERMICULTURE			60		4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)					
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	
	CO-1	✓	✓	✓	✓		✓		✓		
	CO-2		✓	✓	✓		✓	✓	✓		
	CO-3		✓	✓				✓	✓		
	CO-4	✓	✓	✓	✓				✓	✓	
	CO-5		✓	✓	✓	✓			✓	✓	✓
	Number of matches (✓) = ...29.... Relationship = Low/ Medium /High										

SEMESTER - II

Course Title	ENVIRONMENTAL BIOLOGY
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO21B
Course Type	DSE-II B
Credits	4
Marks	100

General objective:

- ❖ To acquire knowledge on eco system, Realize the unique features of marine natural resources and the impact of climate change and global warming on living organisms.

Course objectives:

CO. No	The learners will be able to
CO -1	Explain the different types of ecosystem.
CO -2	Develop the concept of community ecology, succession, species interactions and ecosystem.
CO -3	Examine the various natural resources and renewable resources.
CO -4	Choose the Biodiversity Hotspots.
CO -5	Discuss the conservation and management In situ and Ex situ conservation.

UNIT I: INTRODUCTION AND ECOLOGICAL SUCCESSION

Ecosystem: Concept – types - stability - food chain and food web – types of ecological pyramids; Aquatic ecosystem: freshwater, lentic and lotic ecosystem, marine ecosystem; Terrestrial ecosystem – biogeography - major terrestrial biomass, island biogeography, biogeographical zones of India; Ecological succession : types and general process of succession – concept of climax.

UNIT II: COMMUNITY AND POPULATION ECOLOGY

Community ecology - nature of communities, community structure and attributes, edges, ecotone and ecological dominance - population ecology – population characteristics and population dynamics; Biogeochemical cycles: Water, gaseous and sedimentation cycles; Productivity: Primary productivity process – productivity of different ecosystems – measurement of primary productivity.

UNIT III: NATURAL RESOURCES AND THEIR CONSERVATION

Classification of natural resources: Renewable energy - solar, wind, tidal energy and Water - availability, consumption and prospects in India; Forest-deforestation, afforestation in India; Non-renewable energy: minerals their distribution and prospects, energy, fossil fuel, nuclear energy; Law and environmental protection: India's environmental laws and policy; Pollution control boards: Central and State Government and NGO, International environmental policy, Earth Summit and World Summit.

UNIT IV: BIODIVERSITY AND THREATS TO BIODIVERSITY

Biodiversity: Types - genetic, species and ecosystem diversity, values and uses of diversity, biodiversity hotspots - Western Ghats and Indo- Burma region; threats to animal diversity in India –Status of species – Rare, endemic, threatened and endangered species, loss of biological diversity – IUCN, red list, Bio geographical classification of India; Measurements - Diversity indices: Shannon-Weiner– Diversity and Simpson's diversity index.

UNIT V: CONSERVATION AND MANAGEMENT

In situ and Ex situ conservation- Wildlife sanctuaries – National parks and biosphere reserves in India; Special projects for endangered species: Project tiger – the Gir lion sanctuary – crocodile breeding project; Role of MAB, IUCN, IPR, TRIPS and IKS; remote sensing application– radio telemetry as a wildlife research tool – application – radio transmitters and its application.

TEXT BOOKS

1. Trivedi, P. C., Sharma, K. C., 2003, Biodiversity conservation, Aavishkar Publishers, Jaipur.
2. Saxena, K. K., 2004, Environmental Sciences, University Book Hour (P) Ltd.

REFERENCE BOOKS

1. Anjaneyala, Y. B., 2004, Introduction to environmental science, S. P. B. S. Publications, Hyderabad.
2. Jeffery Clarke, 2005. Ecology: Concepts, Methods and Applications..
3. Martin R. Speight, 2002. Marine Ecology: Concepts and Applications. 1st Edition, Library of Congress Cataloguing in Publications.
4. Sven Erik Jørgensen, 2007, A New Ecology, 1st Edition, Elsevier Science
5. Reiss, M. and J. Chapman. 2000. Cambridge press, United Kingdom.
6. Asthana, D.K and M. Asthana. 2003. Environment: Problems and Solutions, S. Chand and company Ltd, Ram Nagar, New Delhi

COURSE OUTCOMES

CO.NO	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the biogeography, ecosystem diversity and biodiversity hotspots of India.	1,3	Understanding
CO-2	Develop on the productivity of different ecosystems and measurement of primary productivity.	1,2,4	Applying
CO-3	Compare the natural Renewable and non-renewable resources.	1,4	Analyzing
CO-4	Interpret the Indian environmental laws and policy.	1,4	Evaluating
CO-5	Develop on the Status of species – Rare, endemic, threatened and endangered species and loss of biological diversity.	1,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
II	21PEZO21B	ENVIRONMENTAL BIOLOGY				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓		✓		
CO-2	✓	✓	✓			✓	✓		✓	
CO-3	✓	✓	✓	✓		✓			✓	
CO-4	✓	✓	✓		✓	✓			✓	
CO-5	✓	✓	✓		✓	✓				✓
	Number of matches (✓) = ...30.... Relationship = Medium									

SEMESTER – II

COURSE TITLE	NANOBIOTECHNOLOGY
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO21C
COURSE TYPE	DSE – II C
CREDITS	4
MARKS	100

GENERAL OBJECTIVES

To understand and apply the comprehensive knowledge on the major aspects of nanobiotechnology in career development, higher education, research and development.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the importance of nanotechnology in biomedical applications
CO-2	Explain the basic properties of nanomaterials
CO-3	Compile the techniques of nanoparticles synthesis
CO-4	Describe the Characterization of Nanobiomaterials
CO-5	Illustrate the current status of nanobiotechnology

UNIT I INTRODUCTION TO NANOTECHNOLOGY

Introduction - History of nanotechnology, importance of nanoscience and nanotechnology in biomedical applications. Types of solid and powder crystals - Interaction between biomolecules and nanoparticles - Applications of nanotechnology in biotechnology: killing cancer cells, providing oxygen and artificial mitochondria, Nanobiosensors.

UNIT II NANOMATERIALS FOR BIOLOGY

Nanotechnology and nanoscience in Nature; Molecular based study of condensed matter; low dimensional materials; Properties of nanomaterials: size, surface charge, conductivity, optical properties and biocompatibility - Carbon based nanomaterials - carbon nanotubes for biomedical applications, SWCNT and MWCNT - Magnetic nanoparticles - Quantum dots - Quantum dot biomolecular tags - Antibacterial activity; DNA and Peptide based nanomaterials; Polymer nanostructures.

UNIT –III - SYNTHESIS OF NANOPARTICLES

Top-Down approach, Bottom-Up approach, Nano-Lithography, PVD, CVD, Wet deposition techniques, Micro emulsion method, Sol-gel processing - Biological synthesis of

nanoparticles - Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Role of plants in nanoparticle synthesis.

UNIT IV CHARACTERIZATION OF NANOBIMATERIALS

Basic principles, operations and applications of UV-Visible spectroscopy, FT-IR spectroscopy, SEM, TEM, STM, Atomic and Molecular spectroscopy, Photoacoustic spectroscopy, Fluorescence spectroscopy, Fluorescent resonance energy transfer (FRET), computations, AFM of DNA, STM of DNA and Confocal microscopy.

UNIT V ENVIRONMENTAL NANOTECHNOLOGY

Nanotoxicology, Environmental and Health impacts of nanomaterials, Waste remediation, Nanoporous polymers and their application in water purification, Energy conversion; Photo-catalytic fluid purification, Current status of nanobiotechnology, Future perspectives of nanobiology and safety measures of nanomaterials.

REFERENCES:

1. A.K. Bandyopadhyay, 2007, Nanomaterials, New Age International Publishers, New Delhi.
2. Challa Kumar, 2006, Tissue, cell and organ engineering, Wiley-VCH, Verlag.
3. C.N.R. Rao, A. Muller, A.K. Chutham., 2006, The Chemistry of Nanoparticles (Synthesis, Properties and Applications) by Wiley-VCH, Verlag.
4. Robert A. Freitas, 2003, Nanomedicine, Vol. IIA: Biocompatibility by Landes Bioscience, Georgetown
5. Hari Singh Nalwa, 2006, Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology , American Scientific Publishers.
6. C.M.Niemeyer, C.A. Mirkin, 2004, Nanobiotechnology, WILEY-VCH Verlag GmbH & Co. KG aA, Weinheim
7. Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Wiley, Nanocomposite Science & Technology.
8. Bharat Bhusha, 2007, Handbook of Nanotechnology, Springer.
9. C. P. Poole and F. J. Owens, 2006, Introduction to Nanotechnology”, Wiley.
10. M. Ratner and D. Ratner, 2002, Nanotechnology: A Gentle Introduction to the Next Big Idea”, Prentice Hall.
11. L. E. Foster, 2006, Nanotechnology – Science, Innovation, and Opportunity”, Pearson Education.
12. Pradeep, T. (2017) The Essentials: Understanding Nanoscience and Nanotechnology: Mc- Graw-Hill Education.
13. D.A. and Ahmad, W (2014), Phoenix, Nanobiotechnology. One Central Press Ltd.

Course Outcomes

CO. NO.	Upon completion of the course, the students will be able to	PSO's addressed	COGNITIVE LEVEL
CO-1	Describe the Interaction between biomolecules and nanoparticles	1	Understanding
CO-2	Enumerate the Carbon based nanomaterials	1,3,4	Applying
CO-3	Examine the various approaches of nanotechnology	1,4,5	Analyzing
CO-4	Discuss operations and applications of spectroscopy	1,2,4,5	Analyzing
CO-5	Assess the Environmental and Health impacts of nanomaterials	1,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
II	21PEZO21C	NANOBIOTECHNOLOGY				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓		✓	✓	✓		✓	✓	
CO-3	✓				✓				✓	✓
CO-4		✓	✓	✓	✓		✓		✓	✓
CO-5	✓	✓	✓	✓	✓				✓	✓
	Number of matches (✓) = ...31.... Relationship = Low/ Medium /High									

SEMESTER-II

Course Title	DEVELOPMENTAL BIOLOGY PRACTICALS
Total Hrs	60
Hrs / Week	4
Sub. Code	21PCZO2P1
Course Type	PRACTICAL - III
Credits	2
Marks	100/2

General objective:

- ❖ Understand the developmental stages, reproductive system and fertilization process of living organisms.

Course objectives:

CO. No	The learners will be able to
CO -1	Illustrate the different stages of frog including eggs and cleavage stages.
CO -2	Identify the different types of placenta.
CO -3	Distinguish the testis and ovary of frog.
CO -4	Evaluate the mounting of male gametes in fish.
CO -5	Construct the IVF techniques in human chart.

1. Mounting and observation of male or female gamete in fish
2. Temporary mounting and observation of chick embryos.
3. Observations on developmental stages of frog (fertilized eggs, stages of cleavage, blastula, gastrula, tadpoles)
4. Effect of growth hormones on amphibian metamorphosis.
5. Induced ovulation in fish (Demonstration only).

SPOTTERS

1. Frog a) T.S. of testis and Ovary b) Fertilized Egg c) Yolk Plug Stage d) Neurula e) Tadpole.
2. Chick embryo: a) Primitive streak b) 24 hours of chick embryo c) 36 hours of chick embryo d) 48 hours of chick embryo e) 72 hours of chick embryo f) 96 hours of chick embryo.
3. Slides on cleavage: (Chick) 2 cell, 4 cell and 8 cell stages, blastula and gastrula.
4. Types of Placenta: a) Discoidal placenta b) Diffuse placenta c) Cotyledonary placenta.
5. IVF Techniques in human-Chart.

Course outcomes

Co.No	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive level
CO-1	Explain the female gametes in fish.	1,2	Understanding
CO-2	Identify the mounting of chick embryos in 24 hrs, 48 hrs, 72 hrs and 96 hrs.	1,2	Applying
CO-3	Differentiate the different stages of frog including blastula and gastrula stages.	1,2,4	Analyzing
CO-4	Assess the influence of hormone on amphibian metamorphosis.	1,2,4	Evaluating
CO-5	Develop the induced ovulation in fish.	2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
II	21PCZO2P1	DEVELOPMENTAL BIOLOGY PRACTICALS					60	2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓			✓	✓			
CO-3	✓	✓	✓			✓	✓		✓	
CO-4	✓	✓	✓			✓	✓		✓	
CO-5	✓	✓	✓				✓	✓		✓
	Number of matches (✓) = ...29.... Relationship = Low/ Medium /High									

SEMESTER – II

Course Title	GENETICS AND EVOLUTION & ANIMAL BIOTECHNOLOGY PRACTICALS
Total Hours	60/Semester
Hours/Week	4
Subject Code	21PCZO2P2
Course Type	Practical-IV
Credits	2
Marks	100/2

General Objective:

Understanding the Mendelian principle and Mendelian traits.

To know about the DNA and RNA isolation technique

Course Objectives:

CO.No.	The learners will be able to
CO-1	Explain Mendel's Law.
CO-2	Identify the ABO Blood group in human population.
CO-3	Compare gene and genotype frequencies based on the blood groups.
CO-4	Measure the density dependent selection in animal population.
CO-5	Elaborate on the Isolation of DNA and RNA.

1. Verification of Mendel's law-Monohybrid and Dihybrid crosses using coloured beads.
2. Human Mendelian traits.
3. ABO blood group in a large sample of human population or classroom sample.
4. Estimation of gene and genotype frequencies in the light of Hardy –Weinberg law based on ABO blood groups
5. Random genetic drift – using colour beads.
6. Demonstration of density dependent selection in animal population using beads.
7. Isolation of DNA and RNA.
8. Separation of DNA by Agarose gel electrophoresis and PAGE for protein.
9. Visit to biotechnology Laboratory and Research institution and submit report.

SPOTTERS

- 1) Sex-linked inheritance 2) Colour blindness 3) Construction of phylogenetic tree
 4) Colouration: Chamaeleon, Lycodon 5) Mimicry: Phyllium, Stick insect 6) pBR322
 7) CaMV 8) Stem cells 9) Dolly 10) Animal cloning 11) Transgenesis.

COURSE OUTCOME

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Compare the Monohybrid and Dihybrid crosses.	1,2,3	Understanding
CO-2	Identify the ABO Blood group in human population or classroom sample.	1,2,	Applying
CO-3	Examine the Hardy –Weinberg law based on ABO blood groups.	1,2,3	Analyzing
CO-4	Deduct the density dependent selection in animal population using beads.	1,2,4	Evaluating
CO-5	Develop on the isolation of DNA and RNA.	1,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course							Hours	Credits
II	21PCZO2P2	GENETICS AND EVOLUTION & ANIMAL BIOTECHNOLOGY PRACTICALS							60	2
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓		✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓			
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-4	✓	✓	✓	✓	✓	✓	✓			
CO-5	✓	✓	✓	✓	✓	✓		✓		✓
	Number of matches (✓) = 38 Relationship = Low/Medium/ High									

SEMESTER III

COURSE TITLE	SWAYAM - NPTEL ONLINE CERTIFICATION COURSE
TOTAL HOURS	30
HOURS/WEEK	2
SUBJECT CODE	21PSZO21
COURSE TYPE	SEC
CREDITS	2
MARKS	100/2

SWAYAM-NPTEL ONLINE CERTIFICATION COURSES

GUIDELINES AND INSTRUCTIONS

1. National Programme on Technology Enhanced Learning (NPTEL) provides e-learning through online web and video courses in Engineering, Science and Humanities streams through its portal <https://swayam.gov.in/ncdetails/NPTEL>.
2. Enrollment to all the courses is FREE.
3. Enrollment to courses and Examination Registration can be done ONLINE only. The link is available on NPTEL Website <http://nptel.ac.in/>
4. SWAYAM– NPTEL Online Certification Courses are mandated for the students in the PG Programmes from the Academic year 2021-2022.
5. Candidates must have completed Examination Registration successfully within the prescribed time to receive hall tickets and to write examinations.
6. Any Eight – Week, Two-Credit Course in any discipline to offer for two hours a week be chosen by the respective Departments in the second semester of the Postgraduate Programmes.
7. The SWAYAM–NPTEL Online Certification Courses offered during the December – April Semester be chosen by the Departments. The courses may be handled by the Department Mentor or by any teacher in the respective Departments.

8. The allocation of marks for the online examination conducted by the respective IITs is 25:75 for each course.
9. A candidate should obtain a minimum of 40 marks on 100 marks (a minimum of 10 marks for Assignment and 30 marks in the final examination) to pass the Online Courses.
10. If a student fails in the Online Examination conducted by the respective IITs he/she would be permitted to write a Supplementary Examination for 75 marks by the Controller of Examinations of our College.
11. Those who registered for the Online Courses, obtained Assignment marks, appeared for the Online Examination and failed in the courses alone are eligible to apply for the Supplementary Examinations conducted by the College.
12. If a candidate fails in the Supplementary Examinations conducted by the College, the norms followed for taking an Arrear Examination will be adopted.
13. A provision is given to candidates to reappear for Supplementary/Arrear Examinations in the same semester to facilitate them to receive their Degrees.
14. The Question paper in Multiple Choice Question Pattern for 75 marks shall be framed by the respective faculty/ by an External Examiner for conducting the Supplementary Examinations.
15. The Supplementary Examinations would be conducted for three hours.
16. Course Completion Certificate will not be issued by the respective IITs for the candidates who clear the Online Courses through the Supplementary Examinations conducted by the College. The two credits the candidate earns, if passed, would be added in the Consolidated Statement of Marks issued by the Controller of Examinations.

SEMESTER III

COURSE TITLE	ANIMAL PHYSIOLOGY
TOTAL HOURS	75
HOURS/WEEK	5
SUBJECT CODE	21PCZO31
COURSE TYPE	DSC-VII
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

- ❖ To understand the physiology of animals, working mechanism and functions of various organs and to impart knowledge on the recent techniques in physiology.

COURSE OBJECTIVES

CO.NO.	The learners will be able to
CO-1	Illustrate the various process involved in digestion.
CO-2	Identify the blood components and its functions.
CO-3	Differentiate the physiology and anatomy of kidney and lungs.
CO-4	Explain the mechanism of muscle contraction.
CO-5	Develop on the role of hormones and its functions.

UNIT I: DIGESTIVE SYSTEM

Digestive tract – structure and functions, secretory functions of the alimentary tract and digestive glands, role of gastro-intestinal hormones in digestion; digestion and absorption of carbohydrates, proteins and lipids – diseases associated with digestive system.

UNIT II: BLOOD AND CIRCULATION

Blood components – functions of blood – factors affecting RBC production. Functional anatomy of heart – cardiac cycle – cardiac output – regulation of cardio vascular function – blood pressure and related diseases (hypertension, hypotension, stroke)– coronary circulation – cerebral circulation – placental – foetal and neonatal circulation.

UNIT III: RESPIRATION AND EXCRETION

Respiration: Physiology and anatomy of the respiratory tract – gas transport between the lungs and tissues – regulation of respiration. Respiratory adjustments in health and diseases. Excretion: Excretory products – organs of excretion in different animals. Kidney – nephron – renal circulation – urine formation – renal disorders – micturition and dialysis.

UNIT IV: NEUROMUSCULAR AND SENSORY PHYSIOLOGY

Nervous system: Neuron – nerve fibres – classification and properties – neurotransmitters – synapse – reflex activity – structure and function – spinal cord and brain – electro encephalogram (EEG). Muscular system: Classification and properties – mechanism of muscular contraction – energetics of muscular contraction – neuromuscular junction.

Sense organs and receptors: Sense organs of vision, hearing and equilibrium, smell and taste, cutaneous, deep and visual sensations.

UNIT V: ENDOCRINOLOGY

Basic mechanism of hormone action- endocrine glands in mammal - Pituitary, thyroid, adrenal and islets of langerhans- hormones and functions – hormonal disorders - role of hormones in reproductive cycles –menstrual and estrous cycle - pregnancy – parturition - lactation - hormones and neoplastic growth.

TEXT BOOK

1. Dr. P.B. Reddy, 2015. Text book of Animal Physiology, Ratna Prasad Multidisciplinary Research & Educational Society (Regd) no. 1-90, Near VTPS Main Gate, Ibrahimpatnam, Krishna District, A.P., India
2. Verma P.S., Tyagi, B.S. and Agarwal V. 2010. Text book for Animal physiology S. Chand Publishing.

REFERENCE BOOKS

1. Rastogi S. 2019, Essentials of Animal physiology, New Age international publishers, 4th Edition.
2. Gordon, A., Wyse, Marget Anderson., 2008. Animal Physiology, 2nd edition, Richard W.Hill.
3. Verma, P.S.Tyagi B.S. and V.Agarwal, 2005. Animal Physiology. S. Chand and Company Ltd, New Delhi.
4. Sembulingam K. and P. Sembulingam, 2012. Essentials of Medical physiology, 6th Edition, Jaypee Brothers Medical Publishers Ltd. New Delhi.

5. Kim E.Barrett and Susan M. Barman. 2015. Ganong's Review of medical physiology. 25th edition. Lange Basic Science.
6. A. C. Guyton and J. E. Hall. 2011. Textbook of medical physiology. 12th edition. Saunders Elsevier, Philadelphia.

COURSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the role of hormones in digestion and absorption.	1,2	Understanding
CO-2	Identify the different cycles in the circulatory system	1,2	Applying
CO-3	Analyze the mechanism of respiration.	1,2,3	Analyzing
CO-4	Explain the neuromuscular mechanism.	1,4	Evaluating
CO-5	Elaborate the role of hormones in reproductive cycle.	1,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
III	21PCZO31	ANIMAL PHYSIOLOGY				75	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓			
CO-3		✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓			✓	
CO-5	✓	✓	✓	✓	✓	✓			✓	✓
	Number of matches (✓) = ...35.... Relationship = Low/Medium/ High									

SEMESTER - III

COURSE TITLE	BIostatISTICS AND Bioinformatics
TOTAL HOURS	75
HOURS/WEEK	5
SUBJECT CODE	21PCZO32
COURSE TYPE	DSC-VIII
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

- ❖ To acquire knowledge on the mathematical principles governing biological systems and statistical analysis of biological data and to know the various bioinformatics databases governing in day to day life.

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Understand the measures of central tendency.
CO-2	Develop on the theoretical probability distribution.
CO-3	Examine the different kinds of correlation methods.
CO-4	Compare various databases in bioinformatics.
CO-5	Modify the various bioinformatic tools.

UNIT I: TYPES OF DATA AND MEASURES OF CENTRAL TENDENCY

Types of biological data – ratio scale, interval scale, ordinal scale, nominal scale – sample and population; methods of sampling: random sampling, non- random sampling - Types of mean- Arithmetic mean, harmonic mean, geometric mean; median, mode– frequency distribution - Measures of dispersion: standard deviation, coefficient of variation, mean deviation, variance.

UNIT II: INFERENCE STATISTICS

Theoretical probability distribution: normal, binomial and Poisson – skewness and kurtosis, standard error – student's 't' distribution - Chi-square analysis – test for goodness of

fit – test for independence – types of errors: α and β ; Analysis of variance – one-way, two-way, ‘F’ test.

UNIT III: CORRELATION AND REGRESSION

Correlation: kinds, properties –methods: Karl Pearson’s, Rank; Regression analysis: simple, linear and non-linear regression and testing its significance.

UNIT IV: INTRODUCTION TO BIOINFORMATICS

Knowledge of various databases: Basic concepts and scope, Nucleic acid sequence database: Gen bank, EMBL and DDBJ, Protein sequence data base: Swiss Prot, TrEMBL, PIR, PDB, Genome data base:NCBI, EBI, TIGR, SANGER other database of patterns.

UNIT V: BIOINFORMATICS TOOLS

Sequence alignment: Pairwise alignment, local and global sequence alignment, multiple sequence alignment- Sequence analyzing tools: BLAST, FASTA – DNA micro array technique – Hidden Markov model – Homology Modeling.

TEXT BOOKS

1. Sharma, A.K. 2005, Text Book of Biostatistics, Discovery Publishing House.
2. Annadurai P. 2007. A Text Book of Biostatistics, 1st Edition, New Age International Publishers.
3. Neelakanta S. 2020, A Text Book of Bioinformatics. ISBN: 978-981 -121-288- 8.

REFERENCE BOOKS

1. Murthy C.S.V. 2003, Bioinformatics, Himalaya Publishing House, Mumbai, Delhi, Bangalore, India.
2. Ronald F., Lee E. and Hernandez M. 2006. Biostatistics 2nd Edition, Academic Press. ISBN: 978-008-044-677-26.
3. Rosner B. 2016.Fundamentals of Biostatistics 8th Edition, Cenveo Publishers services.
4. Zar, J.H. 2003.Biostatistical Analysis, Person Edition Asia, New Delhi.
5. Liebler, D.L. 2002, Introduction to Proteomics: Tools for the new Biology, Humana press.

COUTSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSO’S addressed	COGNITIVE LEVEL
CO-1	Classify the measures of central tendency.	1,2	Understanding
CO-2	Apply the theoretical probability distribution.	1,2	Applying
CO-3	Differentiate correlation and regression.	1,2,3	Analyzing
CO-4	Evaluate the various tools in bioinformatics.	3,4	Evaluating
CO-5	Create sequence alignment in bioinformatics.	4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
III	21PCZO32	BIostatISTICS AND BIOINFORMATICS				75	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓		✓	✓	✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓			
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓			✓	✓	
CO-5	✓	✓	✓	✓	✓				✓	✓
	Number of matches (✓) = ...35.... Relationship = Low/Medium/ High									

SEMESTER - III

COURSE TITLE	RESEARCH METHODOLOGY
TOTAL HOURS	75
HOURS/WEEK	5
SUBJECT CODE	21PCZO33
COURSE TYPE	DSC - IX
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

- ❖ Enable them to understand research and impart the knowledge of various techniques in research methodology and to develop the skill of writing and interpret a research report

COURSE OBJECTIVES :

CO.NO.	The learners will be able to
CO-1	Classify the various research methods.
CO-2	Apply the principles and techniques involved in various instruments.
CO-3	Examine the chromatographic technique in writing a research .
CO-4	Evaluate the steps involved in collection of data in research.
CO-5	Compose the steps in writing a research report.

UNIT I: INTRODUCTION TO RESEARCH METHODOLOGY

Introduction to research methodology: meaning of research, objectives of research, types of research, research approaches, significance of research, research methods v/s methodology, research and scientific methods, research process, criteria of good research.

UNIT II: PRINCIPLES OF VARIOUS TECHNIQUES

Microscopy: principles–Electron Microscopes and types – atomic force and magnetic force microscopes; Centrifuge: types, principles and applications; pH meter: types – principles and applications; Colorimeter: principles and applications, Cryopreservation and its applications; Freezing and freeze drying microtomes, cytotechniques.

UNIT III: CHROMATOGRAPHY AND ELECTROPHORESIS TECHNIQUES

Chromatography: Paper, Thin layer, Column, Gas liquid and Affinity Chromatography; Electrophoresis: Paper, Cellulose acetate, Gel –immuno electrophoresis;

Blotting techniques: Southern – northern – Western; Radioactive counters: Autoradiography – labeling studies; Spectrophotometer: Spectrofluorometer – ESR –NMR Spectrophotometer – Flame Emission Photometry.

UNIT IV: DATA COLLECTION AND ANALYSIS

Collection of data: methods of data collection, sampling methods, data processing and analysis strategies; tools and data analysis with statistics package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT V: INTERPRETATION AND REPORT WRITING

Meaning of interpretation: techniques of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports.

TEXT BOOKS

1. Prasad W, 2006. Comprehensive text book of biostatistics and research methodology.
2. Kothari C.R. 2004. Research methodology methods and techniques. Revised 2nd edition. New Age International (P) Limited Publishers. ISBN: 978-8122-424-881.

REFERENCE BOOKS

1. Shanthi B.M. and Shashi A 2017. Hand book of Research methodology. Published by Educreation. ISBN: 978-154-570-340-3.
2. Gurumani, N., 2006. Research Methodology for Biological Sciences, MJR Publishers, Chennai.
3. Garg, B.L., Karadia, R., Agarwal,F. and Agarwal,U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2ndVolume.
5. Vijayalakshmi, G. and Sivapragasam, C., 2008. MJP Publishers, Chennai.

COURSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Summarize the objectives of the research.	1,2	Understanding
CO-2	Apply the research experiments using the principles of various instruments.	1,2	Applying
CO-3	Classify the techniques in the research.	1,2,3	Analyzing
CO-4	Evaluate the data collection in writing a research.	3,4	Evaluating
CO-5	Compose and interpret the data collected.	2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PCZO33	Research Methodology					75	4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓		✓		✓	✓			
CO-2	✓	✓		✓		✓	✓			
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓		✓	✓	✓			✓	✓	
CO-5	✓	✓		✓	✓				✓	✓
	Number of matches (✓) = ...30.... Relationship = Low/ Medium /High									

SEMESTER – III

Course Title	MICROBIOLOGY
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO31A
Course Type	DSE-III A
Credits	4
Marks	100

General objective:

- ❖ To impart knowledge on classification, characteristics and significance of microorganisms and to provide knowledge on development of microbiology and industrial application of microbes.

COURSE OBJECTIVES

CO.NO.	The learners will be able to
CO-1	Explain the history and scope in microbiology.
CO-2	Understand the growth kinetics of microorganisms.
CO-3	Examine the structure and functions of genetic materials.
CO-4	Assess the different types of microbial diseases.
CO-5	Construct the steps involved in preservation techniques.

UNIT I: CLASSIFICATION OF MICROBES

History and scope of microbiology, classification of bacteria, fungi, protozoa and virus; Morphology and fine structure of bacteria, Virus and fungi; Isolation– pure culture techniques, identification and maintenance of microbes.

UNIT II: MICROBIAL GROWTH

Requirements for growth: physical and culture characteristics, culture media curve, measurement of microbial growth, growth curve and growth kinetics; microbial control:

physical and chemical methods- methods of estimation of microorganisms in soil, water and air – isolation and identification of bacteria – biochemical tests.

UNIT III: MICROBIAL GENETICS

Structure and functions of genetic material – transfer of genetic information – transformation, transfection, conjugation, retro transfer, transduction and genetic recombination, regulation of gene expression in bacteria.

UNIT IV: MICROBIAL DISEASES

Protozoan diseases: Plasmodium, Entamoeba; Fungal diseases: Mycotoxicosis, Aspergillosis and Dermatomycosis; Bacterial diseases: Meningitis, Cholera, Typhoid, Gonorrhea and Syphilis; Viral diseases – Polio, Hepatitis B, Rabies and AIDS – Mode of transmission, diagnosis and treatment –Types of vaccines.

UNIT V: APPLIED MICROBIOLOGY

Fermentation – definition and types; bioconversion, bio remediation – industrial production of Penicillin, ethanol, vinegar, vitamin B12 – Citric acid and glutamic acid production; Food microbiology – food spoilage and food preservation, fermented foods, probiotics and prebiotics.

TEXT BOOKS

1. Ananthanaryanan, T and Paniker, J.C.K. 2000. Text Book of Microbiology Oriental Longman Ltd., Madras.
2. Dubey, H.C., 2004. A text book of fungi, bacteria and viruses, Vikas Publishing House.

REFERENCE BOOKS

1. R. C. Dubey and D. K. Maheshwari, 2009. A textbook of microbiology, S. Chand & Company, New Delhi.
2. Prescott, Harley and Klein, Microbiology, 2004. 6th Edition, Mc Graw-Hill Higher Education,, New York.
3. R. Y. Stainer, J. L. Ingraham, M. L. Wheelis and P. R. Painter, 2007, General microbiology, Macmillan India Ltd.
4. S.S. Purohit, Microbiology: 2002. Fundamentals and applications, Agro Bios, 6th revised Edition, India.
5. N. Kannan, 2002, Laboratory Manual in General Microbiology, Palani Paramount Publications.
6. J. Cappuccino and N. Sherman, 2013, Microbiology: A laboratory Manual, Pearson Benjamin Cummings, 10th Edition.

COURSE OUTCOME

CO.NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the classification of various microorganisms.	1,2	Understanding
CO-2	Construct the culture methods involved in microbial growth .	2,3	Applying
CO-3	Classify the microbial genetics in bacteria.	2,3	Analyzing
CO-4	Evaluate the different microbial diseases.	2,3,4	Evaluating
CO-5	Discuss the fermentation process in microorganism.	1,2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
III	21PEZO31A	MICROBIOLOGY				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
	CO-1	✓	✓	✓	✓		✓	✓		
	CO-2	✓	✓	✓				✓	✓	
	CO-3		✓	✓	✓			✓	✓	
	CO-4	✓	✓	✓	✓	✓		✓	✓	✓
	CO-5	✓	✓		✓	✓	✓	✓		
	Number of matches (✓) = ...31.... Relationship = Low/ Medium /High									

SEMESTER-III

COURSE TITLE	FISHERIES AND AQUACULTURE
TOTAL HOURS	60
HOURS/WEEK	4
SUBJECT CODE	21PEZO31B
COURSE TYPE	DSE –III B
CREDITS	4
MARKS	100

GENERAL OBJECTIVE:

- ❖ To understand the significance of aquaculture practice and its management in the present scenario.

COURSE OBJECTIVES :

CO.NO.	The learners will be able to
CO-1	Classify the major groups of fish.
CO-2	Apply the crafts and gears involved in fishing .
CO-3	Analyse the present global and Indian scenario in aquaculture.
CO-4	Explain the culture system in aquaculture.
CO-5	Elaborate the nutritional requirements of fish.

UNIT I: INTRODUCTION TO FISHERIES

Major group of fish and their characteristics: morphometric and meristic characters of Elasmobranchs and Teleost fish; growth, reproduction, maturation and spawning in fish–inland, estuarine and marine fisheries: Inland fisheries - riverine fisheries, reservoir fisheries, cold water fishery of lakes, estuarine and marine fisheries.

UNIT II: CRAFTS AND GEARS

Fishing crafts and gears: Fishing crafts - Fishing gears, spear and harpoon, fish traps, nets, types of nets, preservation of nets, fishing by electric current, modernization of fishing methods.

UNIT III: INTRODUCTION TO AQUACULTURE

Aquaculture – definition, objectives, history and scope, importance and need - Indian and global scenario of aquaculture; types of aquaculture, culture systems - pond culture, cage culture, raft culture and pen culture - marine aquaculture, integrated farming.

UNIT IV: CULTURE SYSTEM AND CULTIVABLE SPECIES

Criteria for selection of species for aquaculture, important brackish water and marine species for aquaculture in India – design and construction of culture ponds – preparation and management of culture ponds- hatchery and nursery ponds - induced breeding in fin fish (hypophysation) and shell fish (eye stalk ablation).

UNIT V: FEED AND NUTRITION

Nutritional requirement of cultivable fish - Live feed culture (Micro algal culture, culture of Artemia, Rotifer and copepods) – significance of live feed culture – bio encapsulation; Artificial feed - types of artificial feed, medicated feed - FCR – Feeding strategies and feed dispersion and management.

TEXT BOOKS

1. Khanna S. S., and Singh H.R. 2014. A text book of Biology and Fisheries. Published by Narendra Publishing House. ISBN: 938- 438-712-9.
2. Ahilan B. 2013. Text book on Fresh water Aquaculture. Daya Publishing House, India.

REFERENCE BOOKS

1. Belsare, D.K. 2019. Text book of Fish, Fisheries and Aquaculture. Kindle edition.
2. Sanjay k Gupta and Pawan Kumar B. 2014. Aquaculture and Fisheries environment. Discovery Publishing House.
3. Selvamani, B.R. and Mahadevan, R. K. 2008. Aquaculture, Trends and Issues. Campus Books International. ICAR. 2006. Hand book of Fisheries and Aquaculture. ICAR.
4. Pillay, T.V.R. and Kutty, M. N. 2005. Aquaculture-Principles and Practices. Blackwell.

Course Outcomes

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Classify the major groups of fish and their characteristics.	1,2	Understanding
CO-2	Distinguish crafts and gears involved in fishing.	1,2	Applying
CO-3	Examine the different cultures in aquaculture.	2,3	Analyzing
CO-4	Explain the different species for culture.	3,4	Evaluating
CO-5	Create the different artificial feed for culture fish.	3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PEZO31B	FISHERIES AND AQUACULTURE					60	4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓		✓	✓	✓	✓			
CO-2	✓	✓	✓	✓		✓	✓			
CO-3	✓		✓	✓	✓		✓	✓		
CO-4	✓	✓	✓	✓				✓	✓	
CO-5	✓	✓	✓	✓	✓			✓	✓	✓
	Number of matches (✓) = ...32.... Relationship = Low/ Medium /High									

SEMESTER - III

Course Title	PARASITOLOGY
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO31C
Course Type	DSE – III C
Credits	4
Marks	100

General Objectives

To know the different kinds of parasites, their harmful effects, mode of infection and preventive measures.

Course objectives:

CO No.	The learners will be able to
CO - 1	learn the varied applications of the diagnostic tools in parasite control
CO - 2	Categorizing general principles of parasitology, immunity involved in parasitic infections
CO - 3	Discuss about the mode of infection and treatment of protozoan parasites
CO - 4	Know the pathogenicity and treatment of Helminth parasites
CO - 5	Understand the life history and medical importance of disease transmitting vectors of arthropod parasites

UNIT I INTRODUCTION

Types of animal association- parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection; host- parasitic interactions – parasitic effects benefiting the parasites.

UNIT II PARASITIC ADAPTATIONS

Parasitic mode of life – adaptations- morphological, biochemical and ethological adaptation – immune responses of host and self – defense mechanism – molecular characterization of stage specific antigens – nucleotide probes for diagnosis of protozoan diseases.

UNIT III PROTOZOAN PARASITES

Morphology, Life cycle and Biology, mode of infection and treatment of Mastigophora – *Trypanosoma*, *Leishmania*, *Giardia* and *Trichomonas*; Sarcodina- *Entamoeba*, *Iodamoeba*; Chilophora - *Balantidium* ; Sporozoa - *Toxoplasma* and *Plasmodium*.

UNIT IV HELMINTH PARASITES

Life cycle, Biology, morphology, pathogenesis and treatment of Nematoda - *Ancylostoma*, *Ascaris*, *Enterobius*, *Wuchereria*, *Onchocerca*, *Loa*, *Trichuris*; Trematoda - *Polystoma*, *Schistosoma*, *Echinostoma*, *Fasciola*; Cestoda - *Taenia*, *Echinococcus* and *Dipylidium*.

UNIT V ARTHROPOD PARASITES

Morphology, life history and medical importance of disease transmitting vectors- Diptera- Culicoides, *Aedes*, *Culex*, *Anopheles* and House fly; Siphonoptera -*Xenophylla*, *Ctenocephalides*, *Echidnophag* and *Tunga*; Phthirptera – *Pediculus* and *Pthirus*; Hemiptera - *Cimex*, *Triatoma* ; Malaria, Chikungunya and Dengue fever.

Text book:

1. Prakash Malhotra 2008. Applied Parasitology – Adhyayan Publishers and Distributors – New Delhi.

REFERENCES

1. Berger, S. A., Marr J. (2006) Human Parasitic Diseases Sourcebook, Jones & Bartlett.
2. Despommier, Gwadz, Hotez, Knirsch (2005) Parasitic Diseases 5th edition, Apple Trees Productions, LLC.
3. Margo, W. M. S., Pybus J. and Kocan A. A. (2008). Parasitic Diseases of Wild Mammals, 2nd edition, Iowa State University Press, Ames, Iowa, USA
4. Kochhar S.K. 2004. A Text Book of Parasitology. Dominant Publishers and Distributors – New Delhi.
5. Veer Singh Rathore and Yogesh Singh Sengar, 2005. Diagnosis parasitology. Pointer Publishers Jaipur – India.

COURSE OUTCOME

CONo	Upon completion of the course, the students will be able to	PSO's addressed	Cognitive level
CO - 1	Explain life patterns, morphological adaptation, pathogenicity and diagnostic techniques, protozoans and helminth parasite	1,2	Apply
CO - 2	Understand the different components of immune system and antigenic diversity in parasites and the selection of vaccine targets will be understood	1,2,4	Understanding
CO - 3	Understand the Morphology, Life cycle and Biology, mode of infection and treatment of protozoan parasites	1,2,4	Understanding
CO - 4	Discuss about the Life cycle, Biology, morphology, pathogenicity and treatment of Nematoda	1,2,4	Analyse
CO - 5	Discuss the concerned species, life history, disease transmission, epidemiology and control of the arthropod vectors	1,2	Evaluate

Cognitive level: R - Remember; U-Understanding; A-Apply; An-Analyse; E – Evaluate; C-Create

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PEZO31C	PARASITOLOGY					60	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓	✓	✓			
	Number of matches (✓) = 38 Relationship = Low/ Medium /High									

SEMESTER – III

COURSE TITLE	ANIMAL PHYSIOLOGY PRACTICALS
TOTAL HOURS	60/Semester
HOURS/WEEK	4
SUBJECT CODE	21PCZO3P1
COURSE TYPE	PRACTICAL -V
CREDITS	2
MARKS	100/2

GENERAL OBJECTIVE:

- ❖ To develop the skills of performing experiments, analyzing the results and discussing the observations in Animal Physiology

COURSE OBJECTIVES

CO.NO.	The learners will be able to
CO-1	Interpret the effect of temperature on opercular movement of fish.
CO-2	Identify the total haemoglobin in human blood.
CO-3	Examine the haemin crystals in human blood.
CO-4	Determine the Erythrocyte sedimentation rate.
CO-5	Estimate the Salt loss/salt gain in a fish.

1. Effect of Temperature on opercular movement of fish.
2. Estimation of Total haemoglobin and blood clotting time.
3. Haemin crystals in human blood.
4. Determination of Erythrocyte sedimentation rate (ESR)
5. Rate of Oxygen consumption in a fish

6. Salt loss/salt gain in a fish
7. Quantitative analysis of Nitrogenous waste products.
8. Estimation of blood chloride
9. Virtual dissection of frog- Blood vascular system or Digestive system.
10. Bomb Calorimeter – Demonstration

Spotters

- | | |
|-------------------------|----------------------------|
| 1) Simple muscle twitch | 2) Sphygmomanometer |
| 3) Haemocytometer | 4) Reflex arc model |
| 5) ECG model | 6) Cardiac cycle |
| 7) Dialysis | 8) Family planning devices |

COURSE OUTCOMES

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the effect of temperature on opercular movement of fish.	1,2	Understanding
CO-2	Develop the haemin crystals in human blood.	1,2	Applying
CO-3	Examine the Erythrocyte sedimentation rate (ESR)	1,2,3	Analyzing
CO-4	Compare salt gain and salt loss in fish.	3,4	Evaluating
CO-5	Discuss the various nitrogenous waste products in animals.	3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PCZO3P1	ANIMAL PHYSIOLOGY PRACTICALS					60	2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓			
CO-2		✓	✓	✓	✓	✓	✓			
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓				✓	✓	
CO-5	✓	✓	✓	✓	✓			✓	✓	✓
	Number of matches (✓) = 35..... Relationship = Low/Medium/ High									

SEMESTER - III

COURSE TITLE	BIostatistics AND Bioinformatics & Research Methodology Practicals
TOTAL HOURS	60/Semester
HOURS/WEEK	4
SUBJECT CODE	21PCZO3P2
COURSE TYPE	PRACTICAL– VI
CREDITS	2
MARKS	100/2

GENERAL OBJECTIVE:

- ❖ To analyze and apply statistical techniques and to develop the computational skill and to impart knowledge on various biological databases

COURSE OBJECTIVES:

CO.NO.	The learners will be able to
CO-1	Illustrate the measures of central tendency.
CO-2	Identify the correlation and regression analysis of students.
CO-3	Discuss the study of probability using coin toss.
CO-4	Explain various databases in bioinformatics.
CO-5	Create the bioinformatic tools.

1. Statistical analysis of mean, median and mode, variance, SD, SE, coefficient of variation using neem leaves.
2. Calculation of correlation coefficient – length and width of neem leaves
3. Calculation of correlation coefficient – height and weight of students in the class.
4. Calculation of regression co-efficient using length and width of neem leaves.
5. Study of probability using coin toss.
6. Test of significance (student's t-test)

7. Processing data with statistical package. (SPSS)- Demonstration.
8. PubMed, NCBI, EMBL, SWISS-PROT – printout
9. Select a topic and write a model research proposal.

Biostatistics and Bioinformatics spotters

1. Uniprot
2. Protein Data Bank
3. GenBank
4. Use of BLAST, FASTA (Nucleic Acids and Proteins)
5. Use of EMBOSS
6. Molecular Modelling
7. Homology Modelling – Swissmodeler

Research Methodology spotters

1. pH meter
2. Colorimeter
3. Spectrophotometer
4. Chromatography
5. Electrophoresis

CO. NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Compare mean, median, mode in the statistical analysis.	1,2	Understanding
CO-2	Develop the correlation and regression analysis.	1,2	Applying
CO-3	Analyze the probability by applying the formulae.	1,2,4	Analyzing
CO-4	Compare various databases in statistical analysis.	3,4	Evaluating
CO-5	Design processing data using SPSS package.	4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PCZO3P2	BIostatISTICS AND Bioinformatics & RESEARCH METHODOLOGY PRACTICALS					60	2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓		✓	✓			
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4			✓	✓				✓	✓	
CO-5			✓	✓	✓				✓	✓
	Number of matches (✓) = ...28.... Relationship = Low/ Medium /High									

SEMESTER - III

Course Title	APPLIED ZOOLOGY
Total Hours	30
Hours/Week	2
Subject Code	21PIZO31
Course Type	IDC-II
Credits	2
Marks	100/2

General Objective:

To develop entrepreneur skill in various Zoological field like Vermiculture, Apiculture, Prawn Culture, Sericulture and Poultry Management.

Course Objectives:

CO.No.	The learners will be able to
CO-1	Explain the Earthworm culture technology.
CO-2	Develop knowledge on apiculture, maintaining bee hives and bee products.
CO-3	Classify the process involved in prawn culture.
CO-4	Assess the sericulture techniques and its economy value.
CO-5	Elaborate the process involved in poultry industry.

UNIT I: VERMICULTURE

Introduction to Vermiculture - types of earthworm, biology of *Eudrilus euginea*-rearing of earthworms, equipment/devices used in vermiculture - Vermicompost technology – methods and products - Vermiwash collection - composition and use.

UNIT II: APICULTURE

Morphology and biology of honey bees – honey bee species – social behaviour of honey bees – bee keeping and ancillary industries – Newton's bee hive - extraction of honey – medicinal value of honey – bee products – importance of bee colonies in crop pollination.

UNIT III: PRAWN CULTURE

Prawn fishery – types of prawn fishery – culture of fresh water prawn – culture of marine prawn – preparation of farm; preservation and processing of prawn, export of prawn.

UNIT IV: SERICULTURE

History and present status - sericulture in India - types of silkworms – Mulberry and Non-mulberry - Silkworm rearing – Chawki and late age rearing – Silk reeling, re-reeling - diseases and pests of silkworm: protozoan, viral, bacterial and fungal Diseases (any two); silkworm pests: Indian Uzi fly and Dermestid beetles.

UNIT V: POULTRY MANAGEMENT

Breeds of fowl, housing and equipment, deep litter system, cage management, methods of brooding and rearing, debeaking; management of growers, layers, broilers; feed formulations for chicks, growers and broilers; diseases of fowl; nutritive value of egg and meat.

TEXTBOOKS

1. Jawaid Ahsan and Subhas Prasad Sinha (2009), A Hand book on Economic Zoology, S. Chand Publications, New Delhi.
2. Arumugam, N., Murugan, T., Johnson Rajeswar and R. Ram Prabhu (2009), Applied Zoology, Saras Publication, Nagercoil.

REFERENCE BOOKS

1. Dash, M.C., 2012 Charles Darwin's Plough Tool for vermitechnology, I.K. International Publishing House Private Limited, New Delhi.
2. Ganga, G . 2004. Comprehensive Sericulture, Vol. II, Silk worm Rearing and Silk Reeling, India Book House Private Ltd.
3. Scanes, C.G, Brant, G and Ensminger, M.E., 2004. Poultry Science, 4th Ed. Prentice Hall, USA.
4. Gatoria, G.S., Gupta, J. K., Thakur, R.K. and Singh, J. 2011. Mass queen bee rearing and multiplication of honey bee colonies. All India Co-ordinated project on honey bees and pollinators, ICAR, HAU, Hisar, p70.

COURSE OUTCOME

CO.NO.	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the Vermiculture technology	1,2,3,4	Understanding
CO-2	Develop the techniques involved in Apiculture.	1,2,3	Applying
CO-3	Classify the fresh water prawn and marine prawn.	1,3	Analyzing
CO-4	Estimate the Silkworm cocoon and its economy value.	1,2,3,4	Evaluating
CO-5	Create the self-employment opportunity in poultry industry.	1,5	Creating

Cognitive Level; R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
III	21PIZO31		APPLIED ZOOLOGY			30		2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓				✓
	Number of matches (✓) = 40 Relationship = Low/Medium/ High									

SEMESTER - IV

Course Title	IMMUNOLOGY
Total Hrs	75
Hrs / Week	5
Sub. Code	21PCZO41
Course Type	DSC-X
Credits	4
Marks	100

General objective:

- ❖ To understand the fundamental aspects of infective organisms and the potential of the living systems to resist infections

Course objectives:

CO. No	The learners will be able to
CO -1	Classify the cells of immune system and lymphoid organs.
CO -2	Examine the structure, types and biological properties of immunoglobulins
CO -3	Compare the Classical and alternate pathways of complement system.
CO -4	Asses the immuno response to tumour and immuno diagnosis of tumour.
CO -5	Elaborate on the Transplantation techniques and Treatments.

UNIT I: HISTORY AND TYPES OF IMMUNITY

Introduction: History, types of Immunity: Innate Immunity and Acquired immunity – active and passive immunity – adoptive immunity; Cells of immune system: Lymphoid lineage – T cells and its types – B cells and its types – null cells and its types- Myeloid lineage; organs of immune system: primary lymphoid organs: thymus – bone marrow- bursa of Fabricius – Secondary lymphoid organs: lymph node and spleen.

UNIT II: IMMUNE RESPONSE

Humoral immune response: Primary and secondary humoral immune response – importance of B cells in humoral immune response – factors influencing antibody formation; Cell mediated immune response: cells involved in the cell mediated immune response – cytokines and their actions – Hypersensitivity reaction: Factors causing hypersensitivity – types of hypersensitivity – type I, II, III, IV and V – hypersensitivity reactions; Complement

system: Classical and alternate pathways of complement system – biological functions of complement system.

UNIT III: ANTIGENS AND ANTIBODIES

Antigens: types of antigens – chemical nature of antigen – essential factors for antigenicity; Antibodies: Antibodies and immunoglobulins – structure of immunoglobulin – types of immunoglobulin – biological properties of immunoglobulins G, M, A, D, and E – Monoclonal and polyclonal antibodies; Antigens and antibody reactions: salient features and mechanism of immune complex.

UNIT IV: CLINICAL IMMUNOLOGY

Transplantation immunology: types of transplantation: classification of grafts – mechanism of graft rejection – graft versus host reaction – immuno suppressive therapy during transplantation; Tumour immunology: properties of tumour cells –tumour antigens – immune response to tumour – immune surveillance – immuno diagnosis of tumour – immuno therapy of tumour; tumour vaccines.

UNIT V: DISEASES AND VACCINES

Auto immune diseases: characteristics– causes and classification of auto immune diseases – treatment of auto immune diseases; Immune response to infectious diseases: protozoan parasite (malaria) – bacterial disease (Tuberculosis) – viral disease (HIV) – ELISA and Western Blot; Immuno therapy: immunization and immunization schedule – vaccines – attenuated vaccine – killed vaccine – recombinant vaccine – vector vaccine and DNA vaccine.

TEXTBOOKS:

1. C. V. Rao 2004. An introduction to immunology. Narosa Publishing House.
2. Chakraborty, A.L. 2006. Immunology and Immunotechnology. Oxford University Press, New Delhi.

REFERENCE BOOKS:

1. Klaus D. Elgert, 2009. Immunology: Understanding the Immune System, 2nd Edition, Wiley-Blackwell Publishers Co.
2. Donald M. Weir and John Stewart. 2001. Immunology, 9th edition. ELBS Publication.
3. Aruna Bhatia. 2006. Manual of Practical Immunology. Palani Paramount Publications, Palani.
4. Talwar, G. P. 2000. A handbook of Practical Immunology, Vikas Publication House Ltd. New Delhi.

5. Hudson, L. and Hay, F. 2001. Practical Immunology, 3rd edition, Blackwell Scientific Publication.

Course outcomes

CO.NO	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Compare the different types of immunity and humoral , cell mediated immune response.	1,2 ,4,5	Understanding
CO-2	Identify the types and chemical nature of antigens.	2,4,5	Applying
CO-3	Examine the Factors causing hypersensitivity and types of hypersensitivity.	1,2,3	Analysing
CO-4	Recommend the Immunization and immunization schedule – vaccines.	1,2,4	Evaluating
CO-5	Develop the tumour immunology and tumour therapy	2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours		Credits	
IV	21PCZO41	Immunology					75		4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-2	✓		✓	✓	✓		✓		✓	✓
CO-3	✓		✓	✓		✓	✓		✓	
CO-4	✓		✓	✓		✓	✓		✓	
CO-5	✓		✓	✓	✓		✓		✓	✓
	Number of matches (✓) = ...35.... Relationship = Low/Medium/ High									

SEMESTER - IV

Course Title	ENTOMOLOGY
Total Hours	75
Hours/Week	5
Subject Code	21PCZO42
Course Type	DSC-XI
Credits	4
Marks	100

General Objective:

To understand the aspects of insect classification and to know the harmful insects and beneficial insects, pest management.

Course Objectives:

CO.No.	The learners will be able to
CO-1	Classify the insects in biological order.
CO-2	Explain the morphological structure and functions of different organ systems.
CO-3	Classify the fine structure of receptor organs of insects.
CO-4	Compare the harmful and beneficial insects.
CO-5	Modify the various principles and methods of pest control.

UNIT I: TAXONOMY

Insect classification – Principles and classification of insects based on order– key characteristics with Indian examples – Coleopteran, Diptera, Hemiptera, Dermoptera, and Lepidoptera.

UNIT II: STRUCTURE AND FUNCTION I

General structure of head, thorax with their appendages, abdomen - integumentary system: structure and chemistry – structure and physiology of digestive system; respiratory system: aerial and aquatic respiration – respiration in endoparasites; circulatory system: structure of heart, mechanism of haemolymph circulation– diversity

of haemocytes and their function; excretory system: Malpighian tubules and their function; reproductive system: post-embryonic development.

UNIT III: STRUCTURE AND FUNCTION II

Fine structure of compound eye, coeloconic, Johnston's organ, chordotonal organs and stridulatory organ – bioluminescence; endocrine control of moulting and metamorphosis, vitellogenesis.

UNIT IV: HARMFUL AND BENEFICIAL INSECTS

Insect pests of economically important crops: cotton, paddy, sugarcane and vegetables; insects injurious to man: Mosquitos, House Fly and Sand Fly; beneficial insects: biology, culture and economic importance of honey bees and lac insects.

UNIT V: METHODS AND PRINCIPLES OF PEST CONTROL

Control measures: cultural, mechanical, physical, legal, chemical, biological, genetic chemo sterilant, pheromones, concepts of bio integrated pest control, Biointensive Integrated Pest Management (BIPM).

TEXTBOOKS

1. Rajendra Singh, 2007 Elements of Entomology, Rastogi Publications, Meerut
2. Pedigo, L. P., 1996, Entomology and pest management (2nd edition) –Upper Saddle River, N. J. Prentice Hall.

REFERENCE BOOKS

1. Nayar, K. K., David, B. V. and Anantha Krishnan, T. N., 2004, General and applied entomology, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. David B. V. Ramamurthy T., 2000, Elements of economic entomology, Popular Book Depot, Chennai.
3. D. P. Ambrose, 2004, The insects: Structure, function and biodiversity, Kalyani Publishers, Ludhiana,
4. D. P. Ambrose, 2017, The insects: beneficial and harmful aspects, Kalyani Publishers, Ludhiana.

COURSE OUTCOME

CO.No.	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Understand the taxonomy of insects.	1,2,3	Understanding
CO-2	Identify the digestive system; respiratory system, circulatory system and excretory systems of insects.	1,2,3,4	Applying
CO-3	Examine the fine structure compound eye, coeloconic, Johnston's organ, chordotonal organs and stridulatory organ.	1,2,3	Analyzing
CO-4	Explain the culture of the economically important honey bees and lac insects	1, 3,4	Evaluating
CO-5	Discuss the Biointensive Integrated Pest Management (BIPM).	1,5	Creating

Relationship Matrix

Semester	Course Code			Title of the Course			Hours		Credits	
IV	21PCZO42			ENTOMOLOGY			75		4	
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓		✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	
CO-5	✓	✓	✓	✓	✓	✓				✓
	Number of matches (✓) = 40 Relationship = Low/Medium/ High									

SEMESTER - IV

COURSE TITLE	PROJECT
TOTAL HOURS	120
HOURS/WEEK	8
SUBJECT CODE	21PPZO41
COURSE TYPE	PROJECT
CREDITS	8
MARKS	150

The following are the guidelines to be adhered to by the Postgraduate students :

- Individual Projects should be taken.
- The Project should be written in English only.
- The Minimum number of pages should be 60.
- Project observations, suggestions and summation/conclusion shall form part of the Project Report.
- The Projects will be evaluated by the Internal Examiner and the External Examiner for 150 marks. The distribution of mark should be 90 marks for the Project Report and 60 marks for the Viva-Voce Examination. The Division of marks for the Project Report is as follows:

Particulars	Internal Examiner	External Examiner
Wording of Title	5	5
Objectives / Formulation including Hypothesis	10	10
Review of Literature	15	15
Relevance of the Project to Social Needs	10	10
Methodology / Technique / Procedure Adopted	30	30
Summary / Findings / Conclusion / Summation	10	10
Bibliography / Annexure / Foot notes / Works Cited / Works Consulted	10	10
Total	90	90

- ❖ The Internal Examiner and the External Examiner will award the marks for each candidate. The average mark obtained by the candidate is considered marks for the Project Report.

SEMESTER - IV

Course Title	SERICULTURE
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO41A
Course Type	DSE – IV A
Credits	4
Marks	100

General objective:

- ❖ To understand the various aspects of sericulture and encourage the students for self employment.

CO. No	The learners will be able to
CO -1	Explain Sericulture industry in India and Tamilnadu.
CO -2	Construct the Life cycle of silkworm.
CO -3	Distinguish the diseases of mulberry and non-mulberry plants.
CO -4	Compare the diseases of silk worm.
CO -5	Design the reeling operations applied in sericulture.

UNIT I: HISTORY AND IMPORTANCE OF SERICULTURE

Importance of sericulture - sericulture industry in India and Tamilnadu - sericulture as a cottage industry - role of central silk board, research institutes, national silk seed organization; Moriculture – morphology of Mulberry plant, Mulberry varieties, Artificial seed preparation - package of practices for mulberry and castor plant cultivation.

UNIT II: LIFE CYCLE OF MULBERRY AND NON- MULBERRY SILKWORM

Classification of mulberry silkworm, life cycle - habit and habitat - voltinism, races – morphology of silkworm - structure of egg, larva, pupa, and adult, sexual dimorphism of larva and pupa, fine structure of silk gland; non mulberry silk worm – classification- life cycle and morphology of Eri silkworm.

UNIT III: DISEASES OF MULBERRY AND NON –MULBERRY PLANTS

Diseases of mulberry: Fungal diseases – (Root and Shoot diseases), bacterial diseases (Tukra) - leaf blight disease, rot disease; Viral diseases – Mulberry leaf mosaic disease, dwarf disease; Deficiency diseases: nitrogen, phosphorus, magnesium and calcium deficiency - symptoms and control measures - major pests of mulberry; non mulberry plant diseases and control measures.

UNIT IV: SILKWORM DISEASES

Diseases of silk worm: Protozoan – Pebrine, Viral – Flacherie, Gattine, Bacterial – septicemia, sotto, Fungal - Muscardine, Pests –Uzi fly; diseases of non-mulberry silkworm – Bacterial, fungal, viral diseases (any two) and control measures.

UNIT V: COCOON MARKETING AND REELING OPERATIONS

Rearing of silk worm: selection and construction of rearing house, rearing appliances, rearing operation, maintenance of optimum conditions; Chawki rearing - rearing of late age larva — characteristics of cocoons - defective cocoons; cocoon production, harvesting and marketing; Silk reeling: cocoon stifling - storage of cocoons, cocoon boiling and deflossing; Process of reeling: different methods, reeling techniques- lacing, skinning, twisting and re reeling.- raw silk and marketing.

TEXT BOOKS

1. Ganga, G. and Sulochana Chetty. I , 2014.- An Introduction to Sericulture. Oxford & IBH Publishing Company Private Ltd .New Delhi.
2. Kesary, M . and M .Johnson, 2007. Sericulture, Department of Zoology, N. M. Christian College, Marthandam - 629 165 .

REFERENCE BOOKS

1. Dandin, S. B. , Jayant Jayaswal and K. Giridhas, 2000. Hand Book of Sericulture Technologies, Central Silk Board, Madivala, Bangalore - 68.
2. Ganga, G. 2003,- Comprehensive Sericulture, Vol. I, Moriculture, Science Publishers.U.S..
3. Ganga, G . 2004. Comprehensive Sericulture, Vol. II, Silk worm Rearing and Silk Reeling, India Book House Private Ltd.
4. Ullal, S. and Narasimhana, M.N. 2003. Hand Book of Practical Sericulture- CSB,Bombay.

Course outcomes

CO.No	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive level
CO-1	Summarize the importance of moriculture.	1,2	Understanding
CO-2	Develop the fine structure of silk gland of silkworm.	1,2,3	Applying
CO-3	Differentiate the diseases of mulberry plant.	2,3,4	Analyzing
CO-4	Explain the various diseases of silkworm.	2,3,4	Evaluating
CO-5	Formulate the various cocoon marketing techniques.	1,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
IV	21PEZO41A	SERICULTURE				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓			
CO-2	✓	✓	✓	✓		✓	✓	✓		
CO-3	✓	✓	✓	✓			✓	✓	✓	
CO-4		✓	✓	✓	✓		✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓			✓	✓
	Number of matches (✓) = ...36.... Relationship = Low/Medium/ High									

SEMESTER - IV

Course Title	POULTRY AND DAIRY SCIENCE
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO41B
Course Type	DSE-IV B
Credits	4
Marks	100

General objective:

To acquire more recent knowledge on modern Poultry and Dairy Science technology on self employment opportunity.

Course objectives:

CO. No	The learners will be able to
CO -1	Explain the poultry industry in India and 5 years plan for improvement of poultry field.
CO -2	Interpret the Managements of chicks, growers, layers and broilers.
CO -3	Analyse debeaking and forced moulting for poultry birds.
CO -4	Evaluate the protein and amino acid requirements for chicks, growers, layers and broilers.
CO -5	Develop the Dairy breeds of India : Cattle and Buffaloes, Native and Exotic Breeds.

UNIT I: DEEP LITTER AND CAGE SYSTEM

Poultry in India- a survey- historical review- progress through 5 year plans; types of poultry birds, choosing commercial layers and broilers- poultry housing – construction of poultry sheds - deep litter system – litter management, laying cages, Californian cages; debeaking: methods of debeaking and forced moulting; lighting for chicks, growers, layers and broilers.

UNIT II: MANAGEMENT OF POULTRY BIRDS

Managements of chicks- management details and disease control measures – management of growers – feeding and disease control programmes; management of layers – final housing and daily tasks; management of broilers- broiler growing programme and feed management; summer and winter managements - management of cage birds; poultry diseases – bacterial, fungal and viral diseases.

UNIT III: POULTRY NUTRITION

Poultry nutrition- protein and amino acid requirements – carbohydrates and fats as energy sources – requirements of fat soluble and water soluble vitamins for chicken – essential inorganic minerals for chicks and layers – deficiency symptoms; feed stuffs for poultry – energy sources, vegetable protein sources, animal protein sources, mineral sources and pigmentation sources; non-nutritive feed additives - types.

UNIT IV: DAIRY BREEDS AND NUTRITION

Dairy breeds of India: Cattle and Buffaloes, native and exotic breeds - nutritive value of milk and dairy products in India- milk synthesis and secretion, composition of milk; artificial insemination programme in cattle - merits and demerits of inbreeding and outbreeding.

UNIT V: FARM MANAGEMENT

Housing and equipments of dairy forms- feed, care and management of adult and newborn calves, marketing of dairy products; live stock diseases and management – mastitis, render pest, foot and mouth disease, vaccination programme.

TEXTBOOK:

1. Gnanamani M.R., 2008. Modern aspects of commercial poultry keeping, Giri.
2. Prashad J. 2005. Poultry Production and Management. Kalyani Publishers, New Delhi.

REFERENCE BOOKS:

1. G.S. Shukla and V.B. Upadhyay, 2000. Economic Zoology, Rastogi Publications, NewDelhi.
2. Scanes, C.G, Brant, G and Ensminger, M.E., 2004. Poultry Science, 4th Ed. Prentice Hall, USA.
3. Jull, M.A. 2003. Successful Poultry Management.
4. Leeson, S and Summers, J.D. 2005. Commercial Poultry Nutrition, International Pub.House.

Course outcomes

CO.NO	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Identify the deep litter system and their importance.	1,2,3,4	Understanding
CO-2	Develop the management of cage birds.	1,2,4	Applying
CO-3	Classify the different types of Poultry diseases- prevention and control.	2,3,	Analysing
CO-4	Justify carbohydrates and fats as energy sources – essential fatty acids.	1,2,3,4	Evaluating
CO-5	Modify the Non-nutritive feed additives- merits and demerits of additives.	1,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
IV	21PEZO41B	POULTRY AND DAIRY SCIENCE				60	4			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓	✓	✓	
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	
CO-3	✓	✓	✓		✓		✓	✓		
CO-4	✓	✓		✓		✓	✓	✓	✓	
CO-5	✓	✓	✓		✓	✓		✓	✓	
	Number of matches (✓) = ...36.... Relationship = Low/Medium/ High									

SEMESTER - IV

Course Title	ANIMAL FEED TECHNOLOGY
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEZO41C
Course Type	DSE – IV C
Credits	4
Marks	100

General objectives

To understand the techniques of processing of feed ingredients, various types of feed and strategies of feed storage additives.

Course objectives:

CO. No	The learners will be able to
CO -1	Categorizing the components of foods
CO -2	Explain the digestion and metabolism of nutrients
CO -3	Outline the nutritional characteristics of foods
CO -4	Checking Protein concentrates, Food additives
CO -5	Formulating the feed for animals.

UNIT I THE COMPONENTS OF FOODS

Animal food – Classification of animal food – Carbohydrates - Monosaccharides, Monosaccharides derivatives, Oligosaccharides, Polysaccharides and Lignin. Lipids- Fat, Glycolipids, Phospholipids, Waxes, Steroids and Terpenes. Protein- Amino acids and Peptides -Vitamins and Minerals.

UNIT II THE DIGESTION AND METABOLISM OF NUTRIENTS

Enzymes – Classification of enzymes, Nature of enzymes, Mechanism of enzyme action. **Digestion** - Digestion of Mono gastric Mammals, Microbial digestion in ruminants and other herbivores, alternative sites of microbial digestion, nutrient

digestion and the environment **Metabolism** – Energy metabolism, Protein synthesis, fat Synthesis and carbohydrate synthesis.

UNIT III THE NUTRITIONAL CHARACTERISTICS OF FOODS

Grass and forage crops- Grasses, Legumes, Other forages, Silage-Classification of silages, Nutritive value of silages, Whole crop cereal and legume silages. Hay, artificially dried forages, straws and chaff - Roots, tubers and related by-products- Cereal grains and cereal by-products

UNIT IV PROTEIN CONCENTRATES AND FOOD ADDITIVES

Protein concentrates - Oilseed cakes and meals, Leguminous seeds, Animal protein concentrates, Single cell protein and synthetic amino acids. **Food additives**– Antibiotics, Probiotics, Oligosaccharides, Enzymes, Organic acids, Spray-dried plasma, Modifiers of rumen fermentation.

UNIT V FEED FORMULATION

Need for feed formulation-square method-Linear programming - feed manufacturing (Basis of feed mill) – Feed stability-feed storage-feed spoilage (Bacterial and Fungal toxins)-factors affecting feed storage and nutrient loss.

TEXTBOOKS

1. P Mc Donald *et al.*, 2011, Animal nutrition, Seventh Edition, Prentice Hall

REFERENCE BOOKS

1. Pillai, TVR. and M.N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
2. Michael, B. New. 1985. Feed and feed technology.
3. CMFRI Bulletin-1: Feed Technology

COURSE OUTCOME

CO.NO.	Upon completion of the course, the students will be able to	PSO's addressed	Cognitive Level
CO-1	Classifying Carbohydrates- Lipids-Protein- Vitamins and Minerals.	1,2,3	Understanding
CO-2	Determining the metabolism of Carbohydrates, Lipids and Protein.	2,3,4	Apply
CO-3	Categorizing Grass, forage crops Silage-Hay, straws, chaff-Roots, tubers Cereal grains and cereal by-products.	3,4	Analyse
CO-4	Measuring Antibiotics, Probiotics, Oligosaccharides, Enzymes, Organic acids, Spray-dried plasma.	1,5	Evaluate
CO-5	Making feed manufacturing.	1,2,5	Create

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
IV	21PEZO41C	ANIMAL FEED TECHNOLOGY					60	2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓		✓	✓	✓	
CO-3	✓	✓	✓	✓	✓			✓	✓	
CO-4	✓	✓	✓	✓	✓	✓				✓
CO-5	✓	✓	✓	✓	✓	✓	✓			✓
	Number of matches (✓) = 38 Relationship = Medium									

SEMESTER - IV

Course Title	IMMUNOLOGY PRACTICALS
Total Hrs	60
Hrs / Week	4
Sub. Code	21PCZO4P1
Course Type	PRACTICAL-VII
Credits	2
Marks	100/2

General objective:

- ❖ To understand the different kinds of immunological methods

Course objectives :

CO. No	The learners will be able to
CO -1	Explain the Antigen antibody interaction in vitro - ABO typing and Rh typing.
CO -2	Examine the typhoid antigens by widal test.
CO -3	Examine the Total Counting of WBC - differential count in a blood sample.
CO -4	Choose the culture media for growth of microorganisms (liquid, semisolid and solid).
CO -5	Test the Differential staining and capsular staining.

1. Antigen antibody interaction in vitro - ABO typing, Rh typing.
2. Radio immuno assay
3. ELISA (Demonstration).
4. Rocket immuno Electrophoresis
5. Testing for Typhoid Antigens by Widal Test
6. Dissection of lymphoid organs in fish.
7. Total Counting of WBC - differential count in a blood sample.
8. Isolation of Monocytes from Blood
9. Visit to Medical microbiology laboratory and submission of report (compulsory).

SPOTTERS:

1. Primary Lymphoid organs 2. Secondary Lymphoid organs 3. Blood grouping
4. Monoclonal antibodies 5. Flow cytometer 6. Elisa titre plate 7. Vortex Mixer
8. Agglutination 9. Immunoglobulin types 10. Natural Killer Cell 11. Macrophages.

Course outcomes

CO.NO	Upon completion of the course, the students will be able to	PSO'S addressed	COGNITIVE LEVEL
CO-1	Explain the Radio immuno assay method.	1,2,4,5	Understanding
CO-2	Identify the lymphoid organs in fish.	2,4,5	Applying
CO-3	Analyze the testing for typhoid antigens by Widal Test .	2,3	Analysing
CO-4	Evaluate the Elisa titre plate and Vortex Mixer	2,4,5	Evaluating
CO-5	Elaborate the mechanism of Agglutination.	2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
IV	21PCZO4P1	IMMUNOLOGY PRACTICALS				60	2			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓	✓		✓	✓
CO-2	✓	✓	✓		✓		✓		✓	✓
CO-3	✓	✓	✓		✓		✓		✓	
CO-4	✓	✓	✓		✓		✓		✓	✓
CO-5	✓	✓	✓		✓		✓		✓	✓
	Number of matches (✓) = ...36.... Relationship = Low/Medium/ High									

SEMESTER - IV

Course Title	ENTOMOLOGY PRACTICALS
Total Hours	60
Hours/Week	4
Subject Code	21PCZO4P2
Course Type	PRACTICAL – VIII
Credits	2
Marks	100/2

General Objective:

- ❖ To understand insect morphology and physiology

Course Objectives:

CO.No.	The learners will be able to
CO-1	Understand the morphology of an insect.
CO-2	Construct the digestive system, nervous system, excretory system and reproductive system of the Grass Hopper and Cockroach.
CO-3	Analyze the mouth parts of Honey bees.
CO-4	Evaluate the mouth parts of the Silk worm larva.
CO-5	Discuss the insect preservation technique.

1. Study of morphology of an insect (local insects to be used).
2. Dissection of digestive, nervous, systems of insects of different orders (Grass Hopper or Cockroach).
3. Mounting of different types of mouthparts (Honey bees, Silk worm larva.)
4. Collect insect species and prepare in insect box.
5. Mount any 5 insects belonging to different orders.
 - a) Silverfish b) Dragonfly c) Stick insect d) Leaf insect e) Cricket f) Shield bug
 - g) Water scorpion h) Back swimmer i) Rice weevil j) Rhinoceros beetle.
- 6
 - a. Field study for various methods of pest management.
 - b. Field visit to ware houses and plant protection centres.

Course Outcomes

CO.No	Upon completion of the course, the students will be able to	PSO'S addressed	Cognitive Level
CO-1	Understand the morphology of Cockroach.	1,2,3	Understanding
CO-2	Identify the Grass Hopper and Cockroach Organ system.	1,2	Applying
CO-3	Dissect the Honey bee mouth.	1,2,3	Analyzing
CO-4	Evaluate the insects belonging to different orders.	1,4	Evaluating
CO-5	Create the insect box.	1,2,5	Creating

Cognitive Level; R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Relationship Matrix

Semester	Course Code		Title of the Course			Hours	Credits			
IV	21PCZO4P2		ENTOMOLOGY PRACTICALS			60	2			
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓			
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓			✓	
CO-5	✓	✓	✓	✓	✓	✓	✓			✓
	Number of matches (✓) = 37 Relationship = Low/Medium/ High									

INTERDISCIPLINARY COURSES (2021 – 2024)							
SEM	TITLE OF THE COURSE	COURSE CODE	H/W	C	MARKS		
					I	E	T
DEPT. OF ENGLISH							
II	SOFT SKILLS	21PIEN11	2	2	40	60	100/2
III	ENGLISH FOR BUSINESS COMMUNICATION	21PIEN31	2	2	40	60	100/2
DEPT. OF HISTORY							
II	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS UPTO 1707A.D	21PIHS11	2	2	40	60	100/2
III	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS FROM (1707-1947 A.D)	21PIHS31	2	2	40	60	100/2
DEPT. OF COMMERCE							
II	ENTREPRENEURIAL DEVELOPMENT	21PICO11	2	2	40	60	100/2
III	HUMAN RESOURCE MANAGEMENT	21PICO31	2	2	40	60	100/2
DEPT. OF MATHEMATICS							
II	DISCRETE STRUCTURE – I	21PIMA11	2	2	40	60	100/2
III	DISCRETE STRUCTURE – II	21PIMA31	2	2	40	60	100/2
DEPT. OF CHEMISTRY							
II	ANALYTICAL BIOCHEMISTRY	21PICH11	2	2	40	60	100/2
III	INDUSTRIAL CHEMISTRY	21PICH31	2	2	40	60	100/2
DEPT. OF COMPUTER SCIENCE							
II	DIGITAL LITERACY	21PICS11	2	2	40	60	100/2
III	DIGITAL TECHNOLOGY	21PICS31	2	2	40	60	100/2
DEPT. OF MICROBIOLOGY							
II	MICROBIOLOGY AND HUMAN HEALTH	21PIMB11	2	2	40	60	100/2
III	ENTREPRENEURSHIP IN MICROBIOLOGY	21PIMB31	2	2	40	60	100/2
DEPT. OF PHYSICS							
II	THE BASICS OF DIGITAL ELECTRONICS	21PIPH11	2	2	40	60	100/2
III	ENERGY PHYSICS	21PIPH31	2	2	40	60	100/2
DEPT. OF ZOOLOGY							
II	ORNAMENTAL FISH CULTURE	21PIZO11	2	2	40	60	100/2
III	APPLIED ZOOLOGY	21PIZO31	2	2	40	60	100/2
DEPT. OF NUTRITION AND DIETETICS							
II	DIET THERAPY-I	21PIND11	2	2	40	60	100/2
III	DIET THERAPY-II	21PIND31	2	2	40	60	100/2

THE SCHEME OF EXAMINATIONS UNDER CHOICE BASED CREDIT SYSTEM

- The medium of instruction in all the UG and PG Programmes is English and Students shall write the CIA Tests and the Semester Examinations in English. Three CIA Tests for one hour each will be conducted. For the calculation of CIA Tests marks the average of the best two tests will be taken. The portion for each test can be 1.5 units of the unitized syllabi.
- Two assignments for the Undergraduate Programmes and one assignment and one seminar for the Postgraduate Programmes are compulsory.
- Two Practical Examinations will be conducted for CIA at the end of the semester and the average will be taken.

Distribution of Marks for the Students admitted into the UG and PG Programmes from the academic year 2021-2022 CIA Tests and Semester Examinations

Undergraduate, Certificate, Diploma and Advanced Diploma Programmes						
Course Type	TOTAL MARKS	CIA TESTS MAX.MARKS	SEMESTER EXAMINATION Max. Marks	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	25	75	Nil	30	40
Practical (2Hrs.)	50	20	30	Nil	12	20
Practical (4Hrs.)	100	40	60	Nil	24	40
Project	100	Nil	Report- 60 Marks Viva-Voce- 40 Marks	Nil	Nil	100

Postgraduate Programmes						
Course Type	TOTAL MARKS	CIA MARKS	SEMESTER EXAM	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	40	60	Nil	30	50
Practical	50	20	30	Nil	15	25
Practical (for PG Maths only)	100	40	60	Nil	30	50
Project Report	150	Nil	Project Report- 90 Marks Viva-Voce Examination - 60 Marks	Nil	Nil	150

CIA TESTS

Distribution of Marks

Components	Tests (A)			Assignment (B)	Seminar (C)	Record Note (D)	Total (A+B+C+D)
	I	II	III				
UG-Theory	20	20	20	5	-	-	25
	The Average of the Best Two Tests:20						
PG-Theory	30	30	30	5	5	-	40
	The Average of the Best Two Tests:30						
UG- Practical (2 hrs)	15	15		-	-	5	20
	The Average of the Tests: 15						
UG- Practical (4 hrs)	30		30	-	-	10	40
	The Average of the Tests: 30						
PG- Practical	15	15		-	-	5	20
	The Average of the Tests: 15						
PG- Practical (Maths only)	30	30		-	-	10	40
	The Average of the Tests: 30						

Question Pattern for CIA Test (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	Part-B	Part-C	
UG	MCQs- 8x0.5=4 marks	Internal Choice (Either or type). 2x4=8 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	20
PG	MCQs- 20x0.5=10 marks	Internal Choice (Either or type) 3x4=12 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	30

End Semester Examination (ESE)

The students who have put in the required number of days of attendance are eligible to appear for the End Semester Examinations irrespective of whether they have passed in the CIA Tests or not. They have to pay the examination fees for all the current courses and the arrear courses, if any,

and submit the application form before the due date specified for the purpose. For any reason, the dates will not be extended. Hall tickets will be issued only for those who have paid the fees. The question papers for the End Semester Examinations for all the theory courses of the UG and the PG Programmes will be set for 75 marks.

Question Pattern for End Semester Examinations (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	Part-B	Part-C	
UG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	75
PG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	($\frac{x}{75} \times 60$) 60

The Question Paper Pattern for the End Semester Examinations (Practical)

The Question Paper Pattern is designed by the respective departments.